MITIGATION AND ADAPTATION TO CLIMATE CHANGE: The Role of Community Education

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ABSTRACT

Climate Change *may be limited to a specific region, but its prospect is real. It will affect all mankind unless drastic measures to address it are taken. Climate change is an environmental, economic and social issue that affects all sectors of the economy such as agriculture, water resources, irrigation, health, tourism, energy and transport. It is therefore not just an environmental but also a human development issue of our generation.*
The impact of climate change is already widespread in form of great droughts, famines, and floods and countries must develop their citizens' capacities to respond to its effects. It is here that community education can be used to enhance acquisition of basic skills, knowledge and motivation for survival and coping with practical challenges of climate change such as energy crisis, food security and sustainable development.
Community education at various levels of society can therefore contribute sustainably to environmental conservation and management which are important in climate change and mitigation. The paper analyses the causes and effects of climate change and particularly, the contribution of human activities to all this. It suggests specific measures which need to be taken to mitigate the effects of climate change and how com

1. Introduction

Climate change which may be limited to a specific region or occur across the whole earth is the statistical distribution of weather over periods of time that range from decades to millions of years (*http://en.wikipedia.org/wiki/climate change, March, 2009).* Its prospect is real and it will affect all mankind unless drastic measures are taken to address it. Climate change is an environmental, economic and social issue that affects key sectors of the economy such as agriculture, water resources and irrigation, health, tourism, energy, transport and public works (*Michuki, et al, 2009).* It is a defining human development issue of our generation and the way it is dealt with today will have a direct bearing on various development prospects of a large section of humanity, lest, the poorest are consigned to a future of diminished opportunity. Besides posing a huge barrier to a fulfilling future, climate change has become the greatest moral crisis of our time due to a series of disasters such as typhoon, floods and greenhouse gas emissions which have increased mortality. It is therefore not just an environmental problem but also a human rights issue with the potential of 160,000 child deaths in sub-Saharan Africa and S. Asia arising directly from carbon change (*www/bbc/climate change: what price will future generations pay. 23/11/09)*.

In Kenya, the impact of climate change is already seen cities and villages in the form of great droughts, floods and agricultural problems due to the country's low capacity to respond and adapt (*http:// news.co.bbc.co.uk/2/hi/sciences/nature/upload Wikipedia.org).*

According to Jamah (2010), the answer to climate-related problems lies in adoption of environmental-friendly agricultural practices that reduce carbon emissions to the atmosphere. As they trap heat and increase global temperatures, Carbon dioxide and other green-house gases have been blamed for climate change. Agricultural practices are said to contribute to 12% of global emissions due to *destruction of the trees* for charcoal and to create room for farms. This has interfered with air, rainfall patterns and other climatic conditions.

As ***education*** and development are inseparable and mutually supportive processes, participation in education and learning processes by the various communities is therefore a key element in enhancing the acquisition of necessary skills, knowledge and motivation needed for climate change mitigation and other socio-economic development endeavors (Republic of Kenya, 1997).

2. Education as a tool for mitigation and adaptation

Besides strengthening sustainable development, education enables people to improve their social, cultural and economic situation. Being functionally literate facilitates the realization of individual rights and participation. In environment and climate-related issues, environmental knowledge given through community-based educational programmes is the basis for sustainable use of natural resources. Sustainable and economic use of natural resources is also important in poverty reduction.

Psacharopoulos (1985) had also written that development which basically results from the acquisition of fundamental knowledge and understanding of one's *environment*, equalization in the accessibility and distribution of social product is a result of education.

According to Ayodo *et al* (1991), spill-over effects of education in the community include enlightened attitudes leading to appreciation of common problems such as population control, climate change and promotion of healthcare programmes. This neighbourhood effect of education shows that education has measurable influence on the economy's performance. According to Wolfensohn (2000), there is ample evidence to demonstrate that broad-based education is associated with a wide range of indicators of well-being, the nations' increased productivity, and competitiveness, social and political progress.

