Sustainable Land Management Practices for Climate Change Adaptation in Imo State, Nigeria

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Abstract
The study analyzes the benefits of sustainable land management practices as a climate change adaptation mechanism in Ohaji Area of Imo State. The objectives were to describe the socio-economic characteristics of respondents; identify sustainable land management practices of respondents; and ascertain the benefits of land management practices as a climate change measure. The purpose was to show that farmers management of land in the right way could help adapt to the challenges posed by climate change. A study of this nature will benefit both farmers and scholars as it outlines various practices that could help farmers adapt. Researchers, students and other stakeholders will use the result of this work as a reference point. Data were collected using structured questionnaire and oral interviews to capture stakeholder opinions, although we faced problem of money, reluctance by farmers to respond and time. Descriptive tools of analysis such as frequency counts and mean presented in tabular forms were used to analyze data collected. The survey found that respondents practice mulching, crop rotation, intercropping, mixed cropping, agro forestry and conservation/minimum tillage in their farming practices with direct benefits in yield increase, pest control and crop failure reduction. This implies that sustainable land management practices can contribute to making farming systems of the rural poor farmers more resilient to the adverse effects of climate change. Therefore, there is need to increase farmers environmental literacy and encourage them to embrace new land management technologies especially where present practices cannot encompass the required changes. To accomplish this, extension visits, education and training must be extended regularly to all farmers.

Keywords: climate change, adaptation, agriculture, land management.

INTRODUCTION
Agriculture is a fundamental human activity at risk from climate change in the coming decades (Tubiello, et al., 2008). At the same time it will continue to be, a major driver of environmental and climate change at local, regional and planetary scales. First, it is a major user of land resources. About 14 billion hectares (10 percent of total ice-free land) contribute to crop cultivation and an additional 2.5 billion hectares are used for pasture. Roughly 4 billion hectares is forested land, 5 percent of which is used for plantation and forestry. On this land, 2 billion metric tons of grains are produced yearly for food and feed, providing two-thirds of the total protein intake by humans. Significant quantities of chemical inputs are applied to achieve such high levels of production; about 100 million metric tons of nitrogen are used annually, with large quantities leaching through the soil and leading to significant regional land, water and atmospheric pollution (Tubiello et al., 2008).

Second, agriculture is a major user of water. Over 200 billion hectares of arable land is under irrigation, using 2,500 billion cubic meters of water annually, representing 75 percent of fresh water resources withdrawn from aquifers, lakes, and rivers by human activity. Irrigation sustains a large portion of the total food supply-about 40 percent in the case of cereals. In addition, 150 million metric tons of fish (roughly 55 percent capture fisheries and 45 percent aquaculture) are consumed annually-with 75 percent of global stocks being fully or overexploited, and estimates that an additional 40 million metric tons will be needed by 2020 to maintain current per capita consumption trends-contributing 50 percent or more of total animal protein intake in some Small island
States (SIDS) and other developing countries (mainly in Sub-Saharan Africa (Tubiello et al., 2008).

If emissions of greenhouse gases are not controlled in the coming decades, including those from agriculture, continued growth of their atmosphere concentrations is projected to result in severe climate change throughout the 21st century. Stabilization of atmospheric concentrations of greenhouse gases must be achieved by implementing significant emission reductions in the coming decades, certainly no later than 2020-30, in order to avoid serious damage to natural and managed ecosystems upon which many critical human activities depend (IPCC, 2007).

Agriculture in the 21st century will therefore be undergoing significant challenges, arising largely from the need to increase the global food and timber supply for a world nearing a population of 10 billion, while adjusting and contributing to respond to climate change. Success in meeting these challenges will require a steady stream of technical and institutional innovations, particularly so that adaptation strategies to climate change are consistent with efforts to safeguard food security and maintain ecosystem services, including mitigation strategies that provide carbon sequestration, and offsets under sustainable land management (Easterling, 2007a; Easterling, 2007b).

