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The Roles of Urban Agriculture for Climate Change Adaption in the Case of Debre Markos Town and Surrounding Districts East Gojjam Zone Amhara Region Ethiopia

Mengist Belay*

Department of Natural Resource Management, Debre Markos University, Ethiopia

Abstract

Rapid urbanization and large scale food production both heavily dependent on fossil fuels are arguably the most significant contributors to climate change. They are also increasingly recognized as potential tools in mitigation and adaptation to climate change. Climate change has already affected food production systems leaving loss of crop, grain shortages, and increased commodity price in its wake, all of which undermine food security a fundamental human right. This study establishes that Urban Agriculture is a multipronged tool for adaptation and mitigation to tackle climate change, and is the effective tool to address food security challenges in the cities, educate and reconnect urban and peri urban farms and people to assure food and climate security in the cities.

Keywords: Climate change; Mitigation; Adaptation; Urban; Peri urban.

Introduction

Environmental change is a serious concern today and specialists are affianced in figuring out its effect on development and yield of harvests and furthermore recognizing reasonable administration choices to support the yield efficiency under the environmental change situations. The inconstancy of climatic variables welcomes vacillations on crop yields [1]. As per IPCC environmental change is any adjustment of environment over the long haul, whether because of regular fluctuation or because of human movement. Investigations of environmental change influences on horticulture at first centered around rising CO2 levels [2], yet later it was accounted for that adjustments of temperature, radiation and precipitation and so on should be contemplated to assess the effects of environmental change, past CO2 increment, on crops [3].

Metropolitan populace development straightforwardly affects this connection among farming and environmental change. Urbanization is an inevitable piece of our financial development models. We have now passed the boundary of half of the total populace living in urban areas [4]. Segment examination demonstrates that there are 70 million new metropolitan tenants every year, an enormous extent of who live in non-industrial nations. It is figure that 66% of the populace will live in urban communities by 2025. By 2015 around 26 urban communities on the planet are supposed to have a populace of 10 million or more [5].

An expected 40% of Africa's absolute populace live in metropolitan regions [6]. Despite the fact that urbanization rates differ between and inside nations or locales, writing shows a segment shift toward an undeniably metropolitan crowded across the landmass. The segment change will include both social and natural ramifications inside metropolitan regions and their asset giving areas [7]. As of now, just an unassuming extent of net urbanization in Africa is connected straightforwardly to environment and climate prompted movements, yet this is probably going to increment in the future [8]. As of now, a few urban communities in the Sahel district, for example, Dakar are encountering higher net country metropolitan relocation because of debilitated provincial vocations exacerbated by a variable and changing environment [4]. Numerous city districts in Africa are encountering or are in danger of ocean level ascent, storm floods, saline water interruption, seaside disintegration, floods, and dry seasons [9,10,11]. These effects are probably going to have suggestions for metropolitan frameworks, metropolitan foundation, general wellbeing, financial turn of events, neighborhood ecological assets, food security, and water supplies and will influence excessively the weak metropolitan poor, ladies, older, and the youthful [2,12,13].

Urban areas play a significant part to play in environmental change relief and variation and upgrading environment flexibility of their ghetto and weak occupants. Environmental change adds to existing difficulties looked by urban communities. Environmental change, along with a lessening in retention limit of nursery gasses due decrease in how much green cover, parks, trees and rural surfaces in metropolitan regions, presents serious dangers to metropolitan framework, admittance to fundamental administrations and personal satisfaction in urban communities and adversely influence the metropolitan economy [5].

Simultaneously, fast metropolitan development, developing metropolitan destitution and expanding food costs raise worries about metropolitan food security, particularly for poor people. Urban communities are exceptionally powerless against disturbance in basic (food) supplies and environmental change fuels this weakness. For the ongoing urbanization to be maintainable there is a requirement for "de-coupling" (improving the personal satisfaction while limiting asset extraction, energy utilization and waste age and at the same time shielding environment administrations).

