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Effectiveness of indigenous practices in reducing postharvest losses of maize in Kwara state, Nigeria

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This research analysed the effectiveness of local methods to lessen maize spoilage after harvest in Kwara State, Nigeria. Three hundred and eighty maize farmers chosen via a multi-stage sampling technique throughout four of the State's Local Government Areas were interviewed using a custom-made questionnaire. Quantitative measures such as percentages, frequency distributions, regression analyses, and mean scores were employed in analysing the acquired data. Findings revealed that 1.9kg of maize was lost to harvesting, 0.6kag loss during transportation and 2.3kg during storage. Also, 90.6% applied pepper powder to store maize, 73.4% applied cribs and rhumbus to transport maize, 78.1% applied ashes to store maize, and 63.0% applied neem seed/leaf to store maize. Regression analysis show that the application of indigenous practices significantly affected maize loss during harvesting of maize ($R^2 = 0.265$, $F = 8.851$, $p < 0.01$), maize loss during transportation ($R^2 = 0.324$, $F = 11.743$, $p < 0.01$), and maize loss during storage loss ($R^2 = 0.324$, $F = 11.743$, $p < 0.01$). This study concludes that the applications of indigenous practices can preserve and reduce postharvest loss of maize grain during maize harvesting, transporting and storage stages. The study recommends that upgrading indigenous practices in the treatment of maize by concerned research institutes in Nigeria should be given priority.

Keywords: Effectiveness, indigenous, practices, postharvest and losses

1. Introduction

Indigenous practices (IPs) refer to how indigenous people live and work and the things they have done throughout history (Melchias, 2001). According to Rajasekaran (2013), IPs are the precise accumulation of information gained by local persons via casual examination, the amassing of experience, and the profound grasp of a certain culture's surroundings. Indigenous practise reflects the ever-evolving ways locals make sense of their environment, from the animals and plants to the cultural beliefs and historical events that shape how they interact with those elements (Fernandez & Gutierrez, 2010). In Nigeria, particularly in Kwara State, indigenous methods are widely used, and farmers tend to find them highly effective in decreasing losses and improving their livelihood. However, although claims of success in reducing postharvest losses of maize, especially in Kwara state, have been made, there is a lack of data to support these claims. Insufficient empirical investigations on the efficacy of indigenous practices are one possible explanation for the lack of focus on indigenous practises by non-indigenous/developmental researchers in the field of postharvest losses.

Maize *Zea may*) is a cereal yield widely cultivated in different agro-biological settings worldwide. There are over fifty different species found across the globe, each with its unique combination of colour, size, form, and texture. White and

yellow types are the most sought-after; however, this varies by region (IITA, 2016). However, despite being Africa's second-largest producer of maize, Nigeria possesses one of the lowest average yields per hectare compared to other parts of the world (Cadoni & Angelucci, 2013). In the 1500s, Europeans introduced maize to Africa, quickly becoming one of the continent's most important staple foods. Since 1965, maize output in Africa has increased dramatically, makingit a vital crop in the continent. Around 1.2 billion people in Latin America and sub-Saharan Africa rely heavily on maize as a staple diet (Morris, Tripp &Dankyi, 2009). Energy-rich calories and fibre may be found in a plentiful supply of corn. They have comparable levels of vitamins A and C, as well as other antioxidants, vital minerals, carbohydrates, and proteins (around 9 percent) (Brink & Belay, 2006). Over fifty percent of Ghana's grain harvest comprises maize (IITA, 2016).

Postharvest losses denote a measurable decline in the quality and quantity of an item after it has been harvested (Kikulwe *et al*, 2018) To calculate the proportion of postharvest losses (PHL) in terms of total production, FAO (2011) takes into account losses at each of the five stages from farm to fork, including (1) harvesting (because of accidental spillage and/or mechanical breakdowns), (2) postharvest processes such as winnowing, drying, and storage (rodents, pests, insect, rotting), (3) processing, (4) promotion and dissemination of the product, and (5) consumption (i.e. Food that is perfectly edible and is of high quality). For industrialised countries, PHL is most prevalent at the very end of the supply chainduring retail and consumer purchases (Lipinski et al., 2013).

Researchers have reported several traditional procedures involving the use of pesticidal plants (botanicals) to be effective against maize storage bugs (Mandudzi and Edziwa, 2016; Masundire, 2015). In Mandudzi and Edziwa (2016), E. tereticornis leaf powder was proposed as a pesticide against *S. zeamais* in stored grain. It was noted that this powder should be treated often because its effectiveness declines with time. When it comes to protecting grains, air-dried powdered plant components are far superior to fresh leaves and some other parts of the plant, as proposed by several studies (Parwada et al., 2012; Fekadu et al., 2012). According to research published in 2012 by Parwada et al., the powders prevent weevils from feeding and moving about by drying them up and smothering them. As a natural pesticide, wood ash has been used for decades to keep insects out of maize storage.

