Mayfair Journal of Agribusiness Management. ISSN 2205-6246
http://mayfairjournals.com.au/

Agro-forestry Practices for Climate Change Adaptation among Rural Farmers in Owerri Agricultural Zone of Imo State, Nigeria.

To cite this article: Chikaire, J.U., Anyoha, N.O., Godson-Ibeji, C.C. & Oguegbuchulam, M. (2016). Agro-forestry Practices for Climate Change Adaptation among Rural Farmers in Owerri Agricultural Zone of Imo State, Nigeria. *Mayfair Journal of Agribusiness Management* Volume 1, Issue No 2, Pp 39-49

Agro-forestry Practices for Climate Change Adaptation among Rural Farmers in Owerri Agricultural Zone of Imo State, Nigeria.

Chikaire, J.U. Anyoha, N.O. and Godson-Ibeji, C.C.
Dept. of Agricultural Extension,
Federal University of Technology, Owerri, Imo State, Nigeria.

Oguegbuchulam, M.
Dept. of Agricultural Management and Extension Technology,
Imo state Polytechnic, Owerri, Imo State, Nigeria.

Mayfair Journal of Agribusiness Management. ISSN 2205-6246
For publication details, including instructions for authors and submission:
http://mayfairjournals.com.au/

Agro-forestry Practices for Climate Change Mitigation among Rural Farmers in Owerri Agricultural Zone of Imo State, Nigeria.

Chikaire, J.U., Anyoha, N.O., Godson-Ibeji, C.C. & Oguegbuchulam, M.

Abstract

The aim of this study was to ascertain the benefits of agro-forestry practices as a mitigation strategy for climate change among farmers in Owerri Agricultural Zone of Imo State - Nigeria. The objectives of the study were to describe the socio-economic characteristics of the farmers in the study area, identify evidence of climate change in the area, ascertain agro-forestry practices adopted by the respondents; and examine perceived benefits of agro-forestry practices for mitigating climate change. Data was collected through questionnaire distributed to 180 respondents. It was analysed using descriptive statistics - percentages, frequency distribution tables, mean scores. The results revealed that majority (70.6%) were males, and 29.4% were females, with a mean age of 45.1 years. while 80% of the survey were married, 31.7 % had primary education and 44.4 % had secondary education. The mean size of farm was 1.25 hectares, and the mean size of the household was 5.2 persons. The respondents had a mean farming experience of 30.05 years. The prevalent agro-forestry practices included rotational farming, improved fallow, intercropping, forest fencing and soil and water conservation among others. Climate change evidence identified by the respondents included increased temperature and soil erosion, amongst others – refer to the Tables. The respondents agreed that the benefits of agro-forestry included reduced soil erosion, reduced heat stress, protection of crops from wind damage, reduction of wind speed, among others practices. Extension agents should visit farmers for information dissemination and land should be allocated to enterprising agro-foresters. The government should enact Agroforestry policy, encourage and invest in related researches to determine the best combination of forest and crops production methods best for the environment.

Keywords: Agro-forestry, Climate change, Adaptation, Rural farmers, Mitigation.

Introduction

A large percentage of the population in developing countries depend on agriculture for their livelihood. The practice of the agriculture ranges from the primitive subsistence farming to large scale commercial ventures. At either end of the farming practices' spectrum is the continual exposure of the environment to adverse conditions due to degradation of the forest and the exposure of the soil to agents of erosion. Furthermore the application of farm inputs such as fertilisers and organic manure from livestock creates carbon pollutants in the atmosphere. The trapping of these carbon pollutants such as CO2 and methane from farming and other human activities causes the atmospheric temperature to rise to an extent of altering the world climate (Intergovernmental Panel on Climate Change - IPCC 2007b). The need for food security, raw materials and to enhance socio-economic development has influenced the activities implicated in climate change (Ogbeide & Ele 2016; Abeygunawardena et al. 2003). IPCC (2007b) and Bodegom et al. (2009) also indicated increased evidence that climate change is to a large extent due to human activity and that it will profoundly alter the living conditions for all humans, flora, fauna, and ecosystems.