Climate change is already affecting the natural and managed systems-forests, wetlands, coral reefs, agriculture, fisheries-that societies depend on to provide food, fuel, and fiber, and for many other services. It will depress agricultural yields in many regions, making it harder to meet the world’s growing food needs. It comes as the world faces intensified competition for land, water, biodiversity, fish, and other natural resources. At the same time, societies will be under pressure to reduce the 30 percent of greenhouse gas emissions that come from agriculture, deforestation, land-use change, and forest degradation (WDR, 2010).

To meet the competing demands and reduce vulnerability to climate change, societies will need to balance producing more from their natural resources with protecting these resources. This means managing water, land, forests, fisheries, and biodiversity more efficiently to obtain the services and products societies need without further damaging these resources through overuse, pollution, or encroachment.

Water will have to be used more efficiently. To do that, managers need to think on basin-wide scales and to devise efficient and flexible ways to allocate water among competing quantity and quality demands for human use (such as energy, agriculture, fisheries, and urban consumption) and for healthy ecosystems (such as forests, wetlands, and oceans (WDR, 2010).

Countries also need to get more from their agriculture. The rate of increase in yields for key agricultural commodities has been declining since the 1960s. Countries will have to reverse that trend if the world is to meet its food needs in the face of climate change. Models vary but all show the need for a marked increase in productivity.’ That increase in productivity cannot come at the expense of soil, water, or biodiversity as it has so often in the past. So countries will need to accelerate research, enhance extension services, and improve market infrastructure to get crops to market. But they also need to give farmers incentives to reduce carbon emissions from soil and deforestation. And they need to help farmers hedge against an uncertain climate by diversifying income sources and genetic traits of crops, and better integrate biodiversity into the agricultural landscape (IPCC, 2007).

Applying climate-smart practices will hinge on managing biodiversity better-integrating natural habitats into rural landscapes, protecting wetlands, and maintaining the water storage provided by aquifers. Increasingly, countries are making use of techniques that improve soil and water productivity. But these innovations will bear fruit only if decisions are based on solid inter-sectoral analysis and only if users have the right incentives stemming from policies, institutions, and market conditions (OECD, 2008).

Many natural resources cross borders. As climate change makes resources harder to manage, and growing populations increase demand, countries will need to cooperate more intensively to manage international waters, forests, and fisheries. All countries will turn more frequently to the international agricultural market and so will benefit from a number of measures-from stock management to more competitive procurement techniques to customs and port logistics-that make food trade more reliable and efficient.

Many of these solutions, long advocated in the natural resource literature, have been frustratingly slow in coming to fruition. But three new factors, all related to climate change, could provide new incentives. First, food prices are expected to increase as a result of more climate shocks as well as from growing demand. Increasing food prices should spur innovation to increase productivity. Second, it may be possible to extend carbon markets to pay farmers to store carbon in soil. This step would create incentives to conserve forests and adopt more sustainable farming techniques. The techniques are not yet proven at the needed scale, but the potential is great, and the additional benefits for agricultural
productivity and poverty reduction are substantial. At a high enough carbon price, global emission reductions from agriculture could equal reductions from the energy sector. Third, countries could change the way they support agriculture. Rich countries provide $258 billion annually in agriculture support, more than half of which depends only on the amount of crop produced or input used. Though politically difficult, countries are beginning to change the terms of these subsidies to encourage implementation of climate-smart practices on a large scale (Burke et al., 2006; Burke and Brown, 2008). The above situation raises the following questions:

a) What are the socio-economic characteristics of the respondents?
b) What are the sustainable land management practices of the respondents for climate change adaptation?
c) What are the benefits of sustainable land management practices for climate change adaptation?

The specific objectives are to describe the socio-economic characteristics of respondents; to identify sustainable land management practices of respondents; and to ascertain the benefits of sustainable land management practices.