Decoupling will rely on how city-based energy, transportation, food, water and sterilization frameworks are arranged as well as reconfig-

***Corresponding author:** Mengist Belay, Department of Natural Resource Management, Debre Markos University, Ethiopia, E-mail: mengistbelay@gmail.com

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ured. In such manner, there could be a job for Urban and Peri-metropolitan Agriculture and Forestry (UPAF). UPAF was perceived by the World Bank as an expected methodology for reusing of natural endlessly squander water; having potential energy saving advantages as neighborhood creation diminishes the requirement for transportation and refrigeration and having social advantages including better wellbeing and sustenance and job valuable open doors [14].

Future urbanization directions present the two difficulties and valuable open doors for tending to environmental change influences. While environment fluctuation and ecological change influences are legitimate in rustic regions, writing is progressively highlighting influences in urban communities and their hinterland locales [3]. There are worries about environmental change influences building up destitution, compounding food uncertainty and expanding weakness of metropolitan populaces [3,15,16]. Since urbanization worsens these weaknesses, there is developing proof that metropolitan and peri metropolitan farming and ranger service (UPAF) can assume a part in destitution mitigation and possibly lessen weakness to environmental change [17,18]. The connection among neediness and UPAF has been all around examined and arising information focuses to UPAF's capability to address environment chances [19].

Metropolitan farming can assist urban communities with tending to environmental change at the neighborhood level and plan metropolitan populaces to manage the difficulties it brings. Notwithstanding the numerous natural, social, wellbeing, and monetary advantages is has consistently brought to urban communities, metropolitan horticulture currently plays a part to play as an environmental change variation system. Expanding organically useful green space will assist with easing the metropolitan intensity island impact, act as a water the board methodology, and improve metropolitan food security. Also, metropolitan agribusiness will assist with relieving further environmental change by diminishing transportation needs and changing the ongoing agrarian practices that add to a dangerous atmospheric devation. Moderation stays an essential part of tending to environmental change since it lessens the greatness of future disasters and the requirement for more extreme transformation measures. In Ethiopia, the effects of environmental change are self-evident. They incorporate the decrease of surface water level softening of ice sheet of Mount Ras Dejen and delayed dry spells and capricious downpour cycles experienced in various pieces of the nation including Amhara Region. Subsequently, this paper gives an account of alleviation and variation measures attempted by peri-metropolitan ranchers in intervening the impacts of environmental change in Amhara Region East Gojjam Zone, Debre Markos Town and encompassing regions.

The problem has been addressed through answering the following research questions: i) what is the level of adoption of mitigation and adaptation measures among peri-urban farmers? ii) which mitigation measures are applied by peri-urban farmers to mediate the impact of climate change? iii) which adaptation measures are implemented by peri-urban farmers against climate change?(Table 1).

Education	Percent	farmers
No formal education	12.9	12.9
Primary	68.8	68.8
Secondary	5.4	5.4
Ordinary certificates	0.4	0.4
Adult education	12.5	12.5
Total	100	100
Occupation		
Farming only	49.2	49.2
Farming with petty business	48.3	48.3
Formal employment with farming	2.5	2.5
Total	100	100

Table 1: Socio economic and demographic characteristics of the respondents (n=240)

Materials and Methods

The study area

The study was done in Debre Markos Town and surrounding District in East Gojjam Zone, Amhara Region Ethiopia. The town is 300 kms NW of the capital, Addis Ababa and 265 kms SE of Bahir Dar, the capital of Amhara National Regional State. It is geographically located at 10°20'N37°43'E/10.333°N37.717°E with an average altitude of 2446 m above sea level. It has conducive weather condition with1380 mm average annual rainfall and 18°c average annual temperature. According to the municipality's report, the town has over 123,000 residents of which 97 percent are Amhara and the remaining three percent are from Agaw, Oromo, Tigre and others nations. Although there are various religions (orthodox Christians, Muslims and Evangelical Christians), most of the dwellers are Orthodox Christian.

