

Utilization of Agricultural Residues as Local Alternative Energy to Woodfuel in Sudano-Sahelian Northwestern Nigeria

Halima Inuwa Jibril

Department of Geography, Bayero University Kano, Kano Nigeria

Abstract: *The recourse to agricultural residues for meeting energy needs in the Sudano-Sahelian northwestern Nigeria is necessitated vis-à-vis dwindling access to woodfuel and the rapidly growing population. This paper did an inventory on the local alternatives to woodfuel being utilized in the rural energy system of the Sudano-Sahelian northwestern Nigeria. It also examined sources of the local alternatives its sustainability. Both multi-stage cluster and systematic sampling procedures were employed in selecting the 22 settlements for the study. Data was generated from review of documents, Focus Group Discussions (FGDs), semi structured interviews (SSI) and photographs; 440 people were purposively selected for the FGDs and grouped by age and sex. The data generated were analyzed using descriptive statistics, SPSS (analysed using the frequencies, percentages and cross tabulation) and content analysis. Results were presented in tables as appropriate. The local alternatives were mostly utilized in cooking, and heating. High woodfuel demand and consumption has led to serious destruction of forest resources consequently resulting in the reduction or extinction of some of the tree species. Energy is vital for development; a great influence in the progress of a community, sustainability should be encouraged through curbing deforestation practices among others.*

Keywords: *Agricultural residues, energy, local alternatives, Sudano-Sahelian, woodfuel*

I. Introduction

The Sudano-Sahelian Northwestern Nigeria is among Nigeria's sub regions experiencing rapid population growth and meeting rural household's woodfuel need is a herculean task [1]. In recent years, many rural areas of Nigeria, especially Sudano-Sahelian areas of the country are facing acute inadequacy of woodfuel. To meet energy needs, households have searched for alternatives to woodfuel; alternatives are found in the use of other "local" biomass resources; the most important being crop residues, animal wastes and litter. The region has an estimated rural woodfuel consumption of 27.5m kg/day; the users of biomass energy are often characterized by low income levels, limited energy choices and low literacy levels [2]. The high cost and inadequate accessibility to modern energy sources restricts households and communities from ascending the energy ladder. With inadequacy of biomass in form of woodfuel, households and countries will invariably continue to depend on alternatives [3]. These alternatives at the rural household levels are found in crop residues, animal residues, animal wastes and other domestic refuse [4]. However, similar studies exploring the availability, use and management of alternatives to woodfuel in the rural areas are inadequate. This paper investigates the utilization of these local alternatives to woodfuel among households in the Sudano-Sahelian areas of Northwestern Nigeria.

II. Study Area

The area lies in the Sudano-Sahelian Ecological Zone (SSEZ) of Nigeria, and is located within latitudes 11°N and 13°58'N and longitudes 4°8'E and 10°00'E. It falls within the sokoto plains, high plains of Hausaland and Chad formation [5] (Fig 1). The area shares border with the Republic of Niger to the north; parts of the northeastern fringes of Benin Republic to the West; the southwestern part by Niger state; Kaduna state to the South; Bauchi on the south and eastern corners; Yobe shares a border with the study area in the eastern corner. The climate of the zone is the tropical wet and dry type, classified as Aw by Koppen. The vegetation of the Sudano-Sahelian northwestern Nigeria is mainly Sudan and Sahel savannah. More than half of the region is covered by ferruginous tropical soils which are heavily weathered and markedly laterized [6]; [7]. Farming and pastoralism are the major agricultural activities practiced by the majority of the people of the Sudano-Sahelian region of northwestern Nigeria most especially in its rural areas.