METHODOLOGY
The study was conducted in six villages in Imo State. Imo State is in South east zone of Nigeria. The state is made up of twenty – seven local government areas out of which the Ohaji/Egbema was chosen for the study. Ohaji was purposively chosen because it is an agricultural area in the state with frequency of occurrence of land conflicts among villages. Ohaji/Egbema has a total population of about 209,593 people in 2012 projected from 2006 census figure (NPC, 2006; FGN 2009). Imo State lies between latitudes 5° 12', and 5° 56'. North of the equator and between longitudes 6° 38' and 7° 25' east of the Greenwich meridian. The location of Imo State in the south east zone makes it a strategic commercial centre. The people are known for their traditional hospitality, revered as the cradle of peaceful coexistence and famed for their cultural affinity. Imo state is endowed with abundant natural resources, and the state is an attractive investment centre for various types of industries including agro-allied and petrochemical industries.

Education is the biggest industry in the state (IMSG, 2001). Imo State occupies a landmass of about 5,530 square kilometers with a total population of about 4,500,987 million persons in 2011 projected from the 2006 census figure. The state has two dominant seasons – rainy and dry seasons. Rainfall starts between April and October while the dry season starts from November to early March. The

Igbo is an ethnic group in the state; Christianity and traditional African religions are beliefs professed by people in the state. The state falls within the tropical rain forests zone with dense forest in the south and rich savannah in the north. Agriculture is the mainstay of the economy of the state this is basically due to the rich arable land suitable for the growth of a wide range of tropical crops. Food crops grown in the state include: cassava, maize, oil palm and cocoa fall under the category of cash crops. The people also keep animals like goats, pigs, and poultry (NARP, 1998).

Six villages were purposively selected from the study area. The selected villages include Umuonei, Umuhaja, Umuelm, Obegwe, Umugama and Umuikea. The estimated number of households from the village was 1,200 which was obtained from the village heads in the area. A total of one hundred and twenty (120) households from six villages was sample frame of households. This represented ten percent of the total households. The household head was used as the sampling unit. The household heads include widows who feed for themselves and family. The study made use of both primary and secondary data. The primary data was collected by administering questionnaire to households. Secondary data sources were utilized to provide background information and other necessary information to achieve some of the objectives of the study. Such secondary data includes: journals, proceedings, textbooks. Percentages, frequency distribution table, mean scores were used to analyze data collected.

RESULTS AND DISCUSSIONS
Socio-Economic Characteristics Of Respondents
The findings revealed that 54.5% of the respondents are within the healthy age of 51-60 years fit for farming activities. They are followed by younger respondents of between 41-50 years which represent about 22.7%. Only 18.2% and 4.3% are 61 years and above and 31-40 years. The implication of this to the study is that these individuals have put it an average of age of 27 in farming activities and practice land management for climate change adaptation. The result shows that 54.5% of the respondents are married. They are followed by 24.5% who are widower and 20.9% that are widows. Greater number cultivate between 1.5-2 hectares of land annually as indicated by 54.5%. They are followed by 27.3% who cultivate 0.25 – 1 hectares of land. Only about 13.6% and 4.5% cultivate 2.5-3 hectares and above 3.5 hectares above respectively. Majority of the respondents received education as indicated by 48.7% who attended secondary school. Then, 32.7% have received primary education with only 19.1% receiving no formal education. The level of education helps in adoption of recommended agricultural practices. The farmers due to their level of education practice sustainable land management.
respondents have large families of 7-9 members (40.9%), 4-6 members (20%), 10 members and above 30% and 1-3 members for 9.1%, they also receive the visit of an extension agent at least once month according to 59.1%, twice 27.3% and three times 13.6% farming is the major occupation of majority (69.1%), and 75.5% are males, while 24.5% are females.

