# Understandings of Climate Change, Climate-Smart Small Scale Agriculture and Practices of Climate-Smart Small Scale Agriculture as Climate Change Adaptation in Two Tanzanian Districts. A Case Study of Kilosa and Chamwino Districts.

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## Abstract

*Employing over 70% of Tanzanians, many of them small-scale farmers earning less than US$ 1 per day, the agriculture sector is particularly vulnerable to climate change. While climate change undermines agricultural development in low income countries like Tanzania, globally, agriculture contributes 14% of the anthropogenic greenhouse gases (GHG). Agricultural practices like shifting cultivation; use of fire during farm preparation; use of synthetic fertilizers; forest clearance; higher tillage and livestock keeping are examples of agricultural techniques that are commonly practiced in Tanzania and that contribute to GHG emissions. The study was conducted from December 2012 to March 2013 in 8 villages of Chamwino and Kilosa Districts as well as amongst district and national-level stakeholders. The study was a part of implementation of the Climate Change, Agriculture and Poverty Alleviation (CCAP) project, a partnership initiative between Action Aid Tanzania, MJUMITA, MVIWATA, TFCG and TOAM. It aimed to document understanding of climate change and climate-smart small scale (C3S) agriculture, assess the current uptake of C3S agricultural practices and support of the government in adoption of C3S agriculture. The study used structured and semi structured interviews; key informant interviews; direct observations and reviewing of reports and grey literatures. The study found that: the level of understanding on climate smart, small-scale agriculture is low amongst most stakeholders; and few farmers in the study villages have adopted C3S agricultural techniques. Support by the district authority for C3S agriculture is also low in the study villages. Instead the district targets 'modernising' projects that benefit a few villages each year. The survey also found that the National Climate Change Steering Committee does not see that it is its role to promote policy harmonization in relation to C3S agriculture.*

**Key words:** *climate change, agriculture, poverty, climate-smart small scale agriculture, greenhouse gases*

## Introduction

There is an empirical understanding that climate change has real caused major impacts on people's livelihoods and infrastructure. While impacts are globally unequally distributed, least developed countries have highly suffered the impacts (FAO, Climate-Smart Agriculture. Source Book, 2013). Their suffering is much caused by their low adaptability that is inferred from their poor technological development, limited means of coping with catastrophes, expensively alternative means of lives, and low pace of change in traditional way of living, widespread poverty, low education level and inequality distribution of wealth among other bases (Mitchell & Tanner, 2006). As it is not limited to one sector, climate change has affected number of sectors whereby some of them their operations exacerbate climate change that in return negatively affect them. The very one sector of this nature is agriculture where it has been widely known that some agriculture practices especially those unsustainable one, are responsible for climate change and as a result agriculture itself is affected most by the consequence of climate change caused by its practices.

Agriculture is and will remain the main source of staple food for majority of least developed countries (Mitchell & Tanner, 2006) as such anything disrupting its wellbeing affects the lives of majority of people on the global.

As in other least developed countries, majority of Tanzanian manage to make ends meet through an agriculture sector, the sector that has been cited to be comparatively less developed in spite of efforts devoted by the government to develop it (Mashindano, Kayunze, da Corta, & Maro, 2011). Employing over 70% of Tanzanians, many of them small-scale farmers earning less than US$ 1 per day (Sarris, Savastano, & Christiaensen, 2006 ), agriculture sector is particularly vulnerable to climate change (Mongi, Majule, & Lyimo, 2010). While climate change undermines agricultural development in low income countries like Tanzania, the fourth assessment report of the International Panel on Climate Change (IPCC) reported that globally, agriculture contributes 14% of the anthropogenic greenhouse gases (GHG). Agricultural practices like shifting cultivation; use of fire during farm preparation; use of synthetic fertilizers; forest clearance; deep tillage and livestock keeping are examples of agricultural techniques that are commonly practiced in Tanzania and that contribute to GHG emissions. Climate change is linked with reduced crop yields, exacerbation of poverty and natural resource. The National Adaptation Programme of Action (NAPA) for Tanzania estimated that increases in temperature and reduced rainfall as well as change in rainfall patterns will reduce the average yield of maize by up to 84% in the central region of Tanzania (URT, 2006).

