Organic Agriculture Practices for Climate Change Adaptation and Mitigation in Ohaji Area of Imo State, Nigeria.

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Abstract: Organic agriculture, as an adaptation strategy to climate change and variability, is a concrete and promising option for rural communities and has additional potential as a mitigation strategy. Adaptation and mitigation based on organic agriculture can build on well-established practice because organic agriculture is a sustainable livelihood strategy with decades of use in several climate zones under a wide range of specific local conditions. This research work entitled organic agriculture practices for climate change adaptation and mitigation investigates the importance of organic agriculture as strategy for climate change adaptation and mitigation. The study reveals the organic farming practices of the respondents as opposed to the conventional agriculture. The financial requirements of organic agriculture on adaptation or mitigation strategy are low. Because of use of traditional or indigenous knowledge, farmers spend less and practice crop rotation, use organic and compost manures and others. The study made use of structured questionnaire and oral interview. A total of 140 respondents were used for the study and data analyzed using descriptive statistics. The study reveals the plenty benefits of organic agriculture as a climate change adaptation and mitigation strategy such as avoidance of nutrient loss, lower N_2O emissions, lower CO_2 and lesser CO_2 emissions respectively. It was recommended that agricultural policy at all levels incorporate organic farming as a strategy for climate change adaptation and mitigation.
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Introduction

Climate change holds the potential to radically alter agro-ecosystems in the coming decades, and devastating crop failures arc already evident in several countries of the world. Global warming will not only increase global mean temperatures, but will also increase the frequency of extreme weather events and the variability of weather in general (Tompkins and Adger, 2004). We may expect changes in land vegetation, ocean circulation, sea surface temperature and global atmosphere composition, which will in turn impact rainfall patterns (Salinger, et al., 2005).

These changes will bring new challenges to farmers. The Intergovernmental Panel on Climate change (IPCC) expects that world production of food should remain steady through the next century with less certainty beyond that point (Burton and Lim, 2005). Other sources are more cautious, warning that climate change may depress yields in already food-insecure areas or that previous changes in global climate have had negative impacts on production as a whole (Fuhrer, 2003; Tompkins and Adger, 2004). Even if overall production remains high, certain regions will experience devastating declines. Temperature increases in the tropics, for instance, may render many current crops unfit for the area (Burton and Lim, 2005).

Farmers in LDCs face stark challenges. Nearly 60% of the population of LDCs are farmers, who contribute over 30% of the Gross Domestic Product of these nations (Kandlikar and Risbey, 2000). Individual farmers in developing countries often rely on their production not only for income but as a main source of food. In a world in which millions of people already go hungry, such losses are a matter of grave concern. Every effort must be made to prevent these losses, rather than focus on ways to cope after disaster has occurred. Many agricultural systems provide necessary environmental services that are also vulnerable to the effects of global climate change.

Climate change is likely to disproportionately affect farmers in LDCs. Much research has indicated that marginalized communities suffer the most from altered environmental conditions (Tompkins and Adger, 2004). Poverty already exists in fragile arid and mountainous regions that may respond more quickly to climate change (Altieri and Nicholls, 2006). The IPCC names rainfall variability and related disasters as "the single most determining factor endangering agricultural production in developing countries" (Stigter, et al., 2005). Perhaps the most certain feature of global climate change is its unpredictability, as it is unknown which regions will lace longer dry spells and which will face heavier monsoons, which regions will face longer dry spells and which will face heavier monsoons, which regions will face stronger cyclones and which regions may be spared.

In the light of the above, the committee on World Food Security assessed the food situation in September 2006, during their 32nd session and acknowledged that the World Food summit target of halving the number of hungry people by 2015 will not be met; the number of undernourished has remained virtually unchanged since 1990-92, although there has been a reduction in the percentage of under-nourished (FAO, 2006). Indeed, today's total global agricultural production is sufficient to feed the current world population and both necessary technologies and multilateral environment and conservation need (Scialabba, 2007). However, hunger, poverty and environmental degradation persist even as concerns about global human security issues continue to increase. Moreover, the last decades provide uncompromising evidence of diminishing returns on grains despite the rapid increase of chemical pesticide and fertilizer applications resulting in lower confidence that these high input technologies will provide for equitable household and national food security in the next decades (Sanders, 2006). Over all, global cereal output is declining, mainly among the major producing and exporting countries (FAO, 2007: Sanders 2007).

Farmers in developing countries need tools to help them adapt to these new conditions. Adaptation in agriculture is certainly not new. Changing weather has always concerned farmers, and they have developed ways to respond. The phenomenon of global climate change makes the ability to adapt even more important, as adaptation will need to occur at a much faster pace. IPCC (2001) defines adaptation to climate change specifically as "adjustment in natural or human systems in response to actual or expected climatic *stimuli* or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation."