Table 1: Socioeconomic characteristics of respondents

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31 – 40</td>
<td>5</td>
<td>45</td>
</tr>
<tr>
<td>41 – 50</td>
<td>25</td>
<td>22.7</td>
</tr>
<tr>
<td>51 – 60</td>
<td>60</td>
<td>54.5</td>
</tr>
<tr>
<td>61 and above</td>
<td>20</td>
<td>18.2</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>60</td>
<td>54.5</td>
</tr>
<tr>
<td>Widow</td>
<td>23</td>
<td>20.9</td>
</tr>
<tr>
<td>Widower</td>
<td>27</td>
<td>24.5</td>
</tr>
<tr>
<td>Farm size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.25 – 1</td>
<td>30</td>
<td>27.3</td>
</tr>
<tr>
<td>1.5 - 2</td>
<td>60</td>
<td>54.5</td>
</tr>
<tr>
<td>2.5 – 3</td>
<td>15</td>
<td>13.6</td>
</tr>
<tr>
<td>3.5 and above</td>
<td>5</td>
<td>4.5</td>
</tr>
<tr>
<td>Education level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No formal education</td>
<td>21</td>
<td>19.1</td>
</tr>
<tr>
<td>Primary</td>
<td>36</td>
<td>32.7</td>
</tr>
<tr>
<td>Secondary</td>
<td>53</td>
<td>48.2</td>
</tr>
<tr>
<td>Household size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 – 3</td>
<td>10</td>
<td>9.1</td>
</tr>
<tr>
<td>4 – 6</td>
<td>22</td>
<td>20.0</td>
</tr>
<tr>
<td>7 – 9</td>
<td>45</td>
<td>40.9</td>
</tr>
<tr>
<td>10 and above</td>
<td>33</td>
<td>30</td>
</tr>
<tr>
<td>Extension visit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once monthly</td>
<td>65</td>
<td>59.1</td>
</tr>
<tr>
<td>Twice</td>
<td>30</td>
<td>27.3</td>
</tr>
<tr>
<td>Thrice</td>
<td>15</td>
<td>13.6</td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farming</td>
<td>76</td>
<td>69.1</td>
</tr>
<tr>
<td>Civil servant</td>
<td>24</td>
<td>21.8</td>
</tr>
<tr>
<td>Trading</td>
<td>10</td>
<td>9.1</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>83</td>
<td>75.5</td>
</tr>
<tr>
<td>Female</td>
<td>27</td>
<td>24.5</td>
</tr>
</tbody>
</table>

Table 2: Land management practices (N = 110)

<table>
<thead>
<tr>
<th>Land management</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mulching/Cover crop</td>
<td>90</td>
<td>81.8</td>
</tr>
<tr>
<td>Crop rotation</td>
<td>104</td>
<td>94.5</td>
</tr>
<tr>
<td>Intercropping</td>
<td>102</td>
<td>92.7</td>
</tr>
<tr>
<td>Mixed cropping</td>
<td>110</td>
<td>100</td>
</tr>
<tr>
<td>Minimum tillage</td>
<td>108</td>
<td>98.2</td>
</tr>
<tr>
<td>Agro forestry</td>
<td>84</td>
<td>76.4</td>
</tr>
<tr>
<td>Terracing</td>
<td>70</td>
<td>63.6</td>
</tr>
<tr>
<td>Contour</td>
<td>86</td>
<td>78.2</td>
</tr>
<tr>
<td>Ridging</td>
<td>60</td>
<td>54.5</td>
</tr>
</tbody>
</table>

Table 2 shows a wide range of land management practices by the respondents in the study area. The table reveals that all the responding farmers (100%) practice mixed cropping and 98.2% practice conservation or minimum tillage.

Crop rotation with 94.5% is a common practice as crops follow the other depending on whether they are deep feeders or shallow rooted crops. Another land management practice on the study is mulching which has 81.8% response. The respondents said due to the scavenging heat of the sun, the practice of mulching and planting of cover crops become very important. The planting of leguminous crops is a common practice among farmers in the study area. Other practices are intercropping (92.7%), contour making (78.29%), and ridging (54.5%).

The above finding is in line with Yan et al., (2009) who posited that climate-smart farming practices improve rural livelihoods while mitigating and adapting to climate change. New crop varieties, extended crop rotations, reduced use of fallow land, conversation tillage, cover cropping all increase carbon storage (Smith et al., 2009; Thornton, 2009). Crop rotation, intercropping and agroforestry are promising practices. Thanks to agroforestry and the combination of annual crops, trees and shrubs associated with it, a significant portion of on-farm energy needs can be covered (UNCCD, 2009).