Therefore the interacting effects of climate change and agriculture on the farmers and the environment are already being felt in many countries most times negatively. According to

United States Environmental protection Agency – EPA (2016), more extreme temperature and rainfall prevent crops from growing; flooding and drought also harm crops and reduce yields. Some weeds, pests and fungi thrive under warmer temperature, wetter climates, and increased CO_2 levels. The result is that a wide range of weeds and pests evolve and cause new problems to farmers' crops, the type they have not been exposed to previously.

Dunn (2009) reported that agriculture, its practices and supply chain influence climate change. For example, according to Mok (2009), EPA in 2007 estimated that agriculture accounts for 18% of the U.S. carbon footprint and could be as high as 25-30% as they failed to include the footprint of the manufacture and use of pesticides and fertilizers, fuel and oil for tractors, equipment, trucking and shipping, electricity for lighting, cooling, and heating, and emissions of carbon dioxide, methane, nitrous oxide and other greenhouse gases from these activities.

Studies by Smith, Martino, Cai, Gwary, Janzen, Kumar, McCarl, Ogle, O'Mara, Rice, Scholes, Sirotenko, (2007); Dunn (2009) reported that agricultural land use contributed 10-12 percent of global greenhouse gas emissions. Subsistence and industrial agriculture have implication for climate change as both involved land clearing and exposure that lead to warmer surface. As it is important that food, shelter and the environment be maintained in a sustainable manner, agriculture must be practiced in a way that delivers maximum benefit to the general society. Different models of farming have been suggested including organic (FAO, 2016; Rodale Institute 2014) and agroforestry (Neufeldt 2013; Mbow, C., Smith, P., Skole, S., Duguma, L. & Bustamante, M. 2014).

Literature review

Climate change and agroforestry

Owerri Agricultural Zone lies in the rain forest region of Nigeria and such area can be vulnerable to climate change impact. IPCC (2007a) noted that climate change related issues make agricultural activities in the area highly susceptible to climate-related extreme events such as floods, severe wind storms, soil erosion, and excessive rise in temperature. These extreme events have effects on agricultural production. According to Lal (2004) and Van Oost et al. (2004), continued growth at a declining rate is expected in land productivity due to decreasing returns from increased use of technology and greater use of marginal land with lower productivity. The use of these marginal lands increases the risk of soil erosion and degradation, with highly uncertain consequences for CO2 emissions. This study argued that where farmers do not have access or cannot afford the technology to improve yield from marginal land, the resultant effect will be double whamming due to production and environmental losses.

These effects may prove devastating for many developing countries that historically have been vulnerable to extreme climatic events such as drought and flood. Increase in the frequency of these events are projected to negatively affect local crop production in regions and areas of higher susceptibility (IPCC 2007a). Overall agricultural productivity loss in Africa due to climate change is estimated to be between 17% and 28%, compared to 3% to 16% for the world as a whole (Cline 2007).

While the compounding human needs that fuel increase in greenhouse emission remain coupled with the difficulties of government to achieve a consensus in solving climate change issues, mitigation efforts will therefore only provide a softening of the effects of climate change. The ability of smallholder farmers in developing countries to cope with the effects of climate change is impacted by limited capacity, few alternative sources of income, lack of expertise, and lack of appropriate public policies and financing (Center for Environmental Economics and Policy in Africa - CEEPA 2006). Sociodemographic characteristics also influence adoption of climate change control strategy. According to Laroche et al. (2001) a person's environmentally friendly behaviours can depend on family orientation and that married people with at least one child performed more environmentally friendly actions. Noor, Norsiah Mat, Mat, Jamaluddin, Salleh and Muhammad (2012) in their study of the emerging green product buyers in the Malaysian market reported that married people had higher green purchase behaviour than single and linked the report to the belief that married people were more family and community oriented and, more likely to act in the community interest against climate change.

To alleviate the threats from climate change and overall ecosystem degradation, various land use practices have been recommended. FAO (2016) reported that organic agriculture provides management practices that can help farmers adapt to climate change through strengthening agro-ecosystems, diversifying crop and livestock production, and building farmers' knowledge base to best prevent and confront changes in climate. Similarly Rodale Institute (2014) noted that there should be a shift in the management of the existing cropland to reflect a regenerative model. Regenerative organic agriculture is comprised of organic practices including the use of cover crops, residue mulching, composting and crop rotation. Conservation tillage, while not yet widely used in organic systems, is a regenerative organic practice integral to soil-carbon sequestration. Rodale Institute (2014) argued further that with regenerative organic agriculture, more than 40% of annual emissions could potentially be captured and if at the same time, all global pasture was managed to a regenerative model, an additional 71% of greenhouse gases could be sequestered.