Economic activities carried out in Debre Markos and surround district include farming, businesses as well as wages employment. The main sources of income among the local communities include; farming, sales of food crops, forest products, livestock and associated products. The study used a cross sectional research design to examine existing mitigation and adaptation measures across four selected peri-urban wards Debre Markos town and surrounding District. This design was opted due to the fact that it allows data to be collected at a single point in time [1].

Study method

The study was conducted in five villages representing three agro-ecological zones: Highland (Yegagina and Enarata), midland (Debre Markos and Wenqa) and lowland (Qebie). Rainfall data were acquired from the National Meteorological Agency. Agricultural (vegetables and livestock) development trend information was collected based on historical event time line (Nyssen et al. 2006) in which farmers can easily remember the study years. These years were 1984/5, 1986, 1989, 1994, 1998, 1999, 2002, 2005 and 2007.

In total, 140 household heads were selected for the purpose. Data collected from the questionnaire survey, meteorological data and other secondary sources were analyzed using Microsoft Office EXCEL (2003) software (Figure 1).

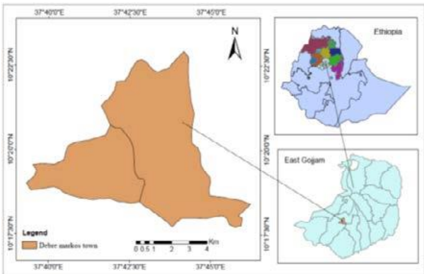

Figure 1: Map of study area

Results and Discussion

Selected socio-economic and demographic characteristics of the respondents

Socio-economic and demographic characteristics were assessed to reveal the baseline information of the characteristics of interest of the study population. These characteristics are presented in The findings show that 59.2% of the respondents were males while 40.8% were females. In terms of the age groups 21 – 34 years comprised of 25.42%, 35 – 59 years 61.66% while 12.92% were respondents with 60 years and above. The mean age was 43.33 indicating that majority of the farmers were more energetic and that they are likely to devote to more time on farming besides other economic activities.Of all the respondents, 68.8% indicated that they had completed primary education, 5.4% had secondary education while less than 1% had ordinary certificates attained upon completion of form four. In terms of occupation, 49.2% were farming, while 48.3 were also doing commercial activities in addition to farming. Based on the findings, PUF is more practiced by middle age people and with low education level. About 88% of the respondents owned land and about 13% either rented or were permitted by land owners to use for farming. (Table: 1)

Rainfall variability and trends

The average annual rainfall in the study area ranged from 1380 mm, with wide temporal and spatial variation. The spatial variation was high, with the highest standard deviation in the lowlands. The lowest deviation was, however, observed in the midlands. The midlands, which cover the largest portion of the study area, also showed a slightly decreasing rainfall pattern over the study periods.

This corresponds with the study of Jan, S. Anja B.Who observed that there was a decreasing trend in the 1980s and a slightly above average trend in the years after 1990. Similar to the study in other parts of northern Ethiopia, this study showed that the rainfall pattern was perceived to have changed over the past decades, particularly in terms of timing and duration. There have also been reports of rainfall variability and drought associated food shortages. The rainfall pattern was extremely unpredictable and erratic with a coefficient of variation ranging from 18 percent in the midlands to 42 percent in the lowlands. This corresponds with the findings of Kurukulasuriya, P. and Mendelsohn, R., in northern Ethiopia, who found a coefficient of variation more than 30 percent. According to the inhabitants, except in more dry years, changes in seasonality and distribution regularity of rainfall were more of a concern than the overall amount of rainfall.

Vegetable production trend

Elders indicated that the changes became more noticeable since the major famine in 1984/85. They felt that the main rainy season was becoming progressively shorter.Moreover, it started late and ceased earlier than it used to. This is in agreement with the rainfall data obtained from national meteorological records. Elders associated the variability with vegetables growing periods by noting that in the past people could see fully germinated vegetables up to the 12th of July and matured vegetables up to the 22nd of August. However, the rains which normally used to start in mid-June, shifted to July and ceased much earlier than was normally the case, which stretched to mid-September. In most of the months, 0 mm rainfall was recorded.

