Gender Analysis of Energy Use for Rice Production in North Central, Nigeria

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Abstract

The study examined gender analysis of energy use for Rice production in north central Nigeria using a sample of 60 Rice farmers. An analysis of gender relations provides the information on the different conditions men and women face, and the different effects that policies and programs may have on them. Simple descriptive statistics were used to analyze the data. Energy efficiency and energy productivity for Rice production were calculated on per hectare basis using equations from literature. The result revealed that male respondents used 1533.21MJ, 41.55MJ, 1695.79MJ, 4569.6MJ, 616.9MJ, 2439.78MJ and 570.57MJ energy equivalents for seed, labour, fertilizer, herbicide, insecticide, diesel and machine inputs respectively and obtained an energy equivalent of 33539.52MJ per ha. Female respondents on the other hand used 1458.24MJ, 74.48MJ, 1244.21MJ, 7854MJ, 338.3MJ, 1556.97MJ and 609.44MJ of energy for the same inputs, in that respect, and obtained an average energy equivalent of 31087.56MJ per ha. Labour and machinery were the most productive energy inputs for the male respondents while labour and insecticide were the most productive inputs for female respondents. Furthermore, men were more efficient in their use of energy (2.9) but the women provided higher per capita specific energy (6.21MJkg^{-1}) for Rice production process in the study area. The study recommended that government should ensure that adequate supplies and distribution of inputs such as fertilizers, insecticides and herbicides should be done with gender considerations.

Key words: Energy, Gender Analysis, Rice Energy Efficiency, Energy Productivity

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1. Introduction

Gender analysis is an essential element of socio-economic analysis. A comprehensive socio-economic analysis would take into account gender relations, as gender is a factor in all social and economic relations. An analysis of gender relations provides the information on the different conditions men and women face, and the different effects that policies and programs may have on them because of their situation (Rahman and Usman, 2004).

Gender-based analyses intend to bring to the fore certain levels of disparity that are latently indoctrinated and perceived as status-quo in our everyday lives. Roles traditionally attributed to men and women from cultural or societal perspectives tend to put women at a disadvantage in their accessing agricultural resources and benefits. Sustainable agricultural development basically entails increasing per capita productivities, in that regard gender equity in development of farmers' productive capacities should be paramount for development agencies and governments. Instead of relegating them to the background, women should actually be given equal opportunities and perceived as subjects of development. Social scientists observed that roles for men and women can be quite different in different societies. For example, In Nigeria, women provide some 60% to 80% of agricultural labour and responsible 80% of food production (Ingawa, 1999; Mgbada, 2000).

In India, women are laborers in the construction industry, and in Ghana, men have traditionally been involved in cloth weaving. It can also be noted that carrying heavy logs of firewood and water, not to mention children, uses women's physical strength, while working on complicated electronic problems can involve much patience and attention to detail on the part of men. Such observations suggest that biological differences do not necessarily determine what men and women can or should do. Rather, these roles are often socially defined, and shaped by the traditions and beliefs of a particular culture. Often, the biological differences between men and women are used to explain these different roles. For example, men's physical strength is seen as making them more suited for doing jobs such as construction work, while women's qualities are supposed to make them more suited for Jobs that involved detail and patience, like sewing. Abubakar and Ahmed (2010) affirmed that developing countries, including Nigeria, do not have enough data on energy expenditure and returns in general. Data determining relative energy inputs disaggregated by gender for crop production are even scarcer. Nevertheless, while gender roles are determined differently across different societies and the kinds of activities required for men and women may vary, the relative values added by men and women can most effectively be determined by the evaluation of their separate energy input relativities to the production process. It is this energy input differentials between men and women Rice farmers in the study area that this study assessed and in effect attempted bridge the dearth of such information.