Numerous researches on indigenous behaviours is evidence of the phenomenon's rising profile and significance. Adedipe, Okuneye, and Ayinde (2004) and Atoma (2011), in two independent studies, examined the importance of indigenous knowledge in Nigerian agriculture and its connection to sub-Saharan Africa's quest for sustainable development, respectively. Studies on indigenous knowledge and smallholder farming have been conducted before, most notably by Fadina and Ogunyemi (2002), Ghoudzi (2010), Claxton (2010), and Ibitoye (2011), who all focused on how indigenous knowledge helps ensure the safety and sufficiency of Nigeria's rural poor. Abioye, Zaid, and Egberongbe (2011) focused on recording and sharing Agricultural Indigenous Knowledge in Nigeria; In their 2014 study, Abdullah and Hassan analysed the significance of Indigenous Knowledge to Sustainable Development in Agriculture.

For these reasons, the research set out to see what influence traditional methods of storing maize grain would have. The

researchers set out to learn how local techniques may help farmers in Kwara State, Nigeria, save money by lowering their post-harvest corn loss. The particular aims were to (i) calculate the amount of corn lost after harvest and (ii) examine the prevalence of traditional methods employed by maize producers. The study's null hypothesis claimed that the amount of maize lost would be the same when using both conventional and traditional methods during the harvest, transportation, and storage phases.

2. Methodology

Kwara State, in Nigeria's North Central geo-political zone, was the focus of this study. 16 LGAs spread over the state's 33,773.3 square kilometres of land. Of the 2,371,089 residents, 1,220,581 are men and 1,150,508. The Kwara State Agricultural Development Programme (KWADP) split the state into four (4) zones based on natural features, cultural norms, and the ease of managing the project. All maize farmers in the state of Kwara were surveyed for the study. The state is divided into sixteen different LGAs. The study used a multistage sampling strategy. Kaima, Edu, Asa and Oyun LGA were chosen as representatives of Zones A, B, C, and D, respectively, due to their high maize output. Furthermore, 4 communities were chosen from each of the LGAs, for a total of 16 communities, using a random sampling method in each of the LGAs. In the end, we used snowball sampling to pick 25 participants from the eight (8) towns. The interviews that formed the backbone of the study's core data set were conducted in the field. Data were analysed using inferential and descriptive statistics, and the interview schedule was distributed to 384 maize farmers. We used standard deviation, mean, percentages, and frequency tables to do this. To test the hypothesis, a multiple regression analysis was used. The analysis was performed using SPSS version 23. The chosen and implicitly defined Ordinary Least Square (OLS) model of multiple linear regression is Equation 1:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + e_i \ldots\ldots \quad 1$$

Where:

Y= dependent variable

X = independent variables

β_0= intercept

e_i = **error term**

4. Results and Discussion

Quantity of postharvest losses of maize

Findings show that 1.9 bags were lost during harvesting, 0.6bag during transportation, and 2.3bags were lost during storage. This implies that the highest quantity of postharvest losses of maize occurred during maize storage. These findings corroborate earlier reports of similar studies that most maize farmers in Nigeria suffered considerable losses in the quantity and quality of their maize produce owing to storage pests (Kitinoja, Dandago and Abdullahi, 2019). This finding also showed that maize farmers in Kwara State lost an average of 5 bags of maize to harvesting, transportation, and storage.

Table 1: Quantity of postharvest losses of maize in Kwara State

Stages of loss	Mean	Standard deviation
Harvesting stage (bag50kg/year)	1.9	2.63
Transportation stage (bag50kg/year)	0.6	1.63
Storage stage (bag50kg/year)	2.3	1.86

Source: Field survey, 2021

Application of Indigenous Practices in Controlling Post-Harvest Losses of Maize

The findings from this study, as represented in Table 2, showed that 248(90.6%) respondents used pepper, 300(78.1%) respondents used wood ashes, 282(73.4%) respondents used cribs and rhumbus, 242(63.0%) respondents used neem seed and leaf, 217(56.5%) respondents used aerial storage, 112(29.2%) respondents used drum/calabash/local pot/gallon/tin/Jerri can, 94(24.5%) respondents used mahogany/Sachi, 24(6.3%) respondents used smoking, 12(3.1%) respondents used cowbone, 10(2.6%) respondents used sandpaper leaf, 10(2.6%) respondents used a nail, 8(2.1%) respondents used Partridge egg, 6(1.6%) respondents used millipede while Six percent (1.6%), of the people surveyed, reported using alum as a traditional method for preventing corn from spoiling after harvest.

