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Research Paper

AGRICULTURAL POST-HARVEST WASTE GENERATION AND MANAGEMENT FOR SELECTED CROPS IN MINNA, NIGER STATE, NORTH CENTRAL NIGERIA

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Abstract: Post-harvest waste generations in selected local government areas of Niger state, North central Nigeria was evaluated. This is with a view to knowing the types, quantity and strength of these resides. The method adopted was investigative approach. Questionnaire was administered and results collected. From the study, maize, groundnut and rice are being produced in large quantity in the place visited. Average grain-straw ratio for maize was 1.34:1, grain-straw husk ratio for rice was 1.28:1 while nut to shell ratio for groundnut was 3.07:1. For maize alone in twelve local governments, 3,423 tonnes of waste is produced, 3,481 tonnes for Rice and 1,742 tonnes of groundnut waste is produced. The major management measure adopted now is burning which is not environmentally friendly. The results gotten from the study can be used to design waste management plants for these local governments.

Keywords: Crop residue, grain, groundnut shell, rice husk

INTRODUCTION

Waste can be defined as something useless produced by the same action that produces something useful or a by-product of industrial, agricultural municipal and mining activities. Man has continually sought to improve the quality of life, transforming nature to provide more food, better living conditions and long life [1]. Agricultural mechanization and technology has helped to accomplish this transformation and to achieve many of man's goals. It has however, left a

profusion of environmental problems in its wake [2]. The question today is whether technology and good waste management can solve the environmental problems which agricultural mechanization and technology has helped to cause. But in order to answer in a more practical way, technological evaluation activities should be expanded and more thought devoted to determining what method is needed to solve today's pressing problems as regards waste management in a mechanized farm. Attention has been mainly focused on problems connected with treatment of wastes at the end of the production line [3]. The method use in handling, treating and disposing of farm waste should be put into consideration. As waste dumped into storm drainage channels, creeks, lagoons and other water impoundment points create a serious environmental problem which has adverse effect on air, water and soil conditions, and may constitute a nuisance to those who dwell nearby [4].

The problems associated with farm waste management are numerous; environmental problems (pollution) which can escalate into disastrous situations resulting from improper waste management [5]. Lack of proper education and adequate information on amount of waste generated, handling, treatment and disposal of waste on the farms and hence the allocation of cost of handling farm waste will not be known [6]. Most of the facilities and equipment for collecting, spreading and treating waste are capital intensive, handling is also laborious and therefore the knowledge of types and quantity of waste generated has to be known. Waste could exist either as solid, liquid or gas and the effect of each phase varies. Farmers have concentrated on intensive production of field crops or on livestock production which has led to the generation of large quantities of vegetal wastes [7]. This paper therefore assesses the generation and management of some agricultural post-harvest wastes in some parts on Niger State and to consider the environmental impacts associated with the generation, handling and disposal of these farm wastes.

MATERIALS AND METHODS

Study area

Niger State is located between latitude 8^0 ,20^1 and 11^0,3^1 and longitude 3^0,30^1 and 7^0,20^1. It has 25 Local Governments, and agricultural activities form the major occupation of the people because about 80% of the population engaged in farming either directly or indirectly. The State experiences two distinct seasons, rainy season which spans between May and November and the dry season between December and April. The annual rainfall is about 1600mm with highest temperature hovering over 34^0C. Three major soil types can be found in the state, ferruginous tropical soil, hydromorphic soil and ferrosol [8]. The most predominant soil type is the ferruginous tropical types which are ideal for the cultivation of guinea corn, maize, millet, rice and groundnut.

Data collection

The methodology adopted in this study is the investigative approach, this includes: mechanized farms visitation and administration of questionnaires to the management of these farms. In the course of this investigation, sixteen villages were visited and ten questionnaires were administered in each of the villages. The state under study was divided into three for this study and four Local Governments each were visited in each division ,they are; Shiroro, Munyan, Paiko and Bosso in Shiroro zone. Kontagora, Wushishi, Magama and kagara in Kontagora zone and Bida, Gbaiko, Lavun and Edati in Bida zone. A total of fifteen questionnaires were administered in each of these Local Governments. Niger State Agricultural Development Programme (NSADP) in Minna and Niger Staet Ministry of Agriculture and Natural Resources

were also visited. Five questionnaires each were administered in these agencies. The questionnaire consists of sections sections; the questions asked in these sections are structured to give precise answers to the problem under investigation. This provides information on the type of wastes generated, sources, and problems associated with the time of waste generated in relation to the environment, and how these wastes are managed to abate their pollution tendencies. Also, questions are asked on the performance of the organizations in terms of their efficiency and rating in managing wastes in line with the specification of environmental protection agencies.

