ENVIRONMENTAL COST AND VALUE ADDED OF RICE PROCESSING IN MILLING COMPANIES IN ABAKALIKI EBONYI STATE

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Abstract

This study investigated the relationship between environmental costs and value-added of rice processing. The broad objective of the study is to investigate the value-added effect of environmental costs of rice processing in Ebonyi State, Nigeria. The specific objectives of the study were to: (1) Ascertain the effect of environmental prevention cost on value-added of rice processing in Ebonyi State; (2) Determine the effect of environmental detection cost on on value-added of rice processing in Ebonyi State; (3) Ascertain the effect of environmental internal failure cost on value-added of rice processing in Ebonyi State; and (4) Evaluate the effect of environmental external failure cost on value-added of rice processing in Ebonyi State. Research questions were stated in line with the research objectives and the study employed descriptive survey research design, and answers were provided by selected rice milling companies in Ebonyi State for the analysis. The population consisted of 1,526 workers from rice milling companies in Abakaliki. The sample size was determined using the Taro Yamani while the Multi-stage sampling technique was used to select the respondents. Questionnaires were administered to the selected participants and descriptive and inferential statistics (regression analysis) were used to analyze the data. Findings revealed that: (1) Environmental protection and prevention had significant effects on value-added costs of rice processing, with prevention and protection costs accounting for 24% and 48.5%, respectively. Environmental internal failure costs explained 44.5% of the variation in value-added costs. On the other hand, environmental external failure costs were found to have no significant effect on value-added cost of rice processing. The study among other things, recommended that there should be investment in research and investment.

Keywords: Relationship, Environmental costs, Value-added, Rice Processing, Ebonyi State.

1.0 INTRODUCTION

1.1 Background to the Study

Environmental costs are incurred because poor environmental quality may or does exist (Hansen & Mendoza, 1999). A company's attitude to the environment is likely to be seen as a benchmark of its commitment to innovation and good management. Companies setting the

pace or giving priority to environmental issues will be seen as the leaders of those sectors. (Lickiss, 1991). Environmental sustainability means responsibly interacting with the planet to maintain natural resources and not jeopardize the ability for future generation to meet their needs, in order words, protecting our natural environment, human and ecological health, while doing innovation and not compromising our way of life that affects the ecosystems (Idris *et al*, 2022).

1.2 Statement of the Problem

Global rice production is releasing damaging greenhouse gases into the atmosphere, doing as much harm as 1,200 average-sized coal power stations (Environmental Defense Fund (EDF), 2019). This show the extent of harm done to the environment through rice production which is quite enormous (Okoye and Irem, 2018) stated that rice milling is said to have negative environmental effects which translates into economic drain and associated health problems.

In Nigeria, Ebonyi state is one of the highest producers of paddy rice and the "highest rice processor with over 2,080,000MT/annum installed capacity" (NEST-FUNAI Conference Paper 2016), and much of the state's feat in the rice industry can be traced to the Abakaliki Rice Mill (Okoye & Irem, 2018).

Although rice is the most economically important food crop in the world, its milling is always characterized with environmental and socio-economic problems. Convinced that Abakaliki Rice Mill was contributing to environmental degradation in Abakaliki Capital City, Ebonyi State Government in 2009, ordered for its relocation (Okoye and Irem, 2018).

In the course of rice processing, not only are serious pollution to the rice milling environment done, but also cause pollution to the environment outside the rice milling area. While having a tangible impact on the environment, the pollution also affects humans especially the rice processors and the growth of plants, which then exerts influence on the ecological environment.

1.3 Objectives of the Study

The general objective of this study was to investigate the environmental cost and value added of rice processing in milling companies in Abakaliki Ebonyi state. The specific objectives of the study were to:

i. Ascertain the effect of environmental prevention cost on value added of rice processing.
ii. Determine the effect of environmental detection cost on value added of rice processing.
iii. Ascertain the effect of environmental internal failure cost on value added of rice processing.
iv. Evaluate the effect of environmental external failure cost on value added of rice processing.

1.4 Research Questions

The following research questions were adopted in the course of trying to achieve the stated objectives:

1.4.1 What effect does environmental prevention cost have on value added of rice processing?

1.4.2 What is the effect of environmental detection cost on the value added of rice processing?

1.4.3 What effect has environmental internal failure cost on value added of rice processing?

1.4.4 What effect has environmental external failure cost on value added of rice processing?

1.5 Research Hypotheses

The null hypotheses to be tested in this study are:

1.5.1 Environmental prevention cost has no significant effect on value added of rice processing.

1.5.2 Environmental detection cost has no significant effect on value added of rice processing.

1.5.3 Environmental internal failure cost has no significant effect on value added of rice processing.

1.5.4 Environmental external failure cost has no significant effect on value added of rice processing. Significance of the Study

1.6 Significance of the Study

The findings of this study will provide relevant information on environmental cost to the following:

Researchers: This work reviewed the notion of green product in relation to associated concepts and empirical consequences discovered in the existing sphere of knowledge, students will bear med with sufficient information and knowledge about the subject under study, as well as identifying other products within the value chain which would require further studies on.

Government: Improved revenue arising from the rice mill company and job creation in the state and beyond.

Donor Agencies: Would be able to assess rice farmers with best environmental cost friendly practice for the purpose of giving them grants/loans to improve their business.

Value chain Actors. These includes Rice Farmers, Rice Processors, Rice Traders, and Consumers would have the opportunity to offer 'green products' by way of improved brands as well as more goods and services available in the value chain.

Consumers: Consumers would have more access to more improved rice quality along the value chain platforms as the producers will be willing to showcase their internationally certified products.

Rice Producers: High Quality products of international standard would be available in the market.

Key Players: The study would also bring to the fore the socio-economic effects of environmental cost on the key players. Sociologically, most of the actors/key players especially service providers like winnowers and small holder rice farmers in this industry are very poor owing to the environmental degradation occasioned by rice processing on their environment such that some find it difficult to even send their children to school, because of their health challenges which incapacitates them. It is believed that Environmental costing brings a plus value as follows: new opportunities are discovered, that is innovations on the activities related to the environment, like recycling resources and their use in other activities (Rakos and Antohe, 2014).