Table 2: Application of Indigenous Practices in Controlling Post-Harvest Losses of Maize

Indigenous Practices	f	%
Neem seed and leaf	242	63.0
Pepper powder	248	90.6
Wood Ashes	300	78.1
Cribs and Rhumbus	282	73.4
Aerial storage	217	56.5
Drum/Calabash/Local pot/Gallon/Tin/Jerrican	112	29.2
Ginger	10	2.6
Mahogany/Sachi	94	24.5
Millipede	6	1.6
Nail	10	2.6
Cow bone	12	3.1
Smoking	24	6.3
Sandpaper leaf	10	2.6
Alum	6	1.6
Partridge egg	8	2.1

Source: Field Survey, 2021

Test of hypothesis

Null hypothesis: Indigenous practices are not significant in the reduction of maize postharvest losses in Kwara state.

The Effectiveness of the Application of Indigenous Practices in Reducing Postharvest Losses of Maize during Harvesting

Table 3 displays the regression analysis results that found the employment of indigenous techniques to decrease maize spoilage after the harvest had a statistically significant impact on harvest losses (R2 = 0.265, F = 8.851, p 0.01). The study found that farmers in the region could save an average of 26.5% on their maize harvest losses if they adopted local harvesting procedures. Only four indigenous practices were shown to impact losses that occurred during maize harvesting significantly; they were the use of neem seed/leaf (β=0.870, p 0.01), cribs and rhumbus (β=0.967, p< 0.01),drum/calabash/localpot/gallon/tin/Jerri can (β=1.111, p 0.01), and peppers (β=-1.798, p< 0.01).

By implication, neem seed/leaf, cribs and rhumbus, and drum/calabash/local-pot/gallon/tin/Jerri can show a positive relationship to reducing postharvest losses of maize during the harvesting stage. Thus, the increase in 1 unit uses of neem seed/leaf, cribs and rhumbus, and drum/calabash/local-pot/gallon/tin/Jerri predicted the possibility for more reduction in losses of maize during harvesting to 0.870 units, 0.967 units, and 1.111 units respectively. These findings imply that using neem seed/leaf, cribs and rhumbus, anddrum/calabash/local-pot/gallon/tin/Jerri can are the most appropriate indigenous practices capable of providing positive results in reducing losses of maize if used when harvesting it on the farm. However, the use of drum/calabash/local-pot/gallon/tin/Jerri can contribute more to reducing losses of maize at the harvesting stage because it predicted stronger

reduction power (unit ≥ 1.0) in reducing postharvest losses of maize during harvesting than the use of neem seed/leaf and cribs and rhumbus method.

Additional results demonstrated an inverse association between the usage of peppers and the prevention of postharvest losses in maize. The increased consumption of peppers per unit projected a -1.798 unit decrease in maize postharvest losses. This implies that pepper is not significantly good for use in reducing postharvest losses of maize during the harvesting stage.

Relationship between Application of Indigenous Practices and Postharvest Losses of maize during transportation

According to the result of multiple regression presented in Table 3, it was shown that the postharvest losses of maize during transportation were significantly influenced by the use of indigenous practices in reducing postharvest losses of maize ($R2 = 0.324$, $F = 11.743$, $p < 0.01$). Farmers in the research area might save an estimated 22.4% of their crop by employing indigenous transport strategies while moving corn. Only neem seed/leaf (β=0.672, p 0.01), drum/calabash/local pot/gallon/tin/Jerri can (β=2.082, p 0.01), Partridge egg (β=7.500, p <0.01), peppers (β=-1.143, p <0.01), and alum (β=-7.602, p <0.01).

By implication, the use of neem seed/leaf, drum/calabash/local-pot/gallon/tin/Jerri can and partridge egg showed a positive relationship to reducing postharvest losses of maize during the harvesting stage. Thus, the increase in 1 unit use of neem seed/leaf, drum/calabash/local-pot/gallon/tin/Jerri can and partridge egg predicted more reduction in losses of maize during transportation to 0.672 units, 2.082 units, and 7.500 units, respectively. These findings imply that the use of neem seed/leaf, drum/calabash/local-pot/gallon/tin/Jerri can, and partridge egg which are indigenous practices are the most appropriate practices that can provide positive results in reducing postharvest losses of maize if used when transporting maize. Nevertheless, the use of partridge egg and drum/calabash/local-pot/gallon/tin/Jerri can contribute more to reducing losses of maize because they predicted stronger reduction power (unit ≥ 1.0) in reducing postharvest losses of maize during transportation than the use of neem seed/leaf method.