Hence in order to avert the impacts of climate change on agriculture, different practices have been sought to be undertaken. They range from change in location, change in practices and change in types of crops grown or animal reared (Smith, 2007). The latter two practices factually refer to adaptation to climate change. Climate-smart small scale (C3S) agriculture is one among environmentally friendly practices that has been advocated so far. C3S agricultural practices is another brand name of climate smart agriculture that were pioneered by the United National Food and Agriculture Organisation (FAO) in 2010 and have been promoted as ways to halt climate change and increase food securities by adopting to climate change impacts (FAO, Climate-Smart" Agriculture. Policies, Practices and Financing for Food Security, Adaptation and Mitigation, 2010). The two statements in this document are used interchangeably and mean the same thing. Although it has been differently defined by FAO and the Word Bank, climate-smart agriculture at a local level includes many field practices that involve conservation agriculture, agroforestry, farm manure management among others (Mdemu, 2013). In a nutshell it involves attaining food security, mitigating climate change and adapting to climate changes together rather than in isolation or in other words it's all about achieving sustainable agriculture in the current world that is being threatened by the impacts of climate changes (FAO, Climate-Smart Agriculture. Source Book, 2013). Understanding of climate change itself has been a step toward knowing how to adapt to it and adopt some technics or practices that reduce its adverse impacts and mitigate it. This understanding at a local level is much important as it is at this level where many are much vulnerable to the impacts of climate change. (FAO, Climate-Smart Agriculture. Source Book, 2013). It is also at the level where new practices, skill and technologies that in one way or another combat climate change in terms of its impacts and its causes are needed. In a situation where such developments are not trickled down into the grassroots setting truly addressing climate change remains as unresolved delinquent.

This study therefore, was carried out to assess the currently understanding of climate changes in two districts of Kilosa and Chamwino. It also aimed to understand the current knowledge of the C3S agriculture practices and its uptake at a local level where the impingements of climate change are highly felt. This was meant to assess to what extent has communities in these two districts adapted climate change and has made progress toward mitigating climate change. Furthermore the study was also conducted to assess governmentally supports for communities to adopt climate-smart small scale agriculture.

## Methodology

### Description of the Study Sites

The study was conducted in Kilosa District in Morogoro region and Chamwino district in Dodoma region specifically in three villages in each district (Figure 1). The two districts were selected based on the criteria that they are the district involved in Climate Change Agriculture and Poverty Alleviation Project (CCAP). Specifically the study was conducted in in Lunenzi, Ibingu, Kisongwe and Lumbiji villages in Kilosa and Mahama, Nzali and Manchali A in Chamwino District (Figure 2).

Chamwino District is one of the six districts of Dodoma region. The district is located between latitude 4° S and 8° S and longitude 36° E and 37° E. It covers acreage of 7870 $km^2$ of which most of the area is semi-arid which receives annual rainfall of between 500 to 800 mm. The dominant ethnic group is Gogo involved in both crop and livestock production.

Similarly Kilosa District is among the six districts in Morogoro region located between latitude 6°S and 8°S, and longitude 36°30'E and 38°E. The district covers and acreage of 14,245 $km^2$. Kilosa district has its most of the areas with 500 meters above the seal level, however, most landforms lies between 200 to 700 meters above the seal level (Lusambo, Monela, Katani, & Mombo, 2007). The district has a bimodal rainfall pattern and it experiences an average of 8 months of rainfall throughout the year with the highest level recorded between February and March (Kajembe, Silayo, Mwakalobo, & Mutabazi, 2013). The area receives a mean annual rainfall range between1,000 and 1,400 mm in the southern flood plain, while further north (Gairo Division) it receives an annual rainfall ranging from 800 to 1,100 mm. The mean annual temperature in Kilosa is about 25°C (Kajembe, Silayo, Mwakalobo, & Mutabazi, 2013).

### Selection of the study villages

The study purposively selected Lunenzi, Kisongwe, Lumbiji and Ibingu village and Mahama, Nzali, Chinangali 1 and Manchali villages in Kilosa and Chamwino District respectively. These villages are the villages that are within the CCAP project.