Table 3: Benefits of Sustainable Land Management

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Mean responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop residue protects soil</td>
<td>4.54</td>
</tr>
<tr>
<td>Increases crop yields/food product</td>
<td>4.52</td>
</tr>
<tr>
<td>Enhance nutrient recycling</td>
<td>4.50</td>
</tr>
<tr>
<td>Assurance of food security</td>
<td>4.50</td>
</tr>
<tr>
<td>Preserves soil moisture</td>
<td>4.20</td>
</tr>
<tr>
<td>Speeds soil microbial activity</td>
<td>4.15</td>
</tr>
<tr>
<td>Aids soil aeration</td>
<td>4.10</td>
</tr>
<tr>
<td>Improve gentle flow of water in soil</td>
<td>3.70</td>
</tr>
<tr>
<td>Reduce flooding /water runoff</td>
<td>3.60</td>
</tr>
<tr>
<td>Production of diseases/pests resistant seeds</td>
<td>3.50</td>
</tr>
<tr>
<td>Valorization of indigenous knowledge</td>
<td>3.45</td>
</tr>
<tr>
<td>Producer crops that adaptation to harsh weather</td>
<td>3.60</td>
</tr>
<tr>
<td>Improves soil property/structure</td>
<td>3.40</td>
</tr>
<tr>
<td>Maintains healthy ecosystem</td>
<td>3.12</td>
</tr>
<tr>
<td>Reduce risk of crop failure</td>
<td>3.10</td>
</tr>
<tr>
<td>Reduces atmospheric carbon dioxide</td>
<td>3.10</td>
</tr>
<tr>
<td>Mitigate soil degradation</td>
<td>2.45</td>
</tr>
<tr>
<td>Enhance ecotourism</td>
<td>2.35</td>
</tr>
<tr>
<td>Improve the provision of local energy</td>
<td>2.50</td>
</tr>
<tr>
<td>Reconstitute carbon pool in soil</td>
<td>2.47</td>
</tr>
<tr>
<td>Keeps alive cultural/natural landscape</td>
<td>2.30</td>
</tr>
</tbody>
</table>

From table 3, one sees the many benefits of sustainable land management as indicated by high mean responses. The foremost benefit of land management is the protection of soil by crop residue use with a mean of 4.54. Other benefits with high mean responses are increase crop yield/food production (mean = 4.54), enhance nutrient recycling.
(mean=4.50), assurance of food scarcity (mean=4.50), preservation of soil moisture (mean=4.20) speeds soil microbial activity (mean=4.15), aids soil aeration improves gentle flow of water with (mean=3.70), reduce flooding (mean=3.60), production of diseases/pests resistant seeds with (mean=3.50), valorisation of indigenous knowledge (mean= 3.45), production of crops that adapt to harsh weather condition with (mean=3.60), and improvement of soil property/structure with (mean=3.40), Maintenance of healthy ecosystem (mean= 3.12), reduce risk of crop failure (mean=3.10), and reduction of atmosphere carbon ox ide with (mean=3.10). Other benefits includes the mitigation of soil degradation (mean=2.45), ecotourism enhancement (mean=2.35), provision of local energy with (mean=2.50), reconstitution of carbon pool in soil (mean=2.87) and keeping alive of cultural and natural landscapes with mean score of 2.30.

The above finding is in line with UNCCD (2009) that maintaining ecosystem functioning is a prerequisites for sustainable land management. Sustainable land management has great potential for preservation and enhancement of ecosystem services in all land use systems. Sustainable land management limits soil degradation, water and vegetation depletion.

CONCLUSION
Climate change is real and affects all aspects of rural and urban livelihood, food security and general welfare of human world over. To adapt to climate change especially in the field of agriculture, practices like mulching/cover cropping, mixed cropping be adopted by farmers. Adoption of and practice of land management have numerous benefits such as increase yield, soil protection, aeration and gentle flow of underground water, production of diseases/pests resistant crops and others. This shows that sustainable land management practices can make our farming system more resilient to the adverse impacts of climate change. Education of farmers be given top priority through extension visits.

REFERENCES