Agroforestry is one of the prominent land use systems across many agro-ecological zones in Africa that cater for food production and mitigates the impact of climate change. It is a practical innovative production approach to improve the economic and ecological sustainability of agricultural systems and at the same time provide a flow of valued ecosystem services (FAO 2011). Agroforestry provides assets and income from carbon, wood energy, improved soil fertility and enhances local climate conditions; it provides ecosystem services and reduces human impacts on natural forests (Neupane & Thapa, 2001; Mbow, Smith, Skole, Duguma, & Bustamante 2014; Nguyen et al. 2013, Verchot et al. 2008; Sen 1991). Agroforestry systems are a key type of agriculture that allow for a high level of progressive adaptation from simply increasing structural and temporal diversity of the production system to selling ecosystem services for increased economic diversification (Lin n.d.).

Methodology

The study was conducted in Owerri Agricultural Zone which is made up of Ezinihitte, Aboh, Ahiazu, Ikeduru, Mbaitolu, Owerri North, Owerri West, Owerri Municipal, Ngor-Okpala, Ohaji/Egbema and Oguta Local Government Areas. Owerri Agricultural Zone consists of 18 extension blocks with 139 extension circles. From the circles, a list of all agro-foresters was obtained from the agents covering the area. The list has a total number of 1,800 agro-foresters and 10% was selected which represented a sample size of 180 respondents. The questionnaire for the survey was designed using tested variables/questions from project reports, scientific publications and bulletins. The variables/questions from the secondary sources were in some cases used without altering them; while others were adapted to suit the study purpose. The questionnaire was used to gather the data from the respondents.

The data were analysed using descriptive statistics such as percentages and mean presented in tables. These were used to analyse objectives 1, 2, and 3. Mean score (M) of the responses to the variables designed as a 4-point Likert scale items was used to analyse objective 4 of the study. The scale ranged from Strongly agree (SA), Agree (A), D (Disagree) to Strongly Disagree (SD) with assigned scores of 4, 3, 2 and 1 respectively, where '4' represented 'strongly agree' and '1' indicated 'strongly disagree'. The mean score of each scale item - 2.50 was used to determine the influence of each variable and any mean response below 2.50 was considered of no effect.

Result and Discussions

Socioeconomic Characteristics of Respondents

Table 1 shows the distribution of the socioeconomic variables of the respondents.

Table 1. Socioeconomic Characteristics of Respondents. Sample size 180

Characteristics	Frequency	Percentage
Sex		
Male	127	70.6
female	53	29.4
Age		
31-40	67	372
41-50	72	40.0
51-60	23	12.8
61 and above	18	10.0
Marital Status		
married	144	80.0
widow	27	15.0
Divorced	9	5.0
Household Size		
1-5	107	59.4
6-10	55	30.6
11 and above	18	100
Educational Level		
No formal education	29	16.1
Primary education	57	31.7
Secondary	80	44.4
Tertiary	14	7.8
Farming Experience		
1-10	5	2.7
11-20	16	8.8
21-20	51	28.3
31 and above	108	60.0
Farm Size (Hectare)		
0.5-1	108	60.0
1.5-2	53	29.4
2.5-3	15	8.3
3.5 and above	4	2.2
Extension service		
Visit - single	20	11.1
Visit – multiple	10	5.6
No visit	150	83.3
Farmers' Organization Membership		
Yes	162	90.0
No	18	10.0

Field survey data, 2016

While 70.6% of the respondents were males, 29.4% were females. This suggests that more men are involved in agroforestry than women. The men usually are the head of the household and most likely determine/influence family decision-making about ownership and use of land for agriculture purposes.