### Data collection

The study employed structured and semi structured questionnaires, direct observation and document review to collect data of this study. As such 199 questioners were admitted to 80 small scale farmers, 80 village council members, 20 MVIWATA members and 20 MJUMITA members from eight villages in both Kilosa and Chamwino district. The study used a stratified sampling whereby for the case of small scale farmers, ten (10) names of small-scale farmers (5 men and 5 women) were written on separate pieces of paper; mixed in a box; and five names were picked from the box to represent farmers who came from sub villages that are remotely located. In addition, six names of small-scale farmers (3 men and 3 women) who were considered to be poor (according to wealth ranking indicators) were written on separate pieces of paper; mixed in a box; and three names were picked from the box to represent small-scale farmers who came from the lowest wealth rank category**.** The same procedure was used for the remaining two farmers where for this case four names (gender was considered) were used to select the remaining two farmers to make a total of 10 small-scale farmers. Every piece of paper picked was placed back in the box to make sure that every piece of paper had equal chance of being selected. During this exercise, gender was considered to ensure that women constituted 50% of the selected small-scale farmers to be interviewed. The same procedure was used to select respondents from village council, MVIWATA and MJUMITA members. Overall the study interviewed 89 respondents from Chamwino and 110 from Kilosa of whom 92 were women and 107 were men. MJUMITA network members came from UMILUI (Uhifadhi Misitu Lunenzi na Ibingu) and UMIKIM (Uhifadhi Misitu Kisongwe na Mfului) MJUMITA networks both in Kilosa. There were no MJUMITA networks in the study villages in Chamwino District. MVIWATA members belonged to Juhudi and Mshikamano groups in Kilosa and Chamwino Districts respectively.

The study also documented other observations relating to activities or communication materials in the study villages related to small-scale agriculture, climate change and current agriculture practices. Stakeholders at District and National level were selected on the basis of their positions.

**Data analysis**

Data analysis involved the development of data entry templates in Statistical Package for Social Science (SPSS), which are essentially, versions of the data collection questionnaires. Data entry was done using SPSS software and Microsoft Excel Spread Sheet as well as Geographic Information System (GIS) software. On completion of data entry, an in-depth analysis of the data obtained from questionnaires was undertaken using SPSS software and excel to establish the project baseline in the study areas. Maps were drawn using GIS.

**Results and discussion**

*Understandings of climate change*

Understanding of climate change is a prerequisite toward generating attentions to this globally pressing issue. This is inferred from the fact that if the knowledge of climate change and its relation to people’s lives is out of touch, implementations of actions that will address it and its impacts will not be possible. As such the results from all the eight villages surveyed in Kilosa and Chamwino indicate disparities in understandings of climate change across the groups interviewed. A responded was regarded to know climate change if he/she was able to describe climate change phenomenon. Phenomenons that were described are change in rainfall, temperature and occurrence of drought. To the interviewed 80 small scale farmers in eight villages in both Kilosa and Chamwino, 42% reported to know climate change and the rest 68% admitted that they do not know it. On the flip side, village government members to a great extent demonstrated higher understanding of climate change (85%, n = 80) as compared to small scale farmers. While it was revealed that small scale farmers has little understanding of climate change compared to village council members, other members of the communities (farmers) who have organised themselves into groups with focus on either agriculture or forest recorded higher understanding of climate change. This was revealed by MVIWATA and MJUMITA members whereby to the interviewed 19 MVIWATA members and 20 MJUMITA, 84% and 75% of them respectively reported to know climate. This can be described that the existence of these groups at the village levels serves as information hubs where members of such groups can easily access information on the ground and know how to respond to the changing climate in order to increase their agriculture productivity and resilience. Moreover, higher percentage of understandings recorded by village council members is attributed to the fact they are normally involved in workshops and seminars either arranged by governments or non-government organisation in the villages or outside the villages. Although there are good percentages of climate change understandings at least to village council members, MJUMITA and MVIWATA members, the very one concerned (farmer) community as the results of this study stipulates, is typically less aware of climate change. These finding are similar with similar study in Niger Delta were the level of climate change awareness at farmer's level was found to be low (Nzeadibe, Egbule, Chukwuone, & Agu, 2011). In spite of efforts made by the government and Non-governmental organisation to raise climate change awareness in the country it is a blatant averment that farmers has not caught the track. While it bears all traits of existence of elite capture (Ngaga, et al., 2013), it is also demonstrate the actuality of a fundamental paradox that exists between the need community and the informed community. Grassroots farmers are in need of climate change information; this information has not adequately reached where it's supposed to belong. Perhaps it may be attributed to many factors that range from methods used to deliver this information (village assembly meetings, seminars with selected groups of villagers, the use of posters, leaflets, radio, etc) lack of extension services to disseminate this information and unavailability of a mechanism for farmers to access this information. But more often, this may be inferred from low pace of understanding and learning to most farmers as the terms, concepts and technical trade-offs of climate changes are all new to them. Although this study did not assess the effective method of communicating this information at the grassroots level, such studies are paramount in addressing the lack of information to information need communities especially in this changing climate where more impacts are felt at the grassroots level.