Rice (*Oryza sativa*) is the second most important cereal in the world after Wheat in terms of production (Jones, 1995). Nigeria ranks the highest as both producers and consumers of Rice in the West Africa sub region (Jones, 1995). However, in terms of area of land under food crop production in the country, Rice ranks sixth (after sorghum, millet, cowpea, cassava and yam) (Imolehin and Wada, 2000). Studies have shown that aggregate Rice production in Nigeria has been growing at about 2.5% per annum in recent years (Olayemi, 1998; Akinbola, 2002; Amaza and Olayemi, 2002). But the annual rate of population growth has been high (about 3%) (Akinbola, 2002). The reality is that Nigeria has not been able to attain self-sufficiency in Rice production despite increasing hectares put into production annularity. The constraints to the rapid growth of food production seem to be mainly that of low crops yield and resource productivity.

2. Materials and methods

Nasarawa State is located in North Central Nigeria. The State covers an area of about 27,117 km^2 with an estimated population of 1,863,275 people (National Population Census, 2006). The State has a mean temperature range of 25^{0}C in October to about 36^{0}C in March while annual rainfall varies from 131.73mm in some places to 145mm in others. Alluvial soils are found are found along the Benue Trough and their flood plain. These are always swampy in nature due to availability of water all year round. A three stage random sampling technique was adopted during the study to determine the sample size. In the first stage, a zone from the three ADP zones of the State (Nasarawa North, Nasarawa West and Nasarawa East) was randomly selected. In the selected zone (Nasarawa East), the list of major Rice producing communities was obtained and three (3) communities (Sabon Gida, Assakio and Awe) were randomly sampled. Finally, 20 Rice farmers of 10 males and females were selected from each community to give a sample size of 60 Rice farmers for the study. Questionnaire administration and interview schedules were used to obtain information on socio-economic characteristics of the Rice farmers as well as their production inputs and outputs. Data were analyzed using simple descriptive statistics, while the amounts of inputs were calculated on per hectare basis and these input data were converted into energy equivalent by multiplying them with the coefficient of energy equivalent. Energy efficiency and energy productivity for Rice crop production were calculated on per hectare basis using equations from literature suggested by Canacki *et al.* (2005); Ozhan *et al*. (2004); Hatirli *et al*. (2005); Singh and Mettal. (1992); Khan *et al*. (2004):

$$\text{Energy Efficiency} = \frac{\text{Total energy output (MJ/ha)}}{\text{Total energy input (MJ/ha)}}$$

$$\text{Energy Productivity} = \frac{\text{Rice yield (Kg)}}{\text{Total energy input (MJ/ha)}}$$

$$\text{Specific energy} = \frac{\text{Energy input (Mj/ha)}}{\text{Rice yield (Kg)}}$$

Each agricultural input and output has its own energy equivalent value. Hence, the inputs and output were converted into their equivalent energy units using the conversion factor in Table 1. The energy equivalences of unit inputs were expressed in Mega Joule (MJ) terms.

Table 1. Energy equivalent for different inputs and output in Rice production

Inputs	Units	Energy equivalent	References
NPK fertilizer	(kg)	11.27	Ibrahim and Ibrahim (2012)
Human labour	(man-hour)	01.96	Singh *et al*. (2003)
Chemical insecticide	(lt)	199.0	Helsel (1992)
Chemical herbicide	(lt)	238.0	Helsel (1992)
Machinery	(h)	62.70	Singh *et al*. (2003)
Diesel-oil	(lt)	56.31	Singh *et al*. (2003)
Rice Seed	(kg)	14.70	Singh *et al*. (2003)
Yield	(kg)	14.70	Canacki *et al*. (2005)