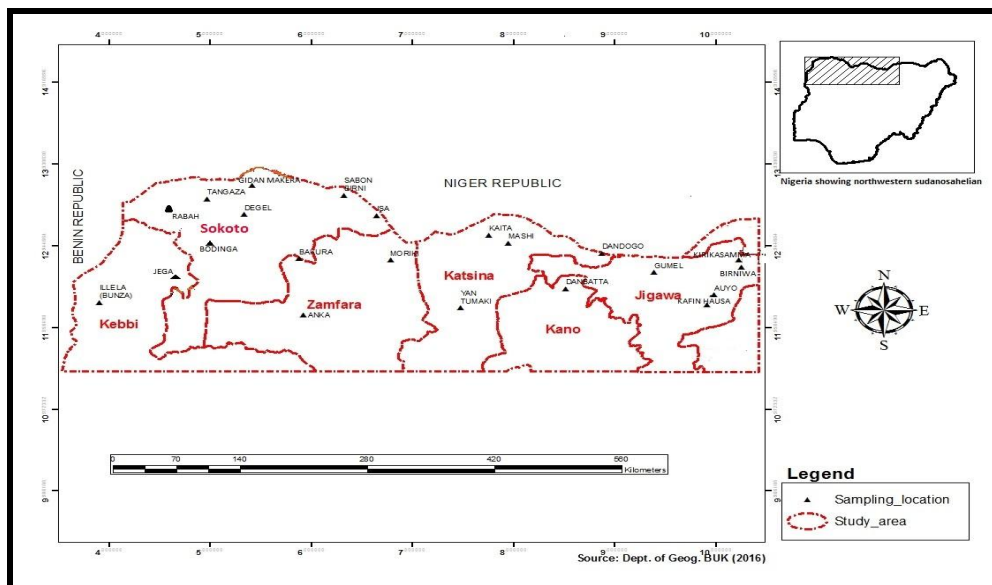


Fig 1: Sudano-Sahelian northwestern Nigeria showing sampling locations

III. Methods

A multistage cluster sampling technique was employed for this study and twenty-two settlements within the Sudano-Sahelian northwestern Nigeria region were systematically selected, a number of 44 Focus Group Discussions (FGDs) were held with a total of 440 participants (comprising equally of 220 females and 220 males) (Table 1). Secondary sources of data used for the study included 2006 census data of the region from the National Population Commission (NPC). Descriptive statistics and content analysis were used to analyse the data generated using the Statistical Package for the Social Sciences (SPSS).

Table 1: Settlements and number of FGD held with participants

SN	Settlements	No Of FGD	No Of Participants	
			Male	Female
1	Anka	2	10	10
2	Auyo	2	10	10
3	Bakura	2	10	10
4	Birniwa	2	10	10
5	Bodinga	2	10	10
6	Danbatta	2	10	10
7	Dandogo	2	10	10
8	Degel	2	10	10
9	Gidan Makera	2	10	10
10	Gumel	2	10	10
11	Illela (Bunza)	2	10	10
12	Isa	2	10	10
13	Jega	2	10	10
14	Kafin Hausa	2	10	10
15	Kaita	2	10	10
16	Kirikasamma	2	10	10
17	Mashi	2	10	10
18	Moriki	2	10	10
19	Rabah	2	10	10
20	Sabon Birni	2	10	10
21	Tangaza	2	10	10
22	Yan Tumaki	2	10	10
	Total	44	220	220

Source: Field survey, 2016

IV. Results and Discussions

Twenty seven local alternatives to fuelwood were identified to be utilized by respondents in all the sites where FGDs were conducted at the study locations. Based on their constituents, the alternatives were classified into four (Table 2);

Table 2 Classification of local alternatives

SN	Category	Local Alternative
1	Animal Wastes	Dung, feathers, livestock waste, poultry droppings
2	Crop Residue	Bagasse, corncob, cotton, husk/chaff, sesame plant stock, shells (coconut and groundnut), sponges, Stover (stalk and leaves),
3	Forest Residues	Barks/stump/twigs, Doum palm fruit, hay/straw/thatch, leaves, sawdust, shrubs, sticks,
4	Household Wastes	Forage, garbage, Old foams, Old shoes, paper, plastics, polythene bags/polymer, rags,

Source: Field work, 2016

The dominant local alternatives found in all the settlements were stover and grasses and hay (plates 1 and 2), doum palm fruit and bagasse (plate 3 and 4) were less dominant while sponge and Old foams (plate 5 and 6) were found to be absent in most of the study locations. It was observed that the sources of these local alternatives are mainly from the farm, forest and markets and are mainly from agricultural i.e. crop residues and animal wastes [7].