Determination of grain-straw ratio

The method used by [9] was used to determine the grain-straw ratio, grain-husk- straw ratio and groundnut-shell ratio. The method involves collecting samples of crop stand at different points on one meter square area. The grain and the straw at each stand are separately weighed. The process is repeated six times at different points on the one meter square area. The average ratio of weight of grain to weight of straw for the six samples is the grain-straw ratio. The same method was used to get groundnut-shell ratio.

RESULTS AND DISCUSSION

Information on respondents and activities of the farms

The farms visited are all privately owned establishment and all the farmers had no formal education. However, much information was got from Niger State Agricultural Development Programme (NSADP). Five major crops were being propagated on large scale in Niger state. But the way and manner they are being grown vary and spread across the state. The crops are; groundnut, maize, yam, sorghum and rice. The distribution of the crops in the selected local Governments that fall within the three zones are as presented.

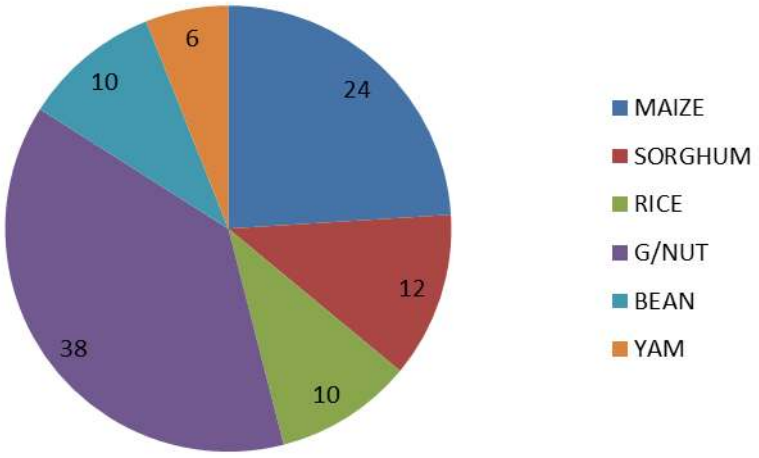

Fig. 1: Average crop production per year in Kontagora zone

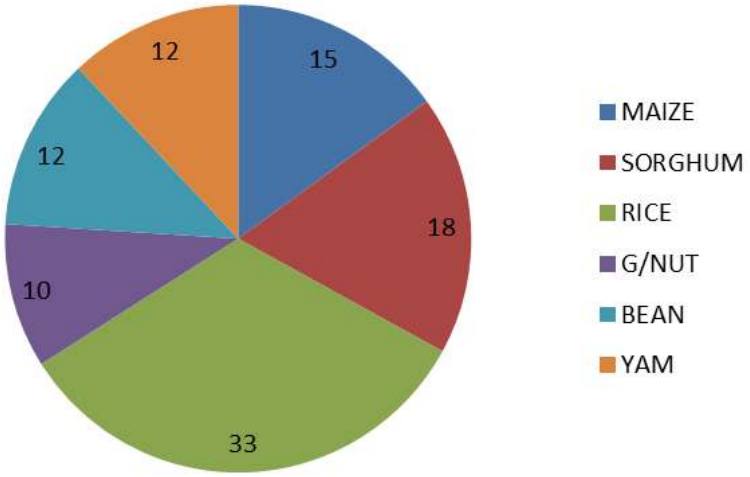

Fig. 2: Average crop production per year in Bida zone

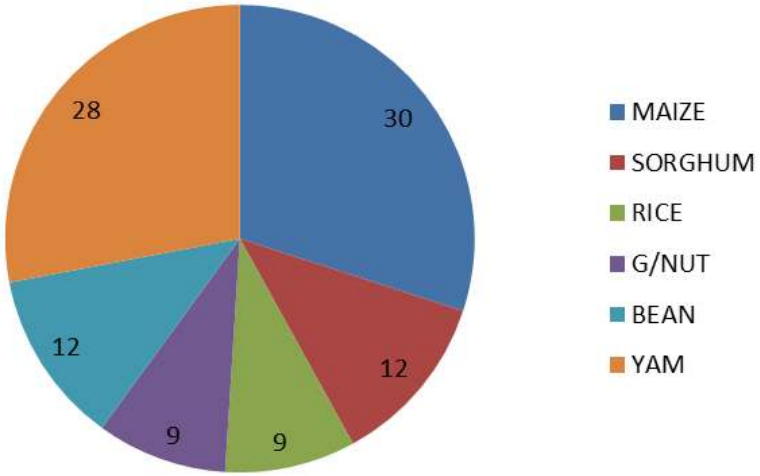

Fig. 3: Average crop production per year in Shiroro zone

It can be seen from Figure 1 that crop that has largest percentage in Kontagora Zone is groundnut and therefore the highest producer of groundnut shell in Niger State. From Figure 2, rice is taking the lead in Bida zone and therefore production rice husks will be more in the zone than any other zones in Niger state. From figure 3, In Shiroro zone, maize and yam are having percentage very close to each other (30% and 28% respectively). However, when post-harvest wastes of maize and yam are compared, yam gets to final consumer almost without undergoing much post-harvest handling. That makes its post-harvest residue to be close to negligible. Therefore maize was taken to be studied in Shiroro zone. The information about average output of the four selected crops as extracted from questionnaire administered in NSADP are summarized in Tables 1. The outputs are for the year between 2005 and 2009 for the 12 selected local Governments.

Table 1: Average output of selected crops from 2005-2009

Local Government	Maize (Tonne/year)	Rice (Tonne/year)	Groundnut (Tonne/year)	Sorghum (Tonne/year)
Bosso	480	239	236	233
Munyan	410	278	218	268
Shiroro	430	298	312	269