Majority - 40% of the respondents were within the age group of 41-50 years, 37.2% were in the 31-40 years age group, while 12.8% and 10% were in the age brackets of 51-60 and above 61 years respectively. The mean age of respondents was 45.05 years. In terms of educational attainment, 44.4% had secondary school education, 31.7% had primary education, with 7.8% having tertiary education. The age and educational distribution of the respondent agro foresters indicated that the farming workforce is relatively young and have the capacity to learn. They can be motivated to practice agriculture in a more sustainable manner when presented with the correct information in a convincing way at the appropriate time.

The Table also showed that 80% of the respondents were married, 15% were widows and 5% divorced. The mean household size was 5.2 members. Although the correlation between marital status and the household size was not investigated, the result revealed potential availability and readiness of family members to provide the needed labour for agroforestry. Furthermore, married people tend to be more interested in climate change mitigation strategy as they consider the future of their children and grandchildren as important to them. They are more incline to conduct their activities in a way that the impact on climate is minimal. The study outcome on marital status supports Ogbeide and Ele (2016); Laroche et al. (2001) and Noor, Norsiah Mat, Mat, Jamaluddin, Salleh and Muhammad (2012).

The respondents' average years of farming experience was 30.05, with a majority of the farmers - 60% having 0.5-1 hectare of farm land. The mean farm size was 1.25 hectare with the majority - 90% of such farm size holdings belonging to social organisations. The farm structure suggest subsistence farming where the land is fragmented. The production is just capable of feeding the farming family and excess production was sold in the local market. On extension visit, 83.3% had not received the visit of any agent, while 11.1% and 5.6% had received such visit once and twice in a monetary respectively.

Evidence of climate change in study area

Table 2 suggests that climate change was felt in the study area. The respondents indicated that the following evidence of climate change were observed; 98.8% of the survey agreed there is a decrease in vegetation cover, 96.1% reported an increase soil erosion while 95% and 93.8% of the sample stated increased drought and changes in growing season respectively.

The number of forest fires has increased as reported by 89.4% of the sample and a decrease in forest productivity was recorded by 89.4% of the respondents. Degraded water quality and loss of farm land due to flooding were reported by 84.4% and 88.3% respondents respectively. Other results on the evidence of climate change effects are in Table 2. These outcomes observed by farmers are indications that if actions are not taken about climate change, the future of humanity particularly those in the study area will be blink more so that no one is able to in absolute term determine the extent to which individual community will be affected.

Agroforestry in Owerri relies on rainfall, temperature and humidity in the right amount to be sustained. Where this is not the case, nutrient uptake and utilisation by crops can be hindered, pest and disease particularly new ones can be prevalent in incidence and virulence in ways that are poorly understood. Diseases and insect populations are strongly dependent upon temperature and humidity, and changes could alter their distributions and activities. Changes in precipitation patterns and amount, and changes in temperature will influence crop growth through changes in soil water content, runoff and erosion, workability, nutrient cycles, salinization, biodiversity, and soil organic matter.

Table 2: Climate change evidence in study area. Sample size 180

Evidence of Climate Change	***Frequency**	**Percentage**
Intense precipitation events	137	76.1
Increased temperatures	128	71.1
Increased drought	171	95.0
Increased wind storm	153	85.0
Changes in growing season	169	93.8
Increased cold temperature	111	61.7
Increased insect, pest/disease problems	143	79.4
Food insecurity	117	65.0
Labour migration	140	77.7
Malnutrition	158	87.7
Loss of farmland	159	88.3
Degraded water quality	152	84.4
Decreased forest productivity	161	89.4
Increased soil erosion	173	96.1
Increased forest fires	161	89.4
Decrease vegetation cover	178	98.8

Field survey data, 2016 *Frequency indicated the number of respondents that agreed with the evidence variables

Agro-forestry practices

Table 3 shows that farmers adopted agro-forestry practices in the study area. The practices adopted by farmers included improved fallow with 98.3% supporting the variable, intercropping trees in farms - 98.8%, rotational farming - 86.1%, mixed farming and cropping - 82.7%, forest farming - 85.5%, soil and water conservation - 91.6%, tree planting along boundaries of the farm - 96.1%, and making of live fences - 100%. Other practices were alley cropping - 73.8%, hedgerow making - 69.4%, and direct tree planting on farm - 56.1%, home garden establishment - 92.7%, maintenance of trees on farm land - 71.1%, tangy systems - 57.7%, orchards making - 60.5%, and plantation/crop combination - 65%.