1.7 Scope of the Study

The study covered the Environmental Cost and Value Added of Rice Processing In Milling Companies in Abakaliki Ebonyi State using value added as the dependent variable, while environmental cost is the independent variable proxy by four components viz: environmental prevention cost, environmental detection cost, environmental internal failure Cost and Environmental External Failure costs.

1.8 Limitation of the Study

One of the shortcomings of this study was limited time of production. There are very few studies on environmental cost of rice processing, hence limited prior research literature available on environmental cost from these rice milling companies. The rice mill had just four (4) hours of operation daily from 9am-1pm, after which they shut down operation thereby making it difficult for the processors to attend to me. Again, the study required distribution of questionnaire to elicit needed information but the workers were often too busy to attend to the researcher and this made the researcher visit the mill quite often.

Finally, the fourth component of the Environmental cost, the eternal failure cost, does not show a significant effect on value added cost of rice processing, whereas it is evident that the operators of the mill who were negatively impacted by the absence of this cost cared less about this situation, therefore further studies could concentrate on this area on rice processing.

2.0 REVIEW OF RELATED LITERATURE

2.1 Conceptual Review

2.1.1 Environmental Costs

Rakos (2014), defines the environmental costs as being those costs whose actions carried out by an economic entity or by others, on its behalf, for the prevention, reduction or reparation of the damage caused to the environment, as a result of the activity of an economic entity or

for the conservation of renewable and/or non-renewable resources.

Budnitz and Holdren (2003), opined that environmental costs cover a wide spectrum of concerns (for example, occupational safety, public health, economic productivity, environmental diversity, social stability), and that each policy or action produces a different mix of impacts and costs. Those impacts present as environmental hazards both to human and to the environment.

Environmental costs can generally be grouped into External and Internal cost. According to Econation (2023) internal costs are easy to see and explain. They are costs that a business bases its price on. They include costs like materials, energy, labour, plant, equipment and overheads. They are costs that influence only company itself; they have no impact on society.

2.1.2 Environmental Prevention Cost

Roy (2023) describes Environmental prevention costs as the costs of activities undertaken to prevent the production of waste that could cause damage to the environment. Examples include the costs of recycling products, training staff, and carrying out environmental studies. These costs are related to quality control processes and include employee training, quality planning, design and testing, and the implementation of quality assurance systems. Prevention costs aim to avoid defects and errors before they occur and for production, to ensure that effluents do not cause harm to the environment.

A detailed example of Prevention costs include Research/Development, Environmental Layout/Assessment, Training and Education, Environmental Management System, Waste reduction program, Eco friendly Design, Regulatory Compliance, Given Certification, Monitoring and Reporting, Environmental Audit etc.

2.1.3 Environmental Detection Costs

In the words of Roy (2023), Environmental detection costs are costs incurred to ensurethat the organization complies with regulations and voluntary standards. These are the costs of activities performed to monitor environmental effects that a firm is responsible for. Examples include the costs of:

- Monitoring Equipment, Sampling Analysis, Data Collection and processing, Environmental Audits, Inspections, Remote Sensing Technologies, Compliance Assessing, Reporting system, Legal and Consulting Fee.
- Early Risk Identification: According to George (2020), risk identification is a challenging process in the management of project risks. There is tendency to spend less time in identifying risks and more time in risk mitigation, ignoring the fact that unidentified risks cannot be mitigated. It is worthy of note that detecting a risk element in rice processing forms the bedrock for mitigating it and would make for a good cost-the detection cost.

Regulatory Compliance: Environmental detection activities help ensure compliance with

environmentalregulations,standards,andpermits.Bystayinginformedaboutevolvingregulatory requirements and monitoring changes in environmental legislation, companies can adapt their practicesandprocedurestoremaincompliant.Compliancewithenvironmentalregulationsreduces the risk of fines, penalties, and legal liabilities, contributing to long-term business sustainability.

Quality Assurance: Environmental detection activities contribute to quality assurance by ensuring that products, processes, and services meet environmental performance standards and customer expectations. For instance, monitoring emissions, effluents, and pollutants can help maintain product quality and safety, preventing contamination and product recalls. Quality assurance builds trust with customers and stakeholders, enhancing brand reputation and market acceptance.

2.1.4 Environmental internal Failure Costs

According to Bhattacharyya (2024), internal failure cost refers to a type of cost of quality related to product failures discovered by an organization before any product leaves the manufacturing unit or factory. Determining such costs helps companies understand the extent to which the manufactured products meet the set quality standards. They are also costs of activities that have to be performed when contaminants and waste have been produced by a company but not discharged into the environment. Examples include treating toxic waste and maintaining pollution equipment. -Some examples of Internal failure cost include:Waste Disposal Cost, Contamination Clean up, Resource Recovery, Products recalls, Equipment and Facility Repairs, Remediation cost, Destructive cost, Health and safety costs, Penalties and Fines, Insurance Premiums

Internal failure costs are costs incurred by a business to address problems that arise within the company, resulting from negative sustainability related events affecting any company resource (people, materials, processes, etc.). These costs include the cost to fix technologies or care for employees owing to environmental incidents that may have occurred.

2.1.5 Environmental-External-Failure-Costs

An external environmental cost is incurred by a business entity in which it has no direct involvement. `External environmental costs are also termed third-party costs or spillover costs.

3.0 METHODOLOGY

3.1 Research Design

This study employed descriptive survey research design since the study provides answers to how environmental costs affect value of rice processing in rice milling companies in Abakaliki, Ebonyi state, Nigeria. Also, the choice of this research design was premised on the fact that the researcher used questionnaire to solicit information from the target audience or population and obtained responses regarding the subject of interest. The observables, measurable and verifiable variables or parameters as being contained in the objectives of the study were assigned values. Moreso, the study used questionnaire techniques as a tool for

data collection. The data collected was analyzed and the result of the study produced for policy recommendations.