As so many of the changes cannot be foretold specifically, farmers must be able to increase their farms' resilience to change. Resilience has been described as a system's ability to maintain normal functions in the lace of unexpected conditions. Applied to agriculture, the concept also includes the farm's dependence on its own resources instead of external inputs and the farmer's ability to experiment with different practices and learn what works best (Mileslead and Darnhofet, 2003; Wall and Smith, 2005). As farmers observe conditions and develop responses to current challenges, they hone skills necessary to adapt to climate change as well (Tompkins and Adger, 2004). Communities as a whole increase their resilience when they develop information and support networks to handle new challenges (Tompkins and Adger, 2004).

Farmers in developed countries may include in their response to climate change increased inputs such as synthetic fertilizers and pesticides and capital investments in irrigation and to help then crops survive. Farmers in developing countries - and small holders in general - have a much smaller set of options and must rely to the greatest extent possible on resources available on their farms and within their communities. OA, with the due knowledge of ecological processes, offers farmers in LDCs many affordable, accessible opportunities to strengthen their farms' resilience. Agriculture is not only affected by climate change but also contributes to it. Ten to twelve percent of global greenhouse gas emissions are due to human food production. In addition intensive agricultural has led to deforestation, overgrazing and widespread use of practices that result in soil degradation. These changes in land use contribute considerably to global CO_2 emissions. Sustainable agriculture and food supply systems are thus more urgently needed than ever before. They must boost the capacity of agricultural production of adapt to more unpredictable and extreme weather conditions such as droughts and floods, reduce greenhouse gas emissions in primary food production and halt or reverse carbon losses in soils.(ITC/FiBL, 2007).

Organic agriculture is the most sustainable approach in food production. It emphasizes recycling techniques and low external input and high output strategies. It is based on enhancing soil fertility and diversity at all levels and make soils less susceptible to erosion. Organic farming links productivity with ecology and creates livelihoods in rural areas: it is a surprisingly multifaceted option.

World wide under-nourishment is not explained only by a lack of food availability as several causes of hardship lie outside the agricultural sector. However, there is need to seek new solutions to address the problems posed by growing populations (and disparities) and environmental degradation through new paradigms for agriculture and food supply chains- the organic agriculture paradigm. The study aims to outline the benefits of organic agriculture as a climate change adaptation strategy. The specific objectives of the study were (i) to describe the socio-economic characteristics of the respondents, (ii) to identify organic farming practices of the respondents and (iii) to identify the benefits of organic agriculture as a climate change adaptation and mitigation strategy.

Methodology

This study was conducted in six villages in Ohaji Area of Imo State, Nigeria because the six villages practice organic agriculture. Imo State is in the South East Zone of Nigeria. The state has a total of twenty -seven Local Government Area out of which Ohaji was selected for the study being an agricultural area. Ohaji/Egbema has a total population of about 209, 593 persons in 2011 projected from 2006 official gazette. Imo State occupies a land mass of about 5.530 square kilometers with a total population of about 4,500,987 million persons in 2011 (NARP, 1992: FGN, 2009). The six villages has an estimated number of 1400 households obtained from the village heads. A total of 140 households were randomly selected from the list. Data collection was by use of structured questionnaire and interview schedule for key informants. Descriptive statistics were used to analyze the data collected.

Results and Discussion

Socio-economic Characteristics of Respondents.

The result in table 1 shows that 39.3% of the respondents are within the age brackets of 51-60 years. They are followed by 26.4% within 41-50 years. About 26% are above 60 years while 8.6% are young people who seek greener pastures outside the agricultural sector. Again, 45.7% of the respondents have a family size of 7-12 members, while 32.9% have a family size of about 1-6 members and 21.4% have more than 13 members. The table also shows that 78.5% have adult education, while 14.3% and 5% attended primary and secondary schools respectively, only 2.1% attended tertiary institution. The table also reveals that 70.7% of the sampled farmers are married, while 7.1% of them are widowers, with 22.1% being widows. Again, 25.7% have 2-3 leadership titles, while 14.3% have 1 title while 1.4% have 4 titles. About 98.8% have been visited by extension agent, while 7.3% did not receive by extension agent. It can be seen that because majority did not receive formal education they prefer nature faming. While the visit of extension agent helped majority as well to embrace organic farming.