3. Results and discussion

3.1. Socio-economic characteristics of Rice farmers in the study area disaggregated by gender

The socio-economic characteristics of Rice farmers disaggregated by gender are given in Table 2. The result reveals that 53.3% of the male respondents had primary education while only 33.3% of the female respondents possessed primary education. Only 13.3% of the male respondents possessed tertiary education while 3.4% of the female respondents possessed tertiary education. About 46.7% of both the male and female respondents were within the 24–34 years age, but for the 57 years and above bracket the male respondents had a higher (26.7) presence than the female respondents (10%). While the mean age of both categories was 35.3 years, the minimum age of both categories was 24 and the maximum was 61. Majority (70%) of the female respondents were married while 63.3% of the male respondents were married. The male respondents (40%) had longer farming experience than the female respondents (33.3%). Majority of female respondents (86.7%) were observed to have no extension visits at all per annum, for the male respondents 73.3% had no extension visits per year. Male respondents earned higher as 13.3% of the male respondents earned the maximum annual income of ₦250, 000.00 and above, as against 6.7% of the female respondents in that category. Most (43.3%) of both the male and female respondents had a farm size of between 1 – 1.99 ha.

3.2. Inputs and outputs levels in Rice production disaggregated by gender

The quantities of inputs/ha used and outputs/ha (paddy) obtained in Rice production, disaggregated by gender, in the study area are presented in Table 3. To cultivate a hectare of Rice in the study area male respondents required an average of 104.3kg of seed, 21.2 man-hours of labour, 144.2kg of fertilizer, 19.2 liters of herbicide, 3.1 liters of insecticide, 43.15 liters of diesel and 9.1 hours of machine. These values were equivalent to 1533.21MJ, 41.55MJ, 1695.79MJ, 4569.6MJ, 616.9MJ, 2439.78MJ and 570.57MJ of energy. The average yield of 2281.6 kg/ha of paddy, equivalent to 33539.52MJ of energy was obtained (Table 3).

On the other hand, to cultivate one hectare of Rice in the study area female respondents required an average of 99.2 kg of seed, 38 man-hours of labour, 105.8 kg of fertilizer, 33 liters of herbicide, 1.7 liters of insecticide, 27.65 liters of diesel and 9.72 hours of machinery. These values were equivalent to 1458.24MJ, 74.48MJ, 1244.21MJ, 7854MJ, 338.3MJ, 1556.97MJ and 609.44MJ of energy. The average yield of 2114.8 kg/ha of paddy, equivalent to 31087.56MJ of energy was obtained (Table 3).

3.3. Energy use patterns and energy use efficiency in Rice production in the study area disaggregated by gender (ha)

The energy use patterns and energy use efficiency of Rice production in the study area, disaggregated by gender, are presented in Tables 4 and 5 respectively. For the men, human labour and herbicide recorded the minimum and maximum energy use at 41.55MJ/ha and 4569.6MJ/ha respectively. Furthermore, Rice seed, diesel and NPK fertilizer constituted 13.38%, 21.21% and 14.19% respectively of the total energy use per hectare. Energy use efficiency stood at 2.9 while energy productivity was 0.20kgMJ^{-1}.

For the women, the minimum and maximum energy use were human labour and herbicide at 74.48MJ/ha and 7854.0MJ/ha (Table 5). Also, machinery, diesel and Rice seed contributed 4.98%, 21.21% and 13.38% of the total energy used per hectare. Energy use efficiency was 2.4 and energy productivity was 0.16kgMJ^{-1}. The result revealed that the men were more efficient (2.9) in their energy use but the women provided more energy per capita (specific energy 6.21MJkg^{-1}).

Comparatively, women farmers were observed to have utilized a higher labour time (38.0 man-hours) than the men's 21.2 man-hours, women used 9.72 hours of machinery while their male counterparts used 9.1 hours. Herbicide use was 19.2 liters for the male Rice farmers and 38.0 liters for female respondents. Men farmers required an average of 3.1 liters of insecticide which was higher than what the women required (1.7 liters), fertilizer requirement for men stood higher at 144.4 kg against the 105.8 kg required by women. Male farmers used nearly twice (43.15 liters) the quantity of diesel required by female farmers (27.65 liters). Male farmers also utilized higher Rice seeds (104.2 kg) than female Rice farmers (99.2 kg).