Plate 1: Stover piled at Gumel, Jigawa State



Plate 2: Grasses and hay piled for drying at Gumel, Jigawa state

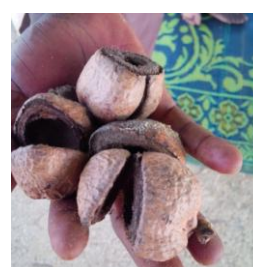


Plate 3: Doum palm fruit at Kaita, Katsina state



Plate 4: Bagasse piled at Anka, Zamfara State



Plate 5: Sponge at Dandogo, Katsina State



Plate 6: Old foams at Yan Tumaki, Katsina state

Table 3 shows the various order of utilization of the local alternatives. Stover (stalk and leaves), barks/stump/twigs, sticks and hay/straw/thatch were found to be in the category of highly utilized local alternatives. It was clearly found that, there were no other alternatives identified in the area that were not utilized by the people

Table 3: Order of utilization of local alternatives

S/N	Order	Local alternative
1	Highly utilized	Stover (stalk and leaves), barks/stump/twigs, sticks and hay/straw/thatch
2	Utilized	Sawdust, dum palm, Other sources
3	Fairly utilized	Dung, sesame plant stock, bagasse, shrubs, leaves and livestock waste
4	Poorly utilized	husk/chaff, poultry droppings, feathers, cotton, sponges, cob, shells
5	Not utilized	-

Source: Fieldwork, 2016

With regards to sources of the alternatives, there is richness in biomass resources in the study area that includes: agricultural/crop residues, forest residues, sawdust and wood shavings, residues from industries, animal dung/poultry droppings, and industrial waste[8] and [9]; and this was also validated by [10] and [11]. Substitute for fuelwood in the rural areas is usually animal waste and agricultural residues was on point as this was observed in most of the study locations by [12] where agricultural and forest residues and animal wastes were the major local alternatives utilized by most households as well as other wastes like forage, plastic, old clothes and polythene. Poverty, low level or insufficiency of fuelwood, low level of accessibility to resources, proximity to available resource, and expensive nature of fuelwood ere all found to be push factors and drivers on

why the alternatives are utilized, although it could be as a result of other factors, this were also cited in the works of [13] and [14]. In this regard, converting wood wastages (wood shavings and sawdust) to briquettes and motivating the public to plant trees would improve energy supply in the study area; as supported by the studies carried out by [15], and [16]. In the dry Sahel, not all households have access to fuelwood or even the local alternatives; in the most extreme circumstances women are unable to cook food properly [17]. This was observed in Tangaza, Sokoto state, where the women at a household visited could not cook due to unavailable energy resources.

V. Conclusion

Energy in the Sudano-Sahelian northwestern Nigeria is poor and declining. Traditionally, biomass sources have always been the main sources of energy for both urban and rural societies, particularly in developing countries. Local alternatives were observed to be more readily available at all the study locations due to intense agricultural activities practiced in the area. These sources are still the current major ingredients of energy needs of rural people in Dryland environment. From the twenty seven different local alternative energy sources identified in the study area which were classified into four groups from crop residues to forest residues, animal wastes and domestic wastes, spatial variation and mode of utilization were observed. Due to the alarming rate of the exploitation and utilization of the agricultural and forest resources, impact on man and the environment are soaring; thus energy crises are therefore observed and witnessed everywhere. In the Dryland areas of West Africa the rate of deforestation is becoming higher; poverty, poor access and insufficient resources are all compounding factors in the increase of such environmental phenomena. The current focus on 'renewable' sources of energy has prompted researchers to study the public attitudes and behaviors toward use of Bioenergy. However, there has been a paucity of survey research in this area, particularly in the Sudano-Sahelian ecological region and Nigeria as a whole. Measures in the form of programs to curb or reduce this energy crisis must be taken.

Acknowledgements

I appreciate the assistance rendered to me by a lot of people most especially my teachers, mentors, family and friends Dr Adnan AbdulHamid, Prof JA Falola, Dr SB Momale, Mrs. Zainab Nuhu, Mr. Ahmad Muhammad and Miss Bilkisu Jibril.