Table 3: Agro-forestry Practices in Study Area. Sample size =180

Adopted Practices	*Frequency	Percentage (%)
Improved fallow	177	98.3
Rotational farming	155	86.1
Alley cropping	133	73.8
Hedgerow making	125	69.4
Direct tree planting	101	56.1
Home garden	167	92.7
Mixed farming/cropping	149	82.7
Forest farming	154	85.5
Maintenance of trees on farm land	128	71.1
Intercropping tree	178	98.8
Soil and water conservation	165	91.6
Wind breakers planting	140	77.7
Tree planting along boundaries of the farm	173	96.1
Taungya	104	57.7
Orchards	109	60.5
Plantain and crop combination	117	65.0
Live fences making	180	100

Field survey data, 2016. *Frequency indicated the number of respondents that agreed with the practice variables

This study argued that agro-forestry systems comprised a list of innovative land management practices that allowed for crop diversification, long rotation systems for soil conservation, home-gardens, boundary plantings, perennial crops, hedgerow intercropping, live fences, improved fallows or mixed strata agro-forestry. Therefore when well managed, agro-forestry can play a crucial role in improving resilience to the uncertain climate through microclimate buffering and regulation of natural resources like water flow. Management options in agro-forestry such as tree pruning are important measures to reduce below-ground competition, particularly for water such that trees tap into deep groundwater rather than top soil moisture that annual crops rely upon.

Benefits of agro-forestry practices for climate change adaptation

Agro-forestry plays prominent role in climate change adaptation both at the environment and farm/agricultural level.

Table 4. Benefits of Agro-forestry for Climate Change Adaptation. Sample size = 180

Statement	SA (%)	A (%)	D (%)	SD (%)	Mean	S.D
Slows down water runoff	53	19 (10.6)	33 (18.3)	75 (41.7)	2.58	1.28
Reduces soil erosion	90 (50)	72 (42)	0 (0)	18 (10)	3.30	0.90
Reduction of flood menace	54 (30)	54 (30)	36 (20)	36 (20)	2.70	1.10
Reduces water pollution	32	35 (19.4)	55 (30.6)	58 (32.2)	2.62	1.08
Reduces heat stress on crops/animals	54 (30)	90 (50)	18 (10)	18 (10)	3.01	0.89
Protects crop from wind damage	90 (50)	72 (40)	0 (0)	18 (10)	3.32	0.90
Reduces cold stress by providing shelter	54 (30)	54 (30)	18 (10)	54 (30)	2.65	1.14
Reduces wind speed	90 (50)	36 (20)	36 (20)	18 (10)	3.10	1.05
Reduces total crop failure	4 (2.2)	140 (77.8)	36 (20)	0 (0)	2.82	0.45
Promotes crop diversity on farmland	6 (3.3)	120 (66.7)	18 (10)	36 (20)	2.53	0.84
Provision of natural habitat for beneficial insects	34 (18.9)	108 (60)	20 (11.1)	18 (10)	2.88	0.83
Builds plant resistance/resilience to disease	36 (20)	72 (40)	35 (19.4)	37 (20.6)	2.59	1.02
Improves soil fertility	54 (30)	90 (50)	16 (8.9)	20 (11.1)	2.98	0.91
Provision of energy needs of rural farmers	55 (30.6)	58 (32.2)	32 (17.8)	35 (19.4)	2.73	1.09
Improves the exchange of gases in the forest	36 (20)	90 (50)	24 (13.3)	30 (16.7)	2.73	0.96
Promotes water use efficiency	18 (10)	36 (20)	108 (60)	18 (10)	2.30	0.78
Improves income of farmers	104	34 (18.9)	29 (16.1)	7 (3.9)	3.30	0.91
Rich sources of food for rural populace	90 (50)	73 (40.6)	17 (9.4)	0 (0)	3.40	0.65
Increase water infiltration	15 (8.3)	46 (25.6)	49 (27.2)	70 (38.9)	2.03	0.99
Promotes soil porosity	39	51 (28.3)	43 (23.9)	47 (26.1)	2.65	1.10
Aids soil air aeration/water retention	53	19 (10.6)	33 (18.3)	75 (41.7)	2.87	1.27
Improves pollination of wild flora	3 (1.7)	106 (58.9)	40 (22.2)	31 (17.2)	2.55	0.79
Rich source of medicinal plants	86	9 (5)	77 (42.8)	8 (4.4)	2.96	1.04
Source of forage for animal	115	27 (15)	30 (16.7)	8 (4.4)	3.38	0.91