The results also revealed a negative correlation between the use of peppers and alum and the prevention of postharvest losses of maize during transportation. The increased usage of peppers and alum per unit indicated a lesser reduction in postharvest losses of maize during transport, with -1.798 units and -7.602 units expected, respectively. This suggests that pepper and alum were not useful in preventing maize from spoiling during transit after harvest.

The Effectiveness of the Application of Indigenous Practices in Reducing Postharvest Losses of Maize during Storage

Based on the result of multiple regression presented in Table 3, it was shown that indigenous practices significantly influenced maize's postharvest losses during storage ($R2 = 0.066$, $F = 1.732$, $p < 0.05$). Farmers in the study region might save 6.6% of their maize crop by applying traditional techniques to reduce spoilage during storage. For maize storage, specifically, only mahogany and sachi (β=3.069, p <0.01) and smoke (β=1.689, p <0.01) were observed to affect postharvest losses significantly.

Therefore, smoke and mahogany/Sachi helped lower post-harvest losses of maize during the storage phase. In this way, it was estimated that maize losses during storage might be reduced by an

additional 3.069 units and 1.689 units for every 1 unit of smoke and mahogany/Sachi used. This research suggests that mahogany, smoke, and sachi have a greater potential to lessen post-harvest maize losses. Therefore, while the smoking process can help reduce maize losses, using mahogany and sachi tree back has been expected to be more valuable and contribute more.

Table 3: Multiple Regression of application of indigenous practices as determinants of postharvest losses during harvesting, transportation and storage of maize

Application of IP	Loss to harvesting			Loss to transportation			Loss to storage		
	Coef.	t-stat	Sig.	Coef.	t-stat	Sig.	Coef.	t-stat	Sig.
Neem seed and leaf	0.870	3.428	0.001**	0.672	3.484	0.001**	-0.586	-2.28	0.023
Pepper	-1.798	-3.384	0.001**	-1.143	-3.616	0.000**	0.083	0.196	0.844
Ash	0.271	0.699	0.485	0.309	1.339	0.181	0.026	0.085	0.932
Cribs and Rhumbus	0.967	2.588	0.010**	-0.145	-0.653	0.514	-0.153	-0.514	0.607
Aerial storage	-0.108	-0.308	0.758	0.368	1.768	0.078	0.3	1.081	0.281
Drum/Calabash/Local pot/Gallon/Tin/Jerrican	1.111	2.749	0.006**	2.082	5.812	0.000**	-0.299	-1.189	0.235
Ginger	1.381	1.693	0.091	0.879	1.812	0.071	0.467	0.721	0.471
Mahogany/Sachi	-0.14	-0.366	0.715	-0.243	-0.844	0.399	3.069	5.096	0.000**
Millipede	1.108	1.123	0.262	-0.151	-0.258	0.797	-0.871	-1.112	0.267
Nail	0.225	0.286	0.775	-0.301	-0.643	0.521	0.469	0.751	0.453
Cowbone	-1.039	-1.375	0.170	-0.37	-0.823	0.411	0.322	0.537	0.591
Smoke	0.015	0.031	0.975	0.109	0.581	0.562	1.689	3.492	0.001**
Sandpaper leaf	0.745	0.452	0.652	-0.212	-0.216	0.829	-1.345	-1.026	0.305
Alum	-2.347	-1.246	0.214	-7.602	-6.781	0.000**	-0.957	-0.64	0.523
Partridge egg	1.50	0.650	0.516	7.500	5.466	0.000**	1.5	0.819	0.413
Constant	3.827	8.608	0.000	0.762	2.883	0.004	2.615	7.408	0.000
R	.515			.569			.257		
R Square	.265			.324			.066		
Adj. R Square	.235			.296			.028		
Std Error of Estimate	2.30623			1.37209			1.83111		
F	8.851			11.743			1.732		
P	0.000			0.000			0.043		

5. Conclusion and Recommendation

This study concludes that the applications of indigenous practices can preserve harvested maize and reduce postharvest losses of maize during harvesting at 7.1%, transporting at 1.7% and storage stages at 12.1%. The study recommends that further research be conducted to refine, upgrade and propagate the indigenous practices found effective in the study area by the concerned research institute in Nigeria. The average number of bags lost were 1.9 bags during harvesting, 0.6bag during transportation, and 2.3bags during storage., giving a total of 4.8bags**.** The most prevalent indigenous practices in the study area are pepper 248(90.6%), wood ashes 300(78.1%), cribs and rhumbus 282(73.4%). However, Mahogany and Sachi stem barkes are found to be very

effective in extending the shelf-life of harvested maize for more than two years. The study therefore recommends the sensitization of farmers and stepdown training on useful indigenous practices and making them available at the right time for farmers. It also recommended that reserved forest areas be established for the enhancement of regular availability of the indigenous practices

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