References

- [1] Ogunsanwo, O.Y. and Ajala, O.O., (2002) Firewood crises in Lagos- implication on the suburban and rural ecosystem management In: JE Abu, PO Oni, L Popoola (Eds). *Proceeding of the 28th annual conference of Forestry Association of Nigeria at Akure, Ondo State Nov. 4th – 8th pp. 257- 264*
- [2] Victor, N. M. and Victor, D. G. (2002) Macro Patterns in the Use of Traditional Biomass Fuels Discussion Draft, not for quotation Stanford/TERI workshop on "Rural Energy Transitions," New Delhi, 5-7 November 2002
- [3] Food & Agriculture Organization of the United Nations (FAO), (2003) *Experience of implementing national forestry programmes in Nigeria Sustainable forest management programmes in African ACP countries* <http://www.fao.org/DOCREP/005/AC918E/AC918E04.htm> (October 10, 2012)
- [4] Forestry Management Evaluation and Coordinating Unit (FORMECU), (2011) (n.d) *Nigerian Ecological Zones Federal Department of Forestry, Federal Ministry of Agriculture and Rural Development, Abuja Forest Resources Study, Main Report: Volume II*
- [5] Alabe, M. (2006) Household Energy Consumption Patterns in Nigeria *Energy for Sustainable Development* 2(5) 42-45.
- [6] Edirin, B. Agbro, I. and Nosa A. Ogie (2012) A Comprehensive Review of Biomass Resources and Biofuels Production Potential in Nigeria *Research Journal in Engineering and Applied Sciences* 1(3) 149-155.
- [7] Gumau, A.W (2007) A Perspective on World Renewable and Non Renewable Resources; *an unpublished post graduate PhD Seminar Paper presented at the Environmental Management Technology, Abubakar Tafawa Balewa University, Bauchi Nigeria, February 15th 2007*
- [8] Ajueyitsi, O.N. (2009) *Optimization of Biomass Briquette Utilization of Fuel for Domestic use (Unpublished PhD Thesis), Federal University of Technology Owerri, Imo*
- [9] Sambo, A.S. (2009) The Challenges of Sustainable Energy Development in Nigeria *Paper Presented at the "Nigerian Society of Engineers Forum", 2nd April, 2009 at Shehu Yar 'Adua Centre, Abuja*
- [10] Tayo, A.Y. (2008) *Nigerians in America: Biofuels in Nigeria; Ensuring a Cautionary Approach*
- [11] Ugochukwu, A. (2009) *Biofuels: How Prepared is Nigeria Focus Nigeria.com*
- [12] Yahaya, S.B. (2002) *The Development and adoption of local alternative sources of energy against fuel wood (A paper presented at a two day training workshop on Agro forestry management, for sustainable agricultural production; Manpower development centre Office of the Head of service, Kano State, Nigeria. pp. 129-130*
- [13] Morduch, J. (2006) Chapter 2: *Concepts of Poverty UN Handbook on Poverty Statistics: Concepts, Methods and Policy Use United Nations Statistics* <http://unstats.un.org/unsd/methods/poverty/Chapters.htm> - accessed September 2014
- [14] Day, R. and Walker, G. (2013) Household energy vulnerability as "assemblage" In: Bickerstaff K, Walker G and Bulkeley H (Eds). *2013 Energy Justice in a Changing Climate Social equity and low-carbon energy Zed Books London pp14-29*
- [15] Obioh, I. and Fagbenle, R.O. (2009) *Energy Systems: Vulnerability Adaptation Resilience (VAR) Hello International*
- [16] Agba, A.M., Ushie M.E., Abam F.I., Agba M.S. and Okoro J. (2010) *Developing the Biofuels Industry for Effective Rural Transformation European Journal of Scientific Research, Vol. 40 No 3 pp 441-449*
- [17] Mugo, F and Ong, C. (2006) *Lessons from eastern Africa's unsustainable charcoal trade. ICRAF Working paper no 20 Nairobi, Kenya World Agroforestry Centre*