Field survey data, 2016

Result in Table 4 revealed the numerous roles of agroforestry as perceived from the respondent's mean (M) response to the statements. The Table shows that agro-forestry reduces soil erosion with a mean response of 3.30, reduces heat stress on crop/animal (M=3.30), improves income of farmers (M=3.30), and a source of food for the rural populace (M=3.4). Other roles included slowing down of water run-off (M=2.58), reduction of flood menace (M=2.70), reduces water pollution (M=2.62), reduces cold stress by providing shelter (M=2.65), reduction of total crop failure (M=2.82), promotes crop diversity on farmland (M=2.53), provision of natural habitat for beneficial soil flora and fauna (M=2.88), building plant resistant/resilience to diseases (M=2.59), and improves soil fertility (M=2.98). The Table revealed also that agro forestry practices provides the energy needs of rural farmers (M=2.73), improves the exchange of gases in the forest (M=2.73), increase water infiltration (M=2.73), promotes soil porosity (M=2.65), improves the pollination of field flora (M=2.55) and aids soil aeration/water retention capacity (M=2.87), rich source of medicinal plants (M=2.96), and source of forage for animal growth/production (M=3.38).

The response from the survey supports Neupane et al., (2001); Sen (1991) and FAO (2011) that agro-forestry systems are not only a source of timber and fuelwood but also support crop production throughout the world. Intercropping of trees and crops has become a common practised with millions of hectares of agroforestry in China, Tanzania, Zambia, India and Pakistan. Furthermore, the result indicated that the use of trees and shrubs in agricultural systems helps to tackle the triple challenge of improving food security, increasing the adaptability of agricultural systems and mitigating climate change. While trees in the farming system can help increase farm income, they enable diversification of production and spread the risk of crop or market failure.

Conclusion

There is the growing and compelling evidence about global warming and its impact on global climate systems and that climate change is real and its consequences will be serious especially for Africa more than any other continent. The agricultural impacts of climate change are of a great concern to most developing countries, particularly in the tropics, because of the high dependence on agriculture as a means of livelihood. The subsistence level of operations, low adaptive capacity and limited institutional support exacerbate the fear of the impact.

Agro-forestry systems offer a win-win opportunity for farmers and the environment. The trees with their large surface area are able to absorb more CO_2 and other atmospheric pollutants while helping to attain food security, maintain farm income, improve soil health and discourage deforestation. While agro-forestry systems clearly offer economic and ecological advantages, it should be given more attention in terms of its practice and support to improve it. Agroforestry policy is important in this regard and more researches should be done to determine the best combination of forest and food crops to yield maximum benefits for agriculture and the environment.

References

Abeygunawardena, P., Vyas, Y., Knill, P., Foy, T., Harrold, M., Steele, P., Tanner, T., Hirsch, D., Oosterman, M., Rooimans, J., Debois, M., Lamin, M., Liptow, H., Mausolf, E., Verheyen, R., Agrawala, S., Caspary, G., Paris, R., Kashyap, A., Sharma, R., Mathur, A., Sharma, M. & Sperling, F. (2003). Poverty and climate change—reducing the vulnerability of the poor through adaptation. World Bank Press.

Bodegom, A.J. van, H. Savenije, and M. Wit. (2009). Forests and Climate Change: adaptation and mitigation. *European Tropical Forest Research Network* 50.

Center for Environmental Economics and Policy in Africa - CEEPA (2006). *Climate change and African agriculture*. CEEPA Policy Note No. 25, University of Pretoria, Pretoria.