3.4. Energy productivity for male and female Rice farmers

The energy productivity differentials between male and female farmers in the study area are presented separately in Tables 6 and 7 respectively. Energy productivity values for male respondents ranged from 0.5 to 54.91 for herbicide and labour respectively. Machinery, insecticide, seed, NPK fertilizer and diesel inputs recorded energy productivity values of 4.0, 3.7, 1.35 and 0.94 respectively. Energy productivity values for female respondents ranged from 0.27 to 28.39 for herbicide and labour respectively. Insecticide, machinery, NPK fertilizer, seed and diesel had energy productivity values of 6.25, 3.47, 1.70, 1.45 and 0.27 respectively.

Table 2. Socio-economic characteristics of Male and Female Rice farmers in the study area

Variables	Male	Percentage	Female	Percentage
Educational status				
Primary	16	53.3	100	33.3
Secondary	5	16.7	4	13.3
Diploma	3	10	5	16.7
Degree/HND	4	13.3	1	3.4
Informal	2	6.7	10	33.3
Total	30	100	30	100
Age				
24-34	14	46.7	14	46.7
35-45	4	13.3	8	26.7
46-56	4	13.3	5	16.6
57- above	8	26.7	3	10
Total	30	100	30	100
Marital status				
Single	9	30	4	13.3
Married	19	63.3	21	70
Divorced	-	-	1	3.4
Widowed	2	6.7	4	13.3
Total	30	100	30	100
Years of farming experience				
3-5	10	33.3	7	23.4
16-28	3	10	10	33.3
29-41	12	40	10	33.3
42 and above	5	16.7	3	10
Total	30	100	30	100
Mode of land acquisition				
Lease	11	36.7	8	26.7
Inherited	17	56.7	8	26.7
Borrowed	1	3.3	9	30
Shared-cropped	1	3.3	5	16.6
Total	30	100	30	100
Annual income ()				
40000-100000	6	20	9	30
110000-170000	12	40	15	50
180000-240000	8	26.7	4	13.3
250000-Above	4	13.3	2	6.7
Total	30	100	30	100
Size of the respondents' farm				
Less than 1ha	3	10	8	26.7
1-2.99ha	13	43.3	13	43.3
3-4.99ha	11	36.7	6	20
5ha and Above	4	13.3	3	10
Total	30	100	30	100
Extension visits				
0	22	73.3	26	86.7
1	4	13.3	2	6.7
2	2	6.7	1	3.3
3	2	6.7	1	3.3
4 and above	0	0	0	0
Total	30	100	30	100

Table 3. Inputs and Output level in Rice production disaggregated by gender

Inputs	Male Mean	Max	Min	Female Mean	Max	Min
Yield (kg)	2281.6 (33539.52)	9800 (144060)	2334.6 (34318.62)	2114.8 (31087.56)	63831 (93831.56)	808.2 (26580.54)
Rice seed (kg)	104.3 (1533.21)	136 (1999.2)	82.4 (1211.28)	99.2 (1458.24)	117.6 (1728.72)	63 9926.1
Human labour (man-hours)	21.2 (41.55)	29 (56.84)	17.7 (34.69)	38 (74.48)	41 (80.36)	37.1 (72.72)
Fertilizer (kg)	144.2 (1695.79)	180 (2116.8)	123.8 (1455.89)	105.8 (1244.21)	142.8 (1679.33)	83.4 (980.78)
Herbicide (Liters)	19.2 (4569.6)	31 (7378)	14.2 (3379.6)	33 (7854)	56.2 (13375.6)	28.5 (980.78)
Insecticide (liters)	3.1 (616.9)	4.2 (835.8)	1.1 (218.9)	1.7 (338.3)	3.0 (597.0)	1.0 (199.0)
Diesel (liters)	43.15 (2439.78)	52.1 (2933.75)	33.1 (1880.75)	27.65 (1556.97)	40 2252.4)	16.7 (1109.31)
Machine	9.1 (570.57)	11 (689.7)	6.5 (407.55)	9.72 (609.44)	13.1 (821.37)	8.3 (520.41)