*Awareness of climate-smart small scale agriculture and its practise*

Promoted by FAO for a decade now for its role to develop a more productive and resilient agriculture especially in developing countries (FAO, Climate-Smart" Agriculture. Policies, Practices and Financing for Food Security, Adaptation and Mitigation, 2010), climate smart agriculture seems to be a new terminology to most farmers in Tanzanian. The results of this study indicate that it was only 3.8% of farmers, 63% of MVIWATA members and 70% of MJUMITA members from both Kilosa and Chamwino who reported to be aware of climate-smart small scale agriculture. Again as reported earlier, associations in the villages acts as information dissemination of new knowledge, skills and practices. While farmers recorded few percentages in their knowledge of climate smart small scale agriculture MJUMITA and MVIWATA members has higher members who knew climate-smart small scale agriculture. However, understanding of climate-smart small scale agriculture will not mean anything if it is not put into practices. Since it is a new approach, mentoring famers of its whereabouts is most important especially when farmers will know its role in addressing the impacts of climate changes and mitigating climate change as well. This current study did assess also whether farmers have attended any formal training on climate smart agriculture. The study has found that only villages. The study did not record any 10%

of the 40 interviewed small-scale small-scale famers who had participated in farmers have participated in C3S C3S agriculture training in Chamwino agriculture trainings in Kilosa study study villages (Figure 1)

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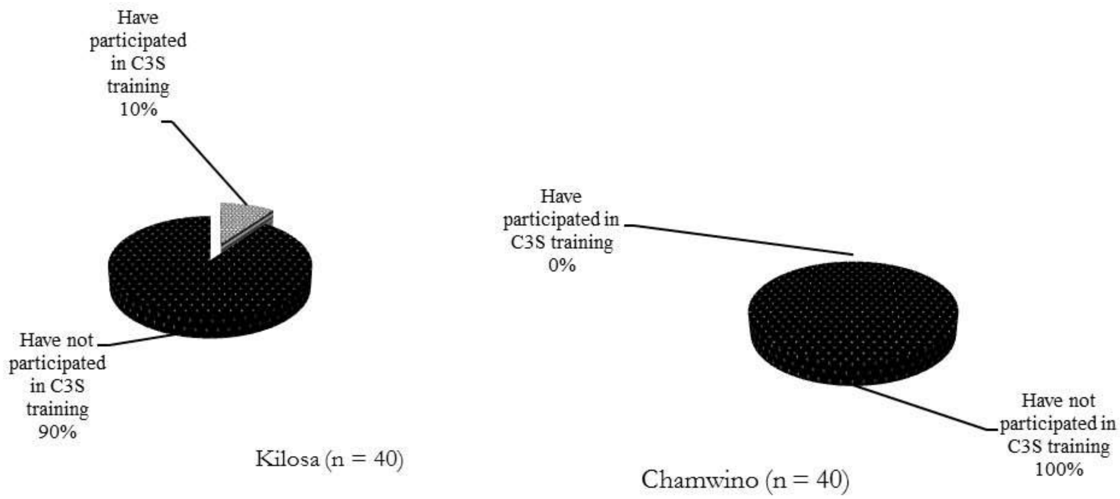


Figure 6. Small scale farmers' responses on whether they have participated in C3S training in Kilosa and Chamwino study villages