Paiko	421	301	298	302
Kontagora	344	187	736	311
Kagara	322	202	675	309
Magama	392	215	612	326
Wushishi	403	304	567	246
Edati	519	613	349	254
Bida	354	710	332	332
Gbaiko	332	654	387	314
Lavun	367	665	401	269

SOURCE: Niger State ADP and Questionnaire

The output confirms the distribution of the crops. It can also be seen from table 1 that groundnut production is more in the four local Governments that make up Kontagora zone while more of rice was recorded in Bida zone. Maize is produced in larger quantity in Shiroro zone. The results of grain – straw ratio for maize, grain-straw-husk ratio for rice and nut-shell ratio for groundnut determined are presented in tables 2, 3 and 4 respectively.

Table 2: Grain- straw ratio of maize test plots

Sample	Weight of grain ($g.m^{-2}$)	Weight of straw ($g.m^{-2}$)	Grain- straw ratio
1	549.6	433.2	1.27:1
2	630.2	456.3	1.38:1
3	657.6	552.2	1.19:1
Average	612.5	480.6	1.28:1

Table 3: Grain- straw-husk ratio of rice test plots

Sample	Weight of grain ($g.m^{-2}$)	Weight of straw+ Husk ($g.m^{-2}$)	Grain- straw- Husk ratio
1	355.30	255.6	1.39:1
2	439.22	310.66	1.41:1
3	544.33	433.20	1.26:1
Average	446.28	333.15	1.34:1

Table 4: Nut- shell ratio of groundnut test plots

Sample	Weight of groundnut ($g.m^{-2}$)	Weight of shell ($g.m^{-2}$)	Nut- shell ratio
1	289.3	98.3	2.94:1
2	302.0	102.1	2.96:1
3	321.0	96.4	3.33:1
Total	304.1	98.9	3.07:1

From the tables average grain to straw ratio for maize is 1.28 to 1, grain-straw-husk ratio for rice is 1.34 to 1 while nut to shell ratio for groundnut is 3.07 to 1. Ratio of that of groundnut is small

because the weight of shell to nut are far from each other, however, groundnut shell, though lighter in weight, occupies more space than rice husk and maize straw. This is evident in the heaps of groundnut shell in Mariga village plate 1, and rice husk heaps in Doko village Plate 2.

Plate 1: Groundnut shell heap in Mariga.

Plate 2: Rice husk heap in Doko village.

The information here is used to estimate the quantity of wastes being generated from these crops in the Local Governments under consideration. This is presented in table 5.

Table 5: Estimated crop waste produced based on calculation for maize

Local Government	Grain – Straw ratio	Total crop output (tonne)	Total crop waste(tonne)
Bosso	1.28:1	480	375.00
Munyan	1.28:1	410	320.30
Shiroro	1.28:1	430	335.94
Paiko	1.28:1	421	328.91
Kontagora	1.28:1	344	268.75
Kagara	1.28:1	322	251.56
Magama	1.28:1	392	306.25
Wushishi	1.28:1	403	314.84
Edati	1.28:1	519	405.47
Bida	1.28:1	354	276.56
Gbaiko	1.28:1	332	259.38
Lavun	1.28:1	367	286.72
Total		4774	3,421.38