3.2 Area of Study

This study fall within Environmental Economics: A Crucial Area of Study in Rice Processing. The research topic "Environmental cost and value-added of rice processing in milling companies in Ebonyi state, Nigeria" falls under the area of study known as Environmental Economics, specifically Agricultural Environmental Economics. This field of study examines the economic and environmental implications of agricultural practices and processes, including rice processing.

Environmental Economics is an interdisciplinary field that combines principles from economics, environmental science, and agriculture to understand the relationships between economic activity and environmental quality. In the context of rice processing, Environmental Economics helps to identify and quantify the environmental costs associated with the process, such as air and water pollution, soil degradation, and waste generation.

Agricultural Environmental Economics, a sub-field of Environmental Economics, focuses specifically on the environmental impacts of agricultural activities, including crop and livestock production, processing, and distribution. This field of study is critical in developing sustainable agricultural practices that minimize environmental degradation while maintaining economic viability.

3.3 Nature and Sources of Data

The research data was a qualitative-quantitative type. The major data for this study was obtained directly from the research respondents using the questionnaire survey approach; hence, a primary sourced data. The questions were based on a structured 5-point Likert scale of strongly agree (SA), agree (A), Undecided (U), disagree (D), and strongly disagree (SD), which was rated as 5, 4, 3, 2 and 1 respectively. The questionnaires solicited opinions of workers of Abakaliki Rice Mill Company Ltd on how environmental costs affect value of rice processing in the Company; however, copies of the well-designed and structured questionnaires were printed and distributed across the various operational Departments in the Company.

Also, the study made use of secondary data since the researcher made reference to data and information from secondary sources such as books, encyclopedias, newspapers, magazines, websites, journals, and other people's project reports on related works.

3.4 Population of the Study

The entire population from which samples were drawn was 1,526 workers in the Rice Mill Company. This covered the three sections operating in the company; namely, A-line with 615 workers, B-line with 462 workers and C-line with 449 workers .A further breakdown showed that the population is heterogeneous, covering rice millers, rice de-stoners, rice

blowers, rice blenders, dusk/husk carriers, bag stitches, and many more.

3.5 Determination of Sample Size

The sample size for the study was determined using Taro Yamane (1967) formula as adopted in the work of Oladimeji *et al*. (2017). The Taro Yamane's formula is suitable since the study population is known. The formula is as presented below:

$$n = \frac{N}{1+(e)^2} \quad (3.1)$$

Where n = Sample size

N = Total population (1,526)

e = Error tolerance (usually 0.05),

1 = constant.

Substituting the values of N=1,526 and e = 0.05 into the equation 3.1, we have that:

$$n = \frac{1526}{1+1526(0.05)^2}$$

n = 316.926272≅317

Therefore, the sample size for the study is 317 workers comprising of those from A-line, B-line and C-line in the Rice Mill Company.

In order to ensure equity and fairness, the distribution of the sample size (317) followed Bowley's proportionate sample allocation method. This method ensures that each of the lines are proportionately represented in the sample study. The Bowley's formula and procedures are as shown below:

$$nh = \frac{nNNh}{\quad} \quad (3.2)$$

Where,

n_h= Number of units allocated to each stratum

N_h = Number of firms/companies in each stratum

n = Sample size

N = Population of study

Such that:

For A-line, we have

$nh = nNNh \Rightarrow \frac{317 \times 615}{1,526} = 127.755570 \cong 128$

n_A=128∴

For B-line, we have $\frac{317 \times 462}{1,526} = 95.972477 \cong 96$

$\therefore n_B = 96$

For C-line, we have $\frac{317 \times 449}{1,526} = 93.2719528 \cong 93$

$\therefore n_C = 93$

Summarily, the result shows that 128 workers were selected in A-line, 96 workers were sampled in B-line whereas 93 workers were sampled in C-line.

$n = n_A + n_B + n_C \Rightarrow 128+96+93=317$ respondents.

The tabular summary of the sampling distribution is as shown in table 3.1 below.

Table3.1: Tabular summary of the sample statistics by location (state capitals) in the area

Lines	Population	Sample
A-line	615	128
B-line	462	96
C-line	449	93
Total	**1,526**	**317**

Source: Field survey, 2024

3.6 Sampling Technique

For the purpose of this study, multi-stage sampling technique was employed to secure the requisite number of respondents for achieving the research target. The choice of multi-stage sampling is because the population is heterogeneous, comprising of individuals from different sections/departments in the company.

From each of the stratum, A-Line, B-Line and C-Line, the simple random sampling (SRS) technique was employed in selecting the individuals to be studied. This sampling technique, SRS of course, ensured that every member of the stratum population has equal chance of being selected for study. Therefore, the results obtained from the study were correct for generalization and for drawing valid inferences.

3.7 Validation of the Instrument

The term "validity" describes the precision or veracity of a measurement (Ibrahim, 2013). In this study, the researcher ensured that the research instrument possess the qualities that enabled the mto measure what they were designed to measure; hence, it was validated by the researcher's supervisors, and two experts in the area of Rice Processing. Contributions and corrections from this group of people helped to ensure that the contents, language structure and variables captured in the questionnaire achieved the research target. Reliability of the Instrument

The Cronbach alpha reliability test method was used in ascertaining the level of internal consistency or dependability of the research instrument. The choice of Cronbach's alpha coefficient method is strictly based on the nature of the research instrument. Particularly, a pilot study was carried out on the pertinent population (Umejit Rice Mill) at Ugbawka, in Nkanu East Local Government Area, Enugu State. The choice of Umejit Rice Mill in Enugu state is because, Enugu state shares common boundary with Ebonyi state, and the Umejit Rice Mill have similar operational features like the Rice Mill Company Nigeria Limited, Abakaliki. Result obtained was adjudged to be reliable (i.e., having high level of internal consistency) if the Cronbach alpha is 0.50 and above, and otherwise if the result is below 0.50.