The C3S agricultural techniques that the 10% farmers reported to have been trained in, in Kilosa, were: basin farming and uphill and downhill trench farming. They said that they received this training from TFCG/MJUMITA staffs working in Kisongwe village under the REDD project. Although few farmers have attended training on C3S agriculture, the study found that currently some small-scale farmers in both Kilosa and Chamwino apply some of the C3S agriculture practices. Table 1 and 2 shows current practices that are implemented by farmers in Kilosa and Chamwino district. Some farmers implement (in descending order of frequency): weed control, crop rotation, use of drought resistant seed varieties, land fallowing, use of early maturing seeds and traditional irrigation in Kilosa (Table 1). In Chamwino small-scale farmers are implementing (in descending order of frequency): weed control, land fallowing, drought resistant crops, crop rotation, minimum tillage and agroforestry (Table 2). Although some of them reported to use perennial crop and agroforestry systems that allocate more carbon below ground and stores significant amount of vegetative carbon in agriculture field (Albretch, 2003), it was only 10% of them that stated to practice agroforestry in Chamwino whilst in Kilosa none of the farmers reported that they are practicing agroforestry. The mostly cited reasons of not using agroforestry system despite of its role in soil conservation and addressing food security, was scarcity of land. Farmers report that they do not have enough land and hence cannot plant trees and crops on the same land. However, there are others who reported that they are willing to use agroforestry but avoid shade to their crop especially maize that it is a light demanding crop and hence will underperform if mixed with trees. However, studies on maize in agroforestry reveals that maize under agroforestry system depending on spacing and species of tree increases maize productivity as compares to when they are mono-cropped (Bertomeu, 2003).

In relation to crop rotations with leguminous crops that increase soil Nitrogen and reduce reliance on synthetic fertilizers, a one sample t-test ($M$=1.53, $SD$ = 0.50;$t$ (79) = 27.1, $p$ = 0.0005) showed that a significant number of respondent farmers from both Kilosa and Chamwino are applying crop rotation in their field. In Kilosa and Chamwino 45% and 50% of the farmers interviewed respectively were applying crop rotations. In Kilosa maize and beans are the most commonly rotated crops whereas in Chamwino the majority of the farmers rotate maize and groundnuts. Beans and groundnuts are leguminous crops that fix atmospheric nitrogen to nitrate that is available to plant. When farmer were asked why they practice crop rotation, most of them said it is because of the growing seasons of individual crops and it has nothing to do with soil fertilization or avoiding the use of synthetic fertilizers. Thirty eight per cent (38%) of farmers of who all are from Chamwino who reported using fertilizers said they are using farmyard manures from their livestock. However, studies report that application of nitrogen in manure is not always efficiently used by crops. The surplus nitrogen is mostly susceptible to emission as nitrous oxide in the atmosphere (McSwiney, 2005). Practices that reduce leaching, volatile losses and improved efficiency use of nitrogen are recommended to reduce nitrous emissions (Barker T., 2007).

Vegetation cover provided by crops also adds carbon to soil and may also extract plant available nitrogen unused by the preceding crops and hence reduction of N emission (Freibauer, 2004). The study has discerned that only 5% of the respondents use cover crops in Kilosa and 3% in Chamwino. This finding indicates a low number of farmers who have adopted this practices in-spite of its role as one of the conservation agriculture.
Soil disturbance tends to stimulate soil carbon loss through enhanced decomposition and erosion. The use of terraces that control soil erosion and minimum tillage contributes to soil carbon gain and helps to reduce soil carbon emissions into the atmosphere. The study found only 5% of the respondents using terraces in Chamwino and only 3% in Kilosa. 18% of farmers in Chamwino and 8% in Kilosa reported that they apply minimum tillage. However, most of those who stated that they are applying minimum tillage are those who are burning and planting without tilling the land. They cited lack of labour power as the reason for practicing minimum tillage. In Chamwino, farmers said that they are now tilling the land using oxen driven ploughs as a good agriculture practices to increase crop yields as opposed to the previously used minimum tillage practices. This practice further disturbs soil and hence increases the loss of soil carbon.