Table 6: Estimated crop waste produced based on calculation for rice

Local Government	Grain-Straw- Husk ratio	Total crop output (tonne)	Total crop waste(tonne)
Bosso	1.34:1	239	178.36
Munyan	1.34:1	278	207.46
Shiroro	1.34:1	298	222.39
Paiko	1.34:1	301	224.63
Kontagora	1.34:1	187	139.55
Kagara	1.34:1	202	150.75
Magama	1.34:1	215	160.45
Wushishi	1.34:1	304	226.87
Edati	1.34:1	613	457.46
Bida	1.34:1	710	529.85
Gbaiko	1.34:1	654	488.06
Lavun	1.34:1	665	496.27
Total		4666	3,481.92

Table 7: Estimated crop waste produced based on calculation for groundnut

Local Government	Nut-Shell Ratio	Total crop output (kg)	Total crop waste
Bosso	2.94:1	236	80.27
Munyan	2.94:1	218	74.15
Shiroro	2.94:1	312	106.12
Paiko	2.94:1	298	101.36
Kontagora	2.94:1	736	250.34
Kagara	2.94:1	675	229.59
Magama	2.94:1	612	208.16
Wushishi	2.94:1	567	192.86
Edati	2.94:1	349	118.71
Bida	2.94:1	332	112.93
Gbaiko	2.94:1	387	131.63
Lavun	2.94:1	401	136.39
Total		51243	1742.51

It can be seen from Tables 5-7 that the quantity of post –harvest residue generated in ten local Governments area of Niger State is very high for the three crops considered. About 1745 tonnes of groundnut shell are produced while about 3,480 tonnes of rice husk is produced and 3420 tonne of maize straw are produced. This may be linked to the types of soil that dominate the farms in the study area which support cultivation of grain and shallow rooted crops. When this post-harvest wastes being produced are not well managed, [10] submitted that the real product (nuts) will be reduced in the subsequent years as a result of pest menace that will be brought about by poor waste management. Therefore, the post-harvest waste production and management should also be considered even before embarking on cultivation.

Residue management

From the in-situ inspection done and the responses to the questionnaires administered, all the farm visited are not having definite waste management practice. The residues are just left on the soil to degrade and in some area; they have formed heaps where weeds grow (plate 3) and become another threat to the nearby farms**.** In some places, they are subjected to burning. Burning, apart from its bad environmental effect of depleting oxone layer, is also harmful for soil micro- organisms. It may also pose health hazard to the nearby villagers that inhale the smoke from this combustion process [11].

Plate 3: Weeds growing on a farm residue heap

Plate 4: Mixture of rice straw and earth aterials used as lining for irrigation canals.

Recommended post-harvest waste management practices

The problems of enormous quantity of crop waste (residue) in the farms can be solved if the crop wastes are prepared as hay and silage to feed the animals. The management of these farms should be well informed of the types of waste they will generate from their farm operations and prepared to deal with it.

The following measures can be taken to reduce the menace of these farms residues;

(i) They can be converted into particle boards that will be used in farm buildings
(ii) Since they are autothermic, they can be subjected to incineration and the hot gas emitted from it be used to operate turbine to generate electricity.
(iii) Many researchers have tested these farm residues and it has been discovered that they have high calorific values; they can be converted into briquettes to be used as fuel.
(iv) Very fine ones among them if treated can be used as part of filter in a slow –sand filtration plant. This has been tested to have capability of reducing amount of nitrogenous pollutant in the water filtered with it.
(v) Rice and maize straw can be mixed with earth materials and used as lining materials for canal for irrigation purposes [12]. This was adopted in Kenya through the intervention of Food and Agricultural Organization (plate 4).
(vi) Large percentage of it can be worked into the soil to serve as manure. This will add to organic content of the soil and at the same time reduce the concentration of these residues on soil.

CONCLUSIONS

The study has provided a base for which post- harvest waste in selected farms can be estimated the type of crops residue on these farms and various management adopted by these farms have been studied and possible suggestions have been proffered on how to curb the menace of these wastes. It is therefore necessary that these wastes are taken care of in view of their increasing magnitude on these farms as the desired for increase agricultural production is achieved through farm mechanisation. This write up is not an exhaustive literature but can serve as guide and reference to a study on waste management in selected farms in Niger state. The waste (crop residue) from these farms can be prepared and sold (Source of income to the management) especially to the cattle rearers (mostly Fulani nomads) who are always experiencing Shortage of feeds during the dry season period. Waste management should be integrated as part of the farm production System. So that it can be cared for as much as the farms product in order to avoid any environmental consequences resulting from poor waste management. Finally, this project work only focused on three crops in twelve Local Governments of Niger State, more work should be done to cover other food crops like, soy bean, sorghum, millet, cowpea etc. This study should also be extended to cover the remaining fifteen Local Governments in the state so that a proper record can be kept on crop residue generation and management in Niger State.

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