3.8 Methods of Data Collection

The research data was collected directly from the target respondents; hence, questionnaire method was used. According to Goodwill and Ozofor (2015), questionnaire is the best tool for collecting data that is out of the researcher's physical grasp. It is a device designed to pierce the mind's surface and gather information. The questionnaire was designed in line withthe research questions and objectives, so as to ensure that only data relevant to the study were collected. The questionnaire was also structured and presented in sections. Apart from

'Section A' which focused on the bio-data and other relevant socio-demographic characteristics of the respondents, other sections of the questionnaire addressed a particular

research question respectively.

3.9 Techniques of Data Analysis

The field survey data were analysed using descriptive statistics such as frequency, percentages, mean, standard deviation and charts. Specifically, at the end of the field data collection process, the responses from the 5-point likert scale structured questionnaire response were coded using valuessuchas5, 4,3,2, and 1 for strongly agree, agree, disagree, and strongly disagree, respectively. These were further converted to quantitative data using weighted mean and standard deviations.

Decision was taken based on the 5-point likert theoretical rating criteria. Since the instrument was a 5-point likert scale, the decision rule for the descriptive statistics was:

If mean ≥ 2.50, the respondents agree
If mean < 2.50, the respondents disagree
Also, the interview responses gathered from the respondents was comprehensively discussed in line with research objectives.

Research hypotheses in the study were tested using inferential t-test statistics. The t-test is one of the statistical tools usually applied to detect whether the sample mean differs significantly from the population mean. In computing the t-statistic, observed/calculated sample mean, theoretical population mean, sample standard deviation, and sample size was used. The t-test formula is denoted mathematically by:

$$t = \frac{\pi_s^{-} \mu}{\sqrt{n}} \qquad (3.3)$$

where, t = Student distribution

π_s^{-} = Mean of the means of each specific objectives (question covering the research question, i.e., measurement questions)

μ = Population mean = 2.50

s = Standard deviation

n = Number of observations

Decision Rule: Decision for every t-test was taken at 95% confidence; otherwise, 0.05 significance level. The t-test decision rule holds that the null hypothesis (Ho) should be rejected if the probability value (p-value) is less than or equal to 0.05; otherwise, the Ho is upheld.

4.0 DATA PRESENTATION AND ANALYSIS

4.1 Data Presentation

The study covers the value added effects and environmental costs of rice processing in Nigeria: A case study of rice milling companies in Abakaliki, Ebonyi state. In order to achieve the main objective, specific objectives were formulated and primary data collected from the rice mill complexes in Abakaliki Rice Mill Company. The variables are value added as the dependent variable, while environmental cost is the independent variable proxied by four components viz: environmental prevention cost, environmental detection cost, environmental internal failure Cost and Environmental External Failure costs. (see summary of Questionnaire as in Appendix 2. Back page)

4.2 Data Analysis

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
PREVENTION_COST_Q1	55	3.00	186.00	61.8000	57.09005
VALUED_ADDED	55	.00	247.00	50.5636	53.29504
DETECTION_COST_Q1	55	.00	172.00	28.0909	48.19531
INTERNAL_FAILURE_Q1	55	.00	155.00	33.7091	46.65304
EXTERNAL_FAILURE_Q1	55	.00	141.00	33.7091	43.53826
Valid N (listwise)	55				

Source: SPSS 21 output, 2023

The descriptive statistics in table 4.2above presents the statistical characteristics of all the observations from environmental prevention cost, environmental detection cost, environmental internal failure Cost and Environmental External Failure costs and value added of rice processing examined in the study. These include measures of central tendency, the mean, Dispersion in the series is also indicated using the standard deviation. The results showed that the figures for the individual variable are highly dispersed as indicated by the mean of the variables which were: prevention cost = 61.80; valued added = 50.5636; detection cost = 28.0909; internal failure = 33.7091 and external failure = 33.7091.

Correlations

		PREVENTION_COST_Q1	DETECTION_COST_Q1	INTERNAL_FAILURE_Q1	EXTERNAL_FAILURE_Q1	VALUED_ADDED
PREVENTION_COST_Q1	Pearson Correlation	1	.241	.123	.160	.024
	Sig. (2-tailed)		.076	.370	.244	.863
	N	55	55	55	55	55
DETECTION_COST_Q1	Pearson Correlation	.241	1	.455**	.621**	.048
	Sig. (2-tailed)	.076		.000	.000	.728
	N	55	55	55	55	55
INTERNAL_FAILURE_Q1	Pearson Correlation	.123	.455**	1	.459**	.044
	Sig. (2-tailed)	.370	.000		.000	.750
	N	55	55	55	55	55
EXTERNAL_FAILURE_Q1	Pearson Correlation	.160	.621**	.459**	1	.072
	Sig. (2-tailed)	.244	.000	.000		.601
	N	55	55	55	55	55
VALUED_ADDED	Pearson Correlation	.024	.048	.044	.072	1
	Sig. (2-tailed)	.863	.728	.750	.601	
	N	55	55	55	55	55

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.3 is the Pearson's Correlation Matrix, which is one of the preliminary tools for data analysis of the study. One important observation from the Correlation Matrix is that all the independent variables and control variables, comprising of environmental prevention cost, environmental detection cost and environmental internal failure Cost exhibited weak relationship with valued added cost but strong relationship with Environmental External Failure costs. The specific results indicate that the relationship between Environmental External Failure costs and valued added cost is positive and statistically strong, the correlation coefficient as observed is 0.750.

Hypothesis one: Environmental prevention cost has no significant effect on value added of rice processing.

Restatement of Hypothesis in Null and Alternate form

Ho: Environmental prevention cost has no significant effect on value added of rice processing.

H_1: Environmental prevention cost has a significant effect on value added cost of rice processing.

Decision Rule/Criteria: Reject Ho if probability value is less than 0.05, otherwise accept.