Irrigation has been cited to increase carbon yields through enhanced vegetation yields and residue return to the soil. Apart from contributing to soil carbon enhancement, it increases crop yields and hence benefits farmers. However, these benefits are realized when it does not rely on machinery and does not drain wetlands. The study found that only 13% of the interviewed farmers apply irrigation in Kilosa and none of the farmers in Chamwino stated to practicing it. Those who reported to use traditional irrigation, said that they dig irrigation ditches from rivers and direct those ditches to their farms especially paddy farms.

Forest clearance causes biodiversity loss; removes an important store and sink for Carbon; and leads to the release of soil carbon through enhanced microbial activities by temperature increase to the cleared area (Canadell, Raupach, & Houghton, 2009). In most cases deforestation for agriculture has been practised by slashing and / or burning. The study found that of the interviewed small – scale farmers, 10% of them are clearing forest to open up new agricultural fields in Kilosa and 15% in Chamwino as means to adapt to climate change. This is general defined as change in location from the previous climate change prone areas. This practice proves to be beneficial in both addressing climate change and food shortage when it does not compromise the ability of the land to store carbon. The current practice as noted by this study however, complicate climate change further as it leads to not only biodiversity loss, removes of important store and sink of carbon but also leads to release of both vegetative carbon and soil carbon that has been conserved by the forest (Makundi & Okinting'ati, 1995) .

The use of downhill and uphill trenches (fanya juu and fanya chini) one of the conservation tillage strategies was only reported as being applied by farmers in Kisongwe village where a small number of interviewed small-scale farmers reported that they practice it. Moreover, a few of the interviewed farmers in Kilosa (8%) and in Chamwino (18%) reported that they use mulching, one of the soil protection methods. Mulching protects soil from direct sunlight, the situation that reduces water evaporation and also lowering microbial activities and hence reducing carbon emission from the soil. Apart from that it protects soil from soil erosion benefiting both crops and storage of soil carbon (Ogban, et al., 2008). As the results of this study stipulate very few farmers are applying this method in the study areas notwithstanding its importance.

***Government support for adoption of climate smart small scale agriculture by small scale farmers***

**A the district level**

The study has established that there is no any practice resilient to climate change and that has low GHG emission that is supported by the two districts to small-scale famers. Instead, the two districts have been helping communities to adapt to the impacts by changing crop varieties and less effort is placed on changing practices. For example in Chamwino, the district official mentioned that they are distributing a drought resistant sorghum seed (macia seeds) that was funded by FAO in 2010. This variety is an early maturing variety. However, apart from this support not have been reached majority of the small-scale farmers, there are no low GHG emission agriculture practices that were reported to accompany the new introduced drought resistant seeds. The study observed that still farmers are practicing unsustainable agriculture practices (Table 3). With the case of Kilosa district, it was reported that currently the district is not supporting any best practices that is resilient and with low GHG but rather agriculture officers are providing advices to farmers to take necessary precautions not to destroy the environment. However, the monitoring is not conducted and hence they are not sure on whether those practices are being implemented.

**Table 1. Climate smart, small -scale agriculture practices currently applied by small-scale farmers in Kilosa study villages (n = 40 for each district).**

| C3S Agriculture practice | Use | Do not use |
|---|---|---|
| Drought resistant seeds | 38% | 63% |
| Early maturing seeds | 20% | 80% |
| Traditional irrigation | 13% | 88% |
| Terrace | 3% | 98% |
| Perennial crops | 15% | 85% |
| Crop rotation | 45% | 55% |
| Cover crops | 5% | 95% |
| Minimum tillage | 8% | 93% |
| Land fallowing | 28% | 73% |
| Weed control | 75% | 25% |
| Uphill and downhill farming | 3% | 98% |
| Agroforestry | 0% | 100% |
| Use of fertilizers | 0% | 100% |
| Change in location (Clearing forest) | 10% | 90% |
| Use of mulching | 8% | 93% |

Table 2. Climate smart, small -scale agriculture practices currently applied by small-scale farmers in Chamwino study villages (n = 40 for each district).