The variation in rainfall among months in each site and each year was very high. As water shortage was already a major development challenge in the study villages, the uneven and erratic nature of the rains will exacerbate the existing problem of drought and land degradation in the midlands in particular. Elders indicated that several traditional vegetables had been lost in the area and several were introduced.

In addition to the major vegetables, many local vegetables such as cabage, qousta, selata and tomato are grown. Each variety were introduced by Bureau of Agriculture and Rural Development. These varieties have gained wide acceptance and are widely grown replacing mono cropping. However, the vegetable sping of oats declined and teff sown during the dry-season has become practically abandoned. A study by Kiunsi, R.in a village in southeastern Tigray also compared the agricultural calendar from 1930 –1950 with the present agricultural calendar. They found a tendency towards fewer vegetables varieties and shifting to a shorter planting season, indicating that most vegetables are planted during mid- to end of June, and are often harvested some weeks earlier as well.

The preference of farmers to new varieties, short growing cycle vegetables with good production, contributed to the reduced vegetables diversity. The average vegetables production in the highlands showed a positive trend (R =0.43 in Debre Markos and R = 0.11 in Wenqa). The yield of cabbage in Yigagina village showed a slight but not significant increase. Miscellaneous vegetables in the village had a strong positive correlation with time (R= 0.74). The yield of qosta and selata in the village Qebie showed a significant difference. Both showed a negative trend (R=-0.58). However, the yield of tomato, pottato and onion significantly increased with R values of 0.72, 0.48 and 0.49, respectively.In addition, the climate and vegetable data shows that there was a general perception among rural households that vegetables production and land productivity declined in the past 20 or so years (R=-0.17 in Debre Markos and R=- 0.47 in Yegagina). Similar studies in other parts of Ethiopia estimated a total loss of annual food production over some areas, while in other areas the loss was as high as 50 percent.

The yield of all major vegetables grown in Wenqa village showed a decreasing trend. However, only mono cropping and chickpea showed a significant difference with R value of -0.69, -0.51 and -0.49, respectively. The yield of tomato, pottato and onion in Debre Markos showed a slight increase with time but not significantly different. However, a significant difference was observed only in the yield of broad bean and sorghum. Both showed a negative trend with R values of - 0.7 and -0.6, respectively. The yield of all major vegetables grown in the selected sample village showed a positive trend (R=0.43).

Climate change and vegetables production

Historically, the study area was affected by many drought events. The drought in 1984/85 was the worst. The change in rainfall distribution and pattern had contributed to the change in vegetable sping pattern and vegetables yield. The study showed a positive correlation between rainfall and vegetables yield in four of the survey villages. Only the Kebie village showed a negative correlation between rainfall amount and vegetables yield. Overall, the coefficient of correlation between rainfall amount and vegetables yield is very small.The lower response of rainfall to vegetables yield could be due to the seasonal variability of rainfall rather than the amount and other non-climatic factors, which needs further investigation.

Climate change and farmers' adaptive mechanisms

Among adaptations made in response to climate change, planting different varieties of the same vegetables and changing planting dates were important everywhere. The study assessed the level of adoption of mitigation and adaptation in order to ascertain an overview of the farmers" initiatives to address climate change at the contextual level. In terms of mitigation measures, the findings reveal that 60.8% of the respondents had the highest level of adoption, 32.5% had medium level and 6.7% had the lowest level. This indicates that the level of mitigation measures pursued by the households in mediating climate change is reasonably high.