According to Malassis (1966), it is through education that the principles of community development inform a variety of approaches for an increased production is possible. This fits well with the objectives of adult and community education where the acquisition of relevant knowledge, positive attitudes and skills should facilitate good health, food production, environmental conservation and adaptation of new technologies and production skills

Although development may take place at a price that is detrimental to the very survival of the human race and general biodiversity (Ishumi, 1981), it involves aspirations and actions towards higher level of socio-economic performance. Community education of adults and youths in particular fits in the broad objectives of the education sector interventions (Wagner, 2000) that aim at eradication of hunger, poverty, ignorance including illiteracy and disease which were identified in Kenya at independence as impediments to national development. In community and adult literacy learning, the complexity and rapidity of social and economic changes that dictate the need for a new learning agenda are recognized; that is learning that facilitates the acquisition of competencies that are centred on skills for survival. This includes the restraining effect that education can have on environmental destruction that has resulted into a number of problems including droughts, floods and unpredictable rainfall patterns *(www/bbc/cc).* Here, the Government of Kenya has responded by having ministries that promote environmental education to communities, and a curriculum for the post-literacy learners. Even Non-Governmental Organizations have all been involved in helping to create environmental awareness and appreciation of the need to protect the environment among communities, all of which are aimed at mitigating climate change efforts (DAE, 2000).

Efforts of community-based Kakamega Environmental Education Programme to sensitize local communities through education to conserve Kakamega forest which is on the verge of extinction due to charcoal burning is an example. The locals are encouraged to plant trees and rare butterflies to generate income (Anyuor, 2011). The money got from these economic activities is therefore used to purchase food and other basic necessities for the family. The strategy to mitigate the effects of climate change through the community education programme is founded on the evidence that, those who are educated have made big gains in socio-economic development, thus providing proof of the importance of education (Republic of Kenya, 2003).

According to UNESCO (2006), community education strengthens the capabilities of individuals and communities to access health, educational, political, economic and cultural opportunities and services. It also helps in eradicating poverty, reducing child mortality, curbing population growth, promoting peace and democracy and ensuring sustainable environmental development.

The need for individuals to use their knowledge, skill and competencies to restrain the effects of environmental destruction is especially critical. This is because the existing climate change variability has had significant social and economic cost, as Kenya has over the past years experienced recurrent floods and droughts (Aluang'a, 2009). The increased input, investment and emphasis on adult and community education should therefore lead to drastic local measures being taken to address the effects of climate change (*www/bbc/climate change: what price to pay).*

3. Causes of climate change

Climate forcings that include such process as solar radiation, deviation in the earth's orbit, mountain building and continental drifts and changes in green house gas concentrations are varied and much more complex than are ordinarily known. Some parts of the climate system such as the oceans and the ice caps respond very slowly to climate change because of their large masses unlike the vegetation *(http://en. wikipeedia.org/wiki/climate change).*

Human activities.

Anthropogenic factors that cause climate change are the human activities that change the environment. In some cases, the influences on the climate are direct or less clear.

It is agreed that human activities are very likely to have been the main cause of rapid increase in global average temperatures over the past several decades. This includes the increase in carbon dioxide (CO_2) levels due to emissions from fossil fuel, aerosols and cement manufacture. Others are land use, ozone depletion, animal agriculture and deforestation which all affect climate. The planet's climate is changing and, scientists agree that this is likely to be due to human activities that emit green house gases like power generation, deforestation, transport, agriculture and industry *(Okoth, 2009).*

- ***Release of green house gases***

Major human activities lead to the release of greenhouse gases, particularly carbon dioxide and methane to the atmosphere gases to the atmosphere. These gases form a blanket on planet earth, keeping it about 33^{o}C warmer than it could be without them. Though these gases are important, their excess concentration normally have adverse environmental effects *(Otieno, 2009).*Industrial emissions through the burning of fossil fuels like coal and oil and deforestation are the biggest contributors to the high levels of green house gases in the atmosphere.

- ***Deforestation***

Deforestation caused by logging for timber, charcoal burning and clearing natural forests to give way to plantations causes 15-20% of all green house gas emissions. It is done in the community and accounts for approximately 20% carbon dioxide released into the atmosphere *(Aluang'a, 2009).* Hence, countries that reduce deforestation can reduce green house gas emissions.

- ***Dairy farming***

Dairy or general livestock industry, contributes heavily to