Dunn, C. (2009). Six Ways Agriculture Impacts Global Warming. Retrieved from http://www.treehugger.com/green-food/6-ways-agriculture-impacts-global-warming.html
EPA (2016). Climate Impacts on Agriculture and Food Supply Retrieved from https://www3.epa.gov/climatechange/impacts/agriculture.html

FAO (2011). Climate-smart crop production system. Retrieved from http://www.fao.org/docrep/018/i3325e/i3325e07.pdf

FAO, (2016). Organic Agriculture and Climate Change. Retrieved from http://www.fao.org/organicag/oa-specialfeatures/oa-climatechange/en/

IPCC (2007a). Climate Change 2007: Impacts, Adaptation and Vulnerability. Summary for Policymakers, IPCC AR4 WGII, Cambridge University Press, Cambridge, UK.

IPCC (2007b). Climate Change: Fourth Assessment Report. Retrieved from IPCC, www.ipcc.ch/

Lal, R., (2004). Soil carbon sequestration impacts on global climate change and food security. *Science*, *304*, 1623-1627.

Laroche, M., Bergeron, J. & Barbaro, F.G. (2001). Targeting consumers who are willing to pay more for environmentally friendly products. *Journal of Consumer Marketing, 18*(6), 503- 520.

Lin, B.B. (n.d). Agroforestry adaptation and mitigation options for smallholder farmers vulnerable to climate change. Retrieved from http://aciar.gov.au/files/node/13992/agroforestry_adaptation_and_mitigation_options_for_10868.pdf

Mbow, C., Smith, P., Skole, S., Duguma, L. & Bustamante, M. (2014). Achieving mitigation and adaptation to climate change through sustainable agroforestry practices in Africa. *Current Opinion in Environmental Sustainability, 6,* 8-14.

Mok, K. (2009). A Tale of Two Will Allen's: Industrial Agriculture One of Most Polluting & Dangerous Industries. Retrieved from http://www.treehugger.com/green-food/a-tale-of-two-will-allens-industrial-agriculture-one-of-most-polluting-dangerous-industries.html

Neufeldt, H. (2013). Agroforestry and Climate Change Adaptation and Mitigation. Retrieved from http://www.fao.org/climatechange/36174-0552b1d21a0dd865ae3a3eda6acc8a3a0.pdf

Neupane, R.P., & Thapa, G.B. (2001). Impact of agroforestry intervention on soil fertility and farm income under the subsistence farming system of the middle hills, Nepal. Agric Ecosyst Environ 2001, 84:157-167. 15. _

Nguyen, Q., Hoang, M.H., O¨born I. & Noordwijk, M. V. (2013). Multipurpose agroforestry as a climate change resiliency option for farmers: an example of local adaptation in Vietnam. Climatic Change 2013, 117:241-257.

Noor, N.A.M., Norsiah Mat, N., Mat, N.A., Jamaluddin, C.Z., Salleh, H.S. & Muhammad, A. (2012). Emerging Green Product Buyers in Malaysia: Their Profiles and Behaviours. Proceeding of 3rd International Conference on Business and Economic Research, Bandung, Indonesia.

Ogbeide, O.A. & Ele, I. (2016). Consumer Attitude, Socio-demographics and Adoption of Climate Change Measures. *Mayfair Journal of Agriculture Development in Emerging Economies 1*(2), 12-31.

Rodale Institute (2014). Reversing Climate Change Achievable by Farming Organically. Retrieved from http://rodaleinstitute.org/reversing-climate-change-achievable-by-farming-organically/

Sen, W. (1991). Agroforestry in China. Ministry of Foreign Affairs, Beijing, China.

Smith, P., Martino, D., Cai, Z., Gwary, D., Janzen, H., Kumar, P., McCarl, B., Ogle, S., O'Mara, F., Rice, C., Scholes, B. & Sirotenko, O. (2007). Agriculture. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds), Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Van Oost, K., G. Govers, T.A., Quine, and G. Heckrath, 2004: Comment on managing soil carbon. *Science, 305*(5690), 1567

Verchot, L.V., Noordwijk, M.V., Kandji, S., Tomich, T., Ong, C., Albrecht, A., Mackensen, J., Bantilan, C., Anupama, K.V. & Palm, C. (2008). Climate Change: Linking Adaptation and Mitigation Through Agro-forestry. *Mitigation and Adaptation Strategies for Global Change, 12*, 901-918.