*Figures in parentheses represent energy equivalents in MJ

Table 4. Energy use pattern and energy use efficiency for Male Rice farmers in the study area

Inputs	Quantity/ha	Total energy equivalent	%
Human labour	21.2	41.55	0.36
Machinery	9.1	570.75	4.98
Herbicide	19.2	4569.6	39.88
Insecticide	3.1	616.9	5.38
NPK fertilizer	144.2	1625.8	14.19
Diesel	43.15	2429.78	21.21
Rice seed	104.2	1533.21	13.38
Total energy input	-	11457.4	100
Yield	2281.6	33539.52	
Energy efficiency	-	2.9	
Energy productivity	-	0.20kgMJ	
Specific energy	-	5.02MJkg	

Table 5. Energy use pattern and energy use efficiency for Female Rice farmers in the study area

Inputs	Quantity/ha	Total energy equivalent	%
Human labour	38.0	74.48	0.56
Machinery	9.72	609.44	4.64
Herbicide	33.0	7854.0	59.80
Insecticide	1.70	338.3	2.58
NPK fertilizer	105.8	1241.9	9.46
Diesel	27.65	1556.97	11.86
Rice seed	99.2	1458.24	11.10
Total energy input	-	13133.33	100
Yield	2114.8	31087.56	
Energy efficiency	-	2.4	
Energy productivity	-	$0.16kgMJ^{-1}$	
Specific energy	-	$6.21MJkg^{-1}$	

Energy productivities were higher for the women for insecticide, NPK fertilizer and diesel at 6.25, 1.70 and 1.36 respectively as against 3.70, 1.35 and 0.94 productivities recorded by men in the same inputs. On the hand, male energy productivities were higher for labour, machinery, herbicides and seeds at 54.91, 4.0, 0.50 and 1.49 respectively against the 28.39, 3.47, 0.27 and 1.45 for the same inputs recorded by the women folks. This implies that while the female farmers used fewer quantities of insecticide, fertilizer and diesel they used it more efficiently than the male folks and while male input quantity usage were lower for labour, machinery, herbicides and diesel the men put them to more efficient usage. The output/kg though was directly proportional to the seed usage as the male farmers produced more output.

Table 6. Energy productivity for male Rice farmers

Inputs	Q/ha	Energy equivalent (MJ)	Energy productivity	Rank
Labour(Man-hours	21.2	41.55	54.91	1st
Machinery (Hrs)	9.1	570.75	4.0	2nd
Herbicides (Liters)	19.2	4569.6	0.50	7th
Insecticide (Liters)	3.1	616.9	3.70	3rd
NPK (15:15:15) (kg)	144.2	1695.8	1.35	5th
Diesel (Liters)	43.15	2429.78	0.94	6th
Seed (kg)	104.3	1533.21	1.49	4th
Yield (kg)	2281	33539.52		

Table 7. Energy productivity for Female Rice farmers

Inputs	Q/ha	Energy equivalent (MJ)	Energy productivity	Rank
Labour(Man-hours	38.0	74.48	28.39	1st
Machinery (Hrs)	9.72	609.44	3.47	3rd
Herbicides (Liters)	33.0	7854.0	0.27	7th
Insecticide (Liters)	1.7	338.3	6.25	2nd
NPK(15:15:15) (kg)	105.8	1241.9	1.70	4th
Diesel (Liters)	27.65	1556.97	1.36	6th
Seed (kg)	99.0	1458.24	1.45	5th
Yield (kg)	2114.8	31087.56		

4. Conclusion and Recommendations

The gender analysis of energy use for Rice production in the area revealed that while men were more efficient in their use of energy (2.9), but the women provided higher per capita specific energy (6.21MJkg^{-1}) for Rice production process in the study area. Further studies such as this, that reveal energy data contributions bringing to the fore who is contributing what and where further interventions can be made, should be conducted for other agricultural crops. Government should ensure that adequate supplies and distribution of inputs for Rice production such as fertilizers, insecticides and herbicides should be done with gender considerations.

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