The Model: valued added $=\beta o+\beta_1 EPC1+B_2 EPC2+\ldots.+B_6 EPC6+\varepsilon$.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.240[a]	.001	-.018	53.78033

a. Predictors: (Constant), PREVENTION_COST_Q1

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	PREVENTION_COST_Q1	B	Std. Error	Beta		
1	(Constant)	.194	10.740		4.580	.000
	PREVENTION_COST_Q1	.022	.128	.024	.173	.035

a. Dependent Variable: VALUED_ADDED

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	86.385	1	86.385	.010	.005[b]
	Residual	153293.143	53	2892.323		
	Total	153379.527	54			

a. Dependent Variable: VALUED_ADDED

b. Predictors: (Constant), PREVENTION_COST_Q1

From table 4.21 above, the beta coefficient value of the variables revealed PREVENTION_COST_Q1 (B1) = 0.022. The ratios of t-statistic is 0.173 respectively for PREVENTION_COST_Q1 showing a slop coefficient of 0.194 indicating that Environmental prevention cost has a significant effect on value added cost of rice processing in Nigeria. The empirical result shows that 24% of the variable effects change in valued added cost for by prevention cost while the remaining 76% proportion is explained by other variables outside the model. The F-statistic of 0.010 with a p-value of 0.005 revealed that the model is well fitted. The estimated relationship equation of the model is: VALUED ADDED = 0.194 +0.022+ ε. The implication is that, for there to be a unit increase in value added cost there was be 0.022decrease in Environmental prevention cost, holding other factors constant. Decision: Going by the rule of thumb, Ho is rejected while H_1 is accepted, since the P-value of the equation is 0.005which is less than the critical value of 0.05(5%). This implies that Environmental prevention cost has a significant effect on value added cost of rice processing in Nigeria at 5% level of significance.

Hypothesis Two: Environmental detection cost has no significant effect on value added of rice processing.

Restatement of Hypothesis in Null and Alternate form

Ho Environmental detection cost has no significant effect on value added of rice processing.

H_1 Environmental detection cost has significant effect on value added of rice processing.

Decision Rule/Criteria: Reject Ho if probability value is less than 0.05, otherwise accept.

The Model: valued added =$\beta o+\beta_1 EDC1+B_2 EDC2+\ldots.+B_6 EDC5 +\varepsilon$.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.485[a]	.002	-.017	53.73337

a. Predictors: (Constant), DETECTION_COST_Q1

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	353.965	1	353.965	.002	.003[b]
	Residual	153025.563	53	2887.275		
	Total	153379.527	54			

a. Dependent Variable: VALUED_ADDED

b. Predictors: (Constant), DETECTION_COST_Q1

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	49.071	8.406		5.838	.000
	DETECTION_COST_Q1	.053	.152	.048	.350	.028

a. Dependent Variable: VALUED_ADDED

The results above reveal that the coefficient of determination R2 of 0.485 represents 48.5% variations in valued added cost of rice processing in Nigeria for the period of study explained by Environmental detection cost while 51.5% are explained by other variables not captured in the model of study; while F-statistic P-value of 0.028<0.05 explained that the variable is well fitted in the model for the study. The coefficient of Environmental detection cost of rice processing as indicated in the table above is 0.053 while the p-value is 0.281. If the

coefficients are replaced in model, the model can be restated as: VAC= 49.071+0.053+ε. This indicates that the coefficient of Environmental detection cost in the regression model is positive with a p-value of 0.003<0.05. In view of these results, we accept the alternative hypothesis that Environmental detection cost has significant effect on value added of rice processing.

Hypothesis Three: Environmental Internal failure cost has no significant effect on value added of rice processing.

Restatement of Hypothesis in Null and Alternate form

Ho: Environmental Internal failure cost has no significant effect on value added of rice processing.

$H_{1:}$ Environmental Internal failure cost has significant effect on value added of rice processing.

Decision Rule/Criteria: Reject Ho if probability value is less than 0.05, otherwise accept.

The Model: valued added =$\beta o+\beta_1 EIFC1+B_2 EIFC2+\ldots.+B_6 EIFC6+\varepsilon$.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.445[a]	.002	-.017	53.74360

a. Predictors: (Constant), INTERNAL_FAILURE_Q1

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	295.676	1	295.676	.037	.003[b]
	Residual	153083.851	53	2888.375		
	Total	153379.527	54			

a. Dependent Variable: VALUED_ADDED

b. Predictors: (Constant), INTERNAL_FAILURE_Q1

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	48.873	8.969		5.449	.000
	INTERNAL_FAILURE_Q1	.050	.157	.044	.320	.750

a. Dependent Variable: VALUED_ADDED

The results above reveal that the coefficient of determination R2 of 0.445 represents 44.5% variations in valued added cost of Environmental Internal failure cost of rice in Nigeria for the period of study while 55.5% are explained by other variables not captured in the model of study; while F-statistic P-value of 0.003<0.05 explained that the variable is well fitted in the model for the study. The coefficient of Environmental Internal failure cost of rice as indicated in the table above is 0.050 while the p-value is 0.750. If the coefficients are replaced in model, the model can be restated as: VAC= 48.873+0.050+ε. This indicates that the coefficient of Environmental Internal failure cost in the regression model is positive with a p-value of 0.003<0.05. In view of these results, we accept the alternative hypothesis that Environmental Internal failure cost has significant effect on value added Cost of rice processing in Nigeria.

Hypothesis Four: Environmental external failure cost has no significant effect on value added of rice processing

Restatement of Hypothesis in Null and Alternate form

Ho Environmental external failure cost has no significant effect on value added of rice processing.

$H_{1:}$ Environmental external failure cost has significant effect on value added of rice processing.

Decision Rule/Criteria: Reject Ho if probability value is less than 0.05, otherwise accept.