This is because most of farmers use more than one mitigation measure to mediate climate change effects. Equally, this implies that local level initiatives are not helpless in the bid to reduce global greenhouse gas emissions. The level of adoption of mitigation measures was correlated with the age groups. Results from a Kruskal Wallis Test suggest statistically significant difference in the level of adoption of mitigation measures across three groups at $p<0.05$. As observed in the table, mean ranks for the groups suggest that the older group (60 years and above) had the highest level of adoption with the younger group reporting the lowest level of adoption. The possible reason for the findings is that the older farmers are more likely to engage in activities which translate to mitigation than the younger farmers and the vegetables mixes selected by farmers differed depending on whether conditions were dry, medium wet, or wet. The findings in this paper suggested that as precipitation increases or decreases, farmers will shift toward water-loving or drought-tolerant vegetables.

Farmers also responded to reduced soil fertility by implementing vegetables management strategies in addition to their management by organic and inorganic fertilizer application. Common vegetables management strategies were sowing vegetables based on the nutrient status of the soil. Moreover, farmers in all villages employed rotational vegetable sping to restore soil fertility. Few farmers applied manure in nearby fields and the use of compost was wide spread. No fallowing was practiced due to shortage of farm land. Instead, they grew grass pea or chick pea to restore fertility and reduce weed infestation. Similar to studies elsewhere [34], poor households were forced to change their normal food intake and adjusted their consumption during acute drought periods so that they could easily adapt to the resources at hand. This included reduction in variety of food consumed, cut meal size and number, postponement of special functions such as marriage and festivals, reducing expenditures on other household goods and eating inexpensive foods.

Relying on wild fruits and vegetables was a common phenomenon in the study villages. The commonly used wild food types were Opuntia ficus-indica, Caralluma penciliata and Brassica nigra. Moreover, they looked for fruits of Carissa edulis and Ficus vista (in the highlands); Cordia Africana (in the midlands); Ziziphus spina-christi and Diospyros mespliformis (in the lowlands). Food relief provided by the government in the form of food for work was the main drought copping mechanism in all study villages. About 80 percent of the elders reported the use of reserve seeds, past cash savings, and barter exchange with neighbors and relatives. Borrowing food from merchants, purchase food stuff on credit from traders, getting credit from money lenders and participating in small petty trading were other drought copping strategies. Withdrawing children from school was also a common drought copping strategy in the study sites. To reduce school withdrawal, the government in collaboration with the World Food Programme served school children with feeding programme.

Conclusion

Urban Agriculture is no longer a romantic option. It is a necessity to address the climate challenge that humanity is facing. Urban Agriculture has a huge advantage in adopting the newer sustainable technologies that are coming down the pipeline as observed by Jay Salinas of Growing Power. Urban agriculture presents our society with a range of opportunities from waste management to food production in a zero waste cycle. Choices that integrate UA into the fabric of urban landscapes have the potential to deliver resilience in economic, social and environmental terms, to reinforce the local It is critically important that UA be engaged in its many forms where it is appropriate, with the focus on strengthening community based regional agriculture.

With UA we witness a step away from corporate agriculture and a step toward community based regional agriculture. Urban Agriculture is important for its productive acreage but it is more important from the perspective of transforming urban dwellers from being consumers into a community of co-producers. By participating in UA, people can develop a deeper understanding for food and respect for the farmers who dedicate their lives to growing it. By networking with local farms in 150 mile radius cities can become resilient, powerful by being locally adapted to the regional food system. Cities can move towards zero waste goals by using UA to utilize the organic fertility generated by the city. The 'waste' will be captured and kept within the regional system in form of carrying capacity of the region. Urban Agriculture is also an economic and social tool which in very simple ways will provide employment opportunities, opportunities for social networking and working together as a community. It will reduce the carbon footprint of city dwellers and decrease their dependence on fossil fuels. Urban Agriculture is a significant tool that if wielded properly, will help us cope with climate change and food insecurity. While search for that is on, we already have an option to reduce our dependence on fossil fuel, by adapting UA. As Mr. Will Allen of Growing Power said (Miner, 2008), "We have to go back to when people shared things and started taking care of each other, that's the only way we will survive." "What better way than to do it with food?"

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None

Conflict of Interest

None

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