| C3S Agriculture practice | Use | Do not use |
|---|---|---|
| Drought resistant seeds | 63% | 38% |
| Early maturing seeds | 18% | 83% |
| Traditional irrigation | 0% | 100% |
| Terrace | 5% | 95% |
| Perennial crops | 3% | 98% |
| Crop rotation | 50% | 50% |
| Cover crops | 3% | 98% |
| Minimum tillage | 18% | 83% |
| Land fallowing | 28% | 73% |
| Weed control | 78% | 23% |
| Uphill and downhill farming | 0% | 100% |
| Agroforestry | 10% | 90% |
| Use of fertilisers | 38% | 62% |
| Change in location (Forest clearing) | 15% | 85% |
| Use of mulching | 18% | 83% |

Table 3. Farm preparation methods to the interviewed farmers

| **Farm preparation methods** | **Study villages** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Chinangali I* n=10** | **Ibingu** n=10** | **Kisongwe** n=10** | **Lumbiji** n=10** | **Lunenzi** n=10** | **Mahama* n=10** | **Manchali A* n=10** | **Nzali * n=10** | **Overall n=80** |
| Slash and Burning | 9(90%) | 5(50%) | 9(90%) | 10(100%) | 7(70%) | 6(60%) | 9(90%) | 8(80 %) | 63(79%) |
| Burning | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 1(10 %) | 1(1%) |
| Slash and leaving slashes to decay in the farms | 1(10%) | 1(10%) | 1(10%) | 0(0%) | 2(20%) | 1(10%) | 1(10%) | 10(10 %) | 8(10%) |
| Tilling by hand hoe | 0(0%) | 4(40%) | 0(0%) | 0(0%) | 1(10%) | 2(20%) | 0(0%) | 0(0%) | 7(9%) |
| Ploughing | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 1(10%) | 0(0%) | 0(0%) | 1(1%) |

Note: * Chamwino villages ** Kilosa villages

**National Climate Change Steering Committee and National Climate Change Technical Committee (NCCSC/NCCTC)**

The study did assess at what level the NCCSC/NCCTC has helped to advocate policy harmonisation in manner that foster climate smart agriculture. Especially on whether there is any policy changes have resulted from the influence of NCCSC and NCCTC. It was found that there has been no any policy change that has been resulted from the influence of NCCTC and it consider that it is not its role to harmonise policies. Rather the chairman of the NCCTC elucidated that the national climate change strategy considers policy harmonisation and that therefore its implementation will perhaps result in policy changes. Being the national body dealing with climate change, it is anticipated to be a body to provide climate resource materials and perhaps approve information on climate change, impact and adaptation to be disseminated to the general public. This was not elucidated to be one of the roles of this body by this study.

**Conclusion and recommendation**

Amongst all stakeholders, there is some awareness of climate change, climate smart agriculture and the linkages between climate change and agriculture. At present some farmers are implementing agricultural techniques that will help to make them more resilient to climate change and / or reduce greenhouse gas emissions. However the majority of farmers are not. Barriers to small scale farmers adopting C3S agriculture include knowledge; technical support; access to inputs and credit; and an unfavourable market structure.

Whilst the District Agricultural Development Plans could provide a mechanism for supporting farmers to adopt C3S agriculture, the DADPs do not yet play that role beyond some externally financed initiatives such as the Chamwino Macia seed distribution project. Instead DADP funds tend to benefit a few villages with large investments such as construction of irrigation schemes or provision of tractors and power tillers. In addition late disbursement of DADP funding leads Districts to prefer ‘one-off’ investments rather than ongoing support for extension services for small-scale farmers.

At national level, the national climate change technical committee does not see that it is its role to harmonise policies in addressing climate change through climate smart agriculture. It does not also provide and approval information on climate change.

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**Reference**

Albretch, C. K. (2003). Carbon sequestration in tropical agroforestry systems. *griculture, Ecosystems and Environment*, 15-27.

Barker T., I. B.-J. (2007). Technical Summary. In: Climate Change 2007: Mitigation. . In O. R. Metz, *Contribution of Working Group III to the Fourth Assessment. Report of the International Panel on Climate Change.* United Kingdom and New York: Cambridge University Press

Bertomeu, M. (2003). Smallholder maize-timber agroforestry systems in Northern Mindanao, Philippines: Profitability and contribution to the timberindustry sector. *The International Conference on Rural Livelihoods, Forests and Biodiversity.* Bonn, Germany: The International Conference on Rural Livelihoods, Forests and Biodiversit.