Organic Agriculture Practices

The result in table 2 shows 96.4% of the farmers use organic manure as a major organic farming practice. Crop rotation followed as the second major organic farming practice with 92.8%. The use of green manure had 88.6% and intercropping recorded 85.7% respectively. Instead of using machines and equipment for drying of farm produce, the farmers sun dry their produce as shown by 78.6%, followed by hand picking of insects with 71.4%, and mixed cropping with 64.3%. Others are tilling with stick (60.0%), use of compost (59.3%), use of leaves as mulching materials (56.4%). Hoeing and hand weeding (52.8%), use of air-tight container for storage (42.8%), and slash and burn with (35.7%), and planting of cover crop and legumes with 75%. Cover crops help hold the soil in place during fallow periods. Permanent vegetation, such as trees and hedgerows, on the borders of fields protects fields from strong winds and storms. Such vegetation also provides benefits for biodiversity. Interview with key informants revealed that the farmers do not burn for fear of killing the soil microbes, while the ones who burn said they add ash to the soil by burning. The understanding here comes from the regular extension contacts with farmers and the fact that culturally they are used to the practices

Benefits of Organic Agriculture

Table 3 reveals the various benefits of organic agriculture as a climate change adaptation strategy. Organic agriculture lower risks of crop failure with 100%, followed by avoidance of nutrient exploitation and lower N_20 emissions due to lower nitrogen input with 92.8% each. Another benefit is the less $C0_2$ emissions through erosion due to better soil structure and more plant cover with 91.4%. Increased soil organic matter content with 89.3% is another benefit. Protection of soil from erosion, soil moisture retention and restoration of productivity of degraded soil with 85.7%, 69.3%, 60.7% respectively are also benefits of organic agriculture for climate change adaptation and mitigation.

Organic agriculture lowers $C0_2$ emissions from farming systems inputs (pesticides, fertilizers produced using fossil fuel) with 53.5%. Reduction in the cost of inputs is another benefit with 78.%, followed by reduction in the indebtedness of the farmers with 71.4%. Others are increase in diversity of income sources, use of adaptable local crop variety, and soil carbon sequestration through management practices such as organic manure application, use of intercrops etc with 57.8%, 57.1% and 50.% respectively.

Table 1 - Socioeconomic Characteristics of Respondents

Characteristics	Frequency*	Percentage
Age		
31-40	12	8.6
41-50	37	26.4
51-60	55	39.3
61 and above	36	25.7
Family size		
1-6	46	32.9
7-12	64	45.7
13 and above	30	21.4
Educational level		
Adult education	110	78.5
Primary	20	14.3
Secondary	7	5.0
Tertiary	3	2.1
Marital status	-	-
Married	99	70.7
Widower	10	7.3
Widow	31	22.1
Leadership status		
None	82	51.6
One	20	14.3
2-3	36	25.7
4 and above	2	1.4
Extension contact		
Yes	130	92.8
No	10	7.3

*Multiple response

Table 2: Organic Farming Practices of Respondents

Organic farming practices	Frequency*	Percentage
Crop rotation	130	92.8
Mixed cropping	90	64.3
Mixed farming	75	53.6
Use of green manure	124	88.6
Use of compost	83	59.3
Hand picking of insects	79	56.4
Use of leaves as mulcting materials	100	71.4
Hoeing/weed removal by hand	74	52.8
Slash and burn	50	35.7
Tillage with sticks	84	60.0
Use of air-light containers for storage	60	42.8
Sun drying of farm produce	110	78.4
Use of organic manures	135	96.4
Intercropping	120	85.7
Tree/hedges planting	78	55.7
Legume/Cover crop planting	105	75.0

*Multiple response

Tables 3: Benefits of Organic Agriculture for Adaptation and Mitigation

Benefits	Frequency*	Percentage
Avoidance of nutrient exploitation	130	92.8
Increase soil organic matter content	125	89.3
Reduce input costs of farming	110	78.5
Lower risks of crop failure	140	100
Increase diversity of income sources	81	57.8
Reduce farmers indebtedness	100	71.4
Use of adaptable local crop varieties	80	57.1
Lower N_2O emissions	130	92.8
Less CO_2 emissions through erosion	128	91.4
Lower CO_2 emissions (during fossil fuel use)	117	83.5
Soil carbon sequestration (organic manure use)	70	50.0
Protect soil for erosion	120	85.7
Soil moisture Retention	97	69.3
Restores productivity of degraded soil	85	60.7

*Multiple response

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Conclusion

Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, and soil biological activity. It relies on crop rotation, green manure, compost, biological pest control without the use of synthetic pesticide and fertilizers. Production in organic agriculture system is thus less prone to extreme weather conditions, such as drought, flooding, and water- logging. Higher farm incomes are thus possible due to lower input costs and higher sale prices. The coping capacity of the farms is increased and the risk of indebtedness is lowered. Risk management, risk-reduction strategies, and economic diversification to build residence are also prominent aspects of adaptation. To be successful, wider recognition of the potentials of organic agriculture is essential. Agricultural policies at both national and local levels should prominently support organic agriculture as an adaptation and mitigating strategy.

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