The Model: valued added $=\beta o+\beta_1 EEFC1+B_2 EEFC2+\ldots.+B_6 EEFC6+\varepsilon$.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.875[a]	.007	-.014	68.55678

a. Predictors: (Constant), EXTERNAL_FAILURE_Q1

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	675.504	1	695.544	.056	.071[b]
	Residual	162553.944	53	2678.943		
	Total	163229.448	54			

a. Dependent Variable: VALUED_ADDED

b. Predictors: (Constant), EXTERNAL_FAILURE_Q1

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	56.572	8.162		5.5533	.000
	EXTERNAL_FAILURE_Q1	.0768	.168	.072	.646	.601

a. Dependent Variable: VALUED_ADDED

From table above, results indicate that the effect of Environmental external failure cost on valued added cost of rice processing in Nigeria is 0.875, representing 87.50% explained variations. The remaining 12.5% variation is by other factors not included in the model of the study. The t-statistics stood at 0.056 with a p-value of 0.071. This implies that Environmental external failure cost does not has statistically effect on valued added cost. The model estimated relationship equation is thus: VAC= 56.572 +0.0768+ ε .Decision: Based on the

empirical results obtained from the analysis, we therefore accept the null hypothesis and conclude that Environmental external failure cost has no significant effect on value added of rice processing in Nigeria.

4.4 Discussion of Findings

4.4.1 H_0^I: Environmental prevention cost has no significant effect on value added of rice processing in Nigeria.

In test of hypothesis one, the null hypothesis was rejected, implying that Environmental prevention cost has a significant effect on value added cost of rice processing in Nigeria at 5% level of significance. The empirical result shows that 24% of the variation in value added cost is explained by environmental prevention cost,while the remaining 76% proportion is explained by other variables outside the model. The F-statistic of 0.010 with a p-value of 0.005 revealed that the model is well fitted. The estimated relationship equation of the model is: VALUE ADDED = 0.194 +0.022+ ε. The implication is that, for there to be a unit increase in value added cost there was 0.022decrease in Environmental prevention cost, holding other factors constant. The result is consistent with the findings of Hussaini *et al* (2019). Determinants and profitability of rice farmers' investment in value addition activities in Kebbi State who used a multistage sampling procedure to select 123 farmers from 3 rice producing Local Government Areas (LGAs) of the State, used Primary data collection. 151 findings show the return of investment by the farmers in various value addition activities employed, which implies that these variables increased the efficiency of the rice farmers' investment in value addition. Omoare and Oyediran (2017) Assessment of factors affecting rice (oryza spp.) value chain (RVC) in Ogun and Niger states, Nigeria. Chi-square analysis shows that there is significant relationship between socio-economic characteristics of the respondents and value addition at $p < 0.05$ level of significance.

4.4.2 H_O^2 Environmental detection cost has no significant effect on value added of rice processing.

Test of hypothesis two for Environmental detection cost has a coefficient of determination R2 of 0.485 represents 48.5% variations in valued added cost of rice processing in Nigeria for the period of study explained by Environmental detection cost while 51.5% are explained by other variables not captured in the model of study; while F-statistic P-value of 0.028<0.05 explained that the variable is well fitted in the model for the study. Based on these empirical findings, we accept the alternate hypothesis then conclude that Environmental detection cost has significant effect on value added of rice processing.

The result of this study is however is in line with the result of Farouk and Saiful Islam (2006) where the Work environment and Environmental pollutions in rice mills of Bangladesh evaluated the awareness of mill workers of the rice mill environment on the hazards envisaged. Oko, Ubi and Efisue (2012) examined the agronomic characteristics of 15 selected indigenous and newly introduced hybrid rice varieties in Ebonyi State, Nigeria.

The rice cultivars were grown under the same conditions and screened for morpho-agronomic traits. Significant variation (P<0.05) was detected among the 20 rice varieties for all the traits evaluated, therefore, be critical in accepting new varieties that may not be comparably outstanding in a holistic sense, in order to preserve the integrity of the all-cherished indigenous rice varieties.

4.4.3H_0^3: Environmental Internal failure cost has no significant effect on value added cost of rice processing

Test of hypothesis three revealed that the null hypothesis was rejected, which indicates that Environmental Internal Failure cost has significant effect on valued added cost of rice processing. The test for hypothesis three shows that the coefficient of determination R2 of 0.445 represents 44.5% variations in valued added cost of Environmental Internal failure cost of rice in Nigeria for the period of study while 55.5% are explained by other variables not captured in the model of study; while F-statistic P-value of 0.003<0.05 explained that the variable is well fitted in the model for the study. The coefficient of Environmental Internal failure cost of rice as indicated in the table above is 0.050 while the p-value is 0.750. Based on these results obtained we accept H_o and reject H_I. since p-value of 0.003<0.05, that Environmental Internal failure cost has significant effect on value added Cost of rice processing in Nigeria.

The result of the findings is in agreement with the outcome of the study carried out by Bello (2009) Work environment in small scale rice mills in Ivo LGA, Ebonyi state, to assess the work environment. The assessment involves the use of questionnaires administered to three classes of people; mill workers, clients and residents around the mill. He concluded that the problems notable among the mills include excessive dust generation, and increased indoor temperatures, inadequate workspace, poor building location and ventilation. Cordelia and Edwin (2020), Analysis of the factors that determines rice farms productivity in Ebonyi state, Nigeria. No abstract, About 476 Rice farms were selected through a multi-stage sampling procedure. Data were collected from primary source using structured questionnaire. Data were analyzed using mean, standard deviation, percentage, Total Factor Productivity (TFP), and regression method

4.4.4 H_0^4: Environmental external failure cost has no significant effect on value added cost of rice processing.

Test of hypothesis four shows that Environmental external failure cost does not have statistical effect on valued added cost. The model estimated relationship equation is thus: VAC= 56.572 +0.0768+ ε. Decision: Based on the empirical results obtained from the analysis, The f-statistics stood at 0.056 with a p-value of 0.071 >0.05 we therefore accept the null hypothesis and conclude that Environmental external failure cost has no significant effect on value added of rice processing in Nigeria.