Blinker, L. M. (2006). *Tanzania -Country Environment Profile.* Les Isnes: AGROFOR Consult

Canadell, G., Raupach, M., & Houghton, R. (2009). Anthropogenic CO2 emissions in Africa. *6, 463–468,*.

FAO. (2010). *Climate-Smart" Agriculture. Policies, Practices and Financing for Food Security, Adaptation and Mitigation.* The Hegue: Food and Agriculture Organisation of the United National.

FAO.(2013). *Climate-Smart Agriculture. Source Book* (Vol. 1). Padova: Food and Agriculture Organisation of the United National.

Freibauer, A. R. (2004). Carbon sequestration in the agricultural soil of Europe . *Geoderma*, 1-23

Kajembe, G., Silayo, D., Mwakalobo, A., & Mutabazi, K. (2013). *The Kilosa District REDD+ pilot project, Tanzania. A socioeconomic baseline survey.* London: IIED.

KDC. (2012). *District Agricultural Development Programme.* Kilosa: Kilosa District Council.

Lusambo, L., Monela, G., Katani, J., & Mombo, F. (2007). Socio-economic analysis of land use factors causing degradation and deforestation of Miombo woodlands in Kilosa District Tanzania. *76*.

Makundi, W., & Okinting'ati, A. (1995). Carbon flows and economic evaluation of mitigation options in Tanzanian's forest sector. *8 (381-393)*.

Mashindano, A., Kayunze, K., da Corta, L., & Maro, F. (2011). *Agricultural growth and poverty reduction in Tanzania 2000-2010: where has agriculture worked for the poor and what can we learn from this?* Manchester: Chronic Poverty Research Center.

Mdemu, M. (2013). *Policy Analysis in relation to climate change adaptation, mitigation,agriculture and REDD.* Dar es Salaam: ActionAid Tanzania.

Mitchell, T., & Tanner, T. (2006). *Adapting to climate change Challenges and opportunities for the development community.* London: Tearfund.

McSwiney, C. R. (2005). Nonlinear response of N2O flux to incremental fertilizer addition in a continuous maize (Zea maysL.) cropping system. *Global Change Biology,*, 1712-1719.

Mongi, H., Majule, A., & Lyimo, J. (2010). Vulnerability and adaptation of rain fed agriculture to climate change and variability in semi-arid Tanzania. *Vol. 4(6), pp. 371-381*.

Nelson, G., Rosegrant, M., Koo, J., Robertson, R., Sulser, T., Zhu, T., et al. (2009). *Climate change. Impact on Agriculture and Costs of Adaptation.* Washington Dc: International Food Policy Research Institute.

Ngaga, Y. M., Treue, T., Meilby, H., Lund, J. F., Kajembe, G. C., Chamshama, S., et al. (2013). Participatory forets management for more than a decade in Tanzania. Does it live up to its goal? *Volume 83*(1).

Nzeadibe, T., Egbule, C., Chukwuone, N., & Agu, V. (2011). *Climate Change Awareness and Adaptation in the Niger Delta Region of Nigeria.* Nairobi Kenya: African Technology Policy Studies Network.

Ogban, P. I., Ogunewe, W. N., Dike, R. I., Ajaelo, A. C., Ikeata, N. I., Achumba, U. E., et al. (2008). Effect of tillage and mulching practices on soil properties and growth and yield of cowpea (Vigna unguiculata (l), walp) in Southeastern Nigeria. *7*(2).

Sarris, A., Savastano, S., & Christiaensen, L. (2006 ). The Role of Agriculture in Reducing Poverty in anzania: A Household Perspective from Rural Kilimanjaro and Ruvuma. *International Association of Agricultural Economists Conference* (p. 36). Gold Coast, Australia: International Association of Agricultural Economists Conference.

Smith, P. D. (2007). Agriculture. In O. D. B. Metz, *In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the.* Cambridge, United Kingdom and New York, NY, USA.: Cambridge University.

URT. (2006).*National Adaptation Programme of Action (NAPA) for Tanzania.* Dar es Salaam: Division of Environment