This finding is well situated with the a priori expectations. Okoye and Irem (2018) Rice Milling in Amagu Community of Ebonyi State: Health and Economic Implications. The

research employed surveyed instruments and hospital records. A total of 396 questionnaires were administered to residents in Amagu Community using clustered systematic sampling technique. The data on the economic effects were analyzed using Wilcoxon Ranks Signed Tests and while Kruskal Wallis Test was used for data on health. The results revealed that whereas the rice mill has a significant positive economic effect (p value>0. 05), it has no significant health implications on the community, with p values; 0.579 The finding of this study is in consonance with the result of Mannan et el, (2022), Impact of Rice Mill Pollution on Surrounding Environment: A Case Study in Sadar Upazila, Dinajpur, Bangladesh. Nine(9), rice mills were randomly selected and data were collected from a number of 104 respondents. Data were collected from the respondents at four distant places away from a rice mill viz. 0 meter (in and around mill area), 100, 500, and 1000 meters away. Appropriate scales were developed to measure both the independent and dependent variables by using Microsoft Excel and the SPSS (Statistical Package for Social Sciences) program.

Results showed maximum respondents attitude (>50%) towards the impact of rice mill pollution on environment, agriculture and their health status were not positive (score was 8-15 out of 32), i.e., they were suffering from the rice mill pollutions.

5.0 SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

The following summary of results was achieved through comparative analyses of value added response to environmental costs of rice processing: a case study of rice milling companies in Abakaliki, Ebonyi State. It was found that in rice processing in Abakiliki, Ebonyi State Nigeria:

i. The null hypothesis was rejected, implying that Environmental prevention cost has a significant effect on value added cost of rice processing in Nigeria at 5% level of significance. The empirical result shows that 24% of the variation in value added cost is explained by environmental prevention cost.
ii. Based on these empirical findings, coefficient of determination R2 of 0.485 represents 48.5% variations in valued added cost of rice processing in Nigeria for the period of study explained by Environmental detection cost while F-statistic P-value of 0.028<0.05 we accept the alternate hypothesis then conclude that Environmental detection cost has significant effect on value added of rice processing.
iii. Test of hypothesis three revealed that the null hypothesis was rejected, the coefficient of determination R2 of 0.445 represents 44.5% variations in valued added cost of rice processing in Nigeria for the period of study explained by Environmental Internal Failure cost while F-statistic P-value of 0.003<0.05
iv. Test of hypothesis four shows that Environmental external failure cost does not have statistical effect on valued added cost. The model estimated relationship equation is thus: VAC = 56.572 + 0.0768 + ε. Decision: Based on the empirical results obtained from the analysis, the f-statistics stood at 0.056 with a p-value of 0.071 >0.05

5.2 Conclusions

Rice production, particularly in Nigeria, has significant environmental and socio-economic implications. The Abakaliki Rice Mill in Ebonyi State, one of the largest rice producers in Nigeria, contributes to environmental degradation and health problems. The rice processing techniques used in Nigeria are inefficient, resulting in low-quality rice that is expensive and unpopular among consumers and no-implementation of environmental cost principles during rice processing accounts for these problems.

The study therefore confirms that three (3) out of the four components of environmental costs (prevention, detection, and internal failure) significantly impact the value-added cost of rice processing in Nigeria, whereas the fourth component, external failure cost does not.

External Failure Cost.

Although not statistically significant, should still be considered in overall environmental cost management. On further enquiry on the reason for their indifference on the damage caused by the activities of the rice mill to the immediate environment, it was discovered that there was lack of awareness or they have not been adequately informed about the impact on both their health and on the environment leading many of them to downplay or ignore adverse environmental and health issues arising from the rice mill.

Secondly, many residents rely on the rice mill for employment and economic stability, making them hesitant to question or lay complaints that could jeopardize their jobs. Some individuals assume that dust and noise pollution or health issues have been present for a long time there, and residents have come to accept these conditions as normal and do not recognize them as problems.

5.3. Recommendations

The findings of this study have revealed that the rice processing techniques used in Nigeria are inefficient, resulting in low-quality rice that is expensive and unpopular among consumers and non-implementation of environmental cost principles during rice processing accounts for these problems. Therefore, rice processors in the rice producing industry should consider the following policy recommendations in order to spur economic growth.

5.3.1 On the basis of Prevention Cost:

One of the environmental theories that align with this study is the theory of ecological modernization and based on this theory, it is recommended that investment in research and innovation in new technologies and practices that can further reduce the environmental impact of rice processing should be undertaken. Modernizing our industrial systems to be more environmentally friendly is key to rice processing and sustainability. This would make for standardization of quality of product which will bring about a boost in production and ensure a high quality rice processing that will be of international standard thereby ensure economic growth and environmental sustainability.

5.3.2. On the basis of Detection Cost:

It is worthy of note that detecting a risk element in rice processing greatly enhances the chances of correction of any impending damage, therefore prompt corrective action must be taken to minimizing the potential impact on operations, reputation, and organizations must also comply with regulations and voluntary standards.

Again, equipment monitoring is very critical in rice processing because this determines the physical quality of the rice produced by the machine. Most consumers are usually attracted to buy rice whose qualities are most physically appealing. By adopting cleaner technologies, and improving production processes we can integrate environmental considerations into our decision-making, and create a more sustainable environmental future.

5.3.3 On the basis of Internal Failure cost:

The rice mill should invest in proactive environmental management and risk mitigation strategies; this will enhance their overall performance and competitiveness in the marketplace. These costs include the cost to fix technologies or care for employees owing to environmental incidents that may occur. Some may be mitigated by providing standard equipment to aid respiration by the workers during rice processing and forestall incidences of respiratory and health impacts to inhalation of emissions from rice husk dusts, physical impacts of vibration and noise which may lead to deafness and other side-effects to employees.

However, any cost arising from an organization, resulting from negative sustainability related events affecting that organization's resource (people, materials, processes, etc.) should be avoided. These findings and recommendations can inform policy decisions, guide rice processors, and contribute to sustainable and environmentally friendly rice production practices in Nigeria.

5.4 Contribution to Knowledge

This research builds upon existing knowledge by offering a fresh perspective on environmental costs in rice processing. In three key ways, this study contributes to the ongoing conversation:

1. A Comprehensive framework for categorizing Environmental Costs.

For the first time, this research provides a thorough framework for categorizing environmental costs in rice processing. This framework includes four critical categories: Prevention, Detection, Internal Failure, and External Failure Costs.

2. Qualifying the Value Added Effects of Environmental Cost Reduction

This study is a step further by qualifying the value-added effect of environmental cost reduction strategies in rice processing. The findings highlight the benefits of cost savings, improved brand reputation, increased efficiency, and compliance with regulations.

3. Informing Sustainable Rice Processing Practices.

Ultimately, this research aims to inform sustainable rice processing practices by emphasizing the importance of environmental cost management. By providing guidance on strategies for reducing environmental costs, this study supports the development of environmentally responsible rice production and processing systems.

From the results of this study would bring improvements in the industry and new values added to the processing of rice in the study area.

References

Abey Francis. (2017). Value added – Concept, definition, and uses.

Abubakar, H., Umar, B. F., Gbanguba, A. U., Dauda, N. S., Hamisu, S., & Abubakar, M. B. (2023). Adoption of improved rice processing technologies: A case of small-scale rice processor groups under IFAD-Value Chain Development Program in Niger State.

Adediran, & Alade. (2013). Impact of environmental costs on corporate performance.

Agu, & Chukwu. (2013). Rice in the economy of Abakaliki, Southeast Nigeria, 1940–2011.

Ahiduzzaman, & Sadrul. (2009). Energy utilization and environmental aspects of rice processing industries in Bangladesh.

Ailani, G. (2024). External failure cost - What is it, examples, how to reduce?

Ajala, A. S., & Gana, A. (2015). Analysis of challenges facing rice processing in Nigeria. *Journal of Food Processing*, 893673.

Ajala, A. S., & Gana, A. (2015). Analysis of challenges facing rice processing in Nigeria. *Journal* of *FoodProcessing*, 2015, 893673.

Akanbi, O., Olaniyi, A., Adekunle, O., Olohungbebe, & Alao. (2023). Technical efficiency and profitability of local rice processing in Kwara state, Nigeria.

Amolegbe, *et al*. (2016). Value chain analysis of the rice industry in Nasarawa state, Nigeria.

Ani, M., & Ecoma. (2017). Role of Norwegian Church Agricultural Project (NORCAP) in promoting rice production in the clan.

Anvar, M., & Venter, M. (2014). Attitudes & purchase behaviour of green products among generation Y consumers in South Africa. *Mediterranean Journal of Social Sciences*, 5(183-194).

Basuki, *et al*. (2018). Adaptation to coastal flooding and inundation: Mitigations and migration pattern in Semarang City, Indonesia.

Bello. (2009). Work environment in small-scale rice mills in Ivo LGA, Ebonyi state.

Bodie, A. R., Micciche, A. C., Atungulu, G. G., Rothrock, M. J., Jr., & Ricke, S. C. (2019). Current trends of rice milling byproducts for agricultural applications and alternative food production systems. *Frontiers in Sustainable Food Systems*, 3, 47.

Budnitz, R., & Holdren, J. P. (2003). Social and environmental costs of energy system. *Annual Review of Energy*, 1(1), 553-580. OI:10.1146/annurev.eg.01.110176.003005

Chen, T. B., & Chai, L. T. (2010). Attitude towards the environment and green products: Consumers' perspective. *Management Science and Engineering*.

Čuček, L., Klemeš, J. J., & Varbanov, P. S., & Kravanja, Z. (2015). Significance of environmental footprints for evaluating sustainability and security of development.

International Rice Research Institute (2022). Annual Report.

Kumar, A., Singha, S., Sengupta, B., Dasgupta, D., Datta, S., & Mandal, T. (2016). Intensive insight into the enhanced utilization of rice husk ash: Abatement of rice mill wastewater and recovery of silica as a value-added product. *Ecological Engineering*, 91:270–281.

Lancon, F., Erenstein, O., Akande, S. O., Titilola, Akpokodje, G., & Ogundele, O. O. (2003). *Rice processing in Nigeria: A survey.* Abidjan: WARDA.

Maris, C.-M. (2021). Analysis of value chain in rice production systems in Ebonyi State, Nigeria. *Afribary*. Retrieved on January 15, 2024,

Maris, C.-M., Ohajianya, D. N., Obasi, P., & Onyeagocha, S. (2019). Profitability of rice production in different production systems in Ebonyi State, Nigeria. *Open Agriculture*, 4:237–246.

Mbah, C. N., & Onweremadu, E. U. (2009). Effect of organic and mineral fertilizer inputs on soil and maize grain yield in an acid ultisol in Abakaliki, South-Eastern Nigeria. *American-Eurasian Journal of Agronomy*, 2(1), 7–12.

Obisesan, O. O., Salmann, ., & Egbedi, G. O. (2017). Analysis of profit efficiency among rice processors in Ekiti and Ebonyi states, Nigeria. *Regional Journal of Agricultural and Socio-Economic Sciences*, 3(1), 18-20.

Oguntade, A. E. (2011). Assessment of protection and comparative advantage in rice processing in Nigeria. *Economic Review Journal*, 43.

Okoye, C. O., & Irem, C. O. (2018). Rice milling in Amagu community of Ebonyi state: Health and economic implications. *Tropical Built Environment Journal*, 6(2), 51–54.

Uche, M. N. (2019). Nigeria's import of wheat and rice to rise. Gain Report. United Nations (2019). Environment Programme. *United States Department of Agriculture, Foreign Agricultural Service. (2001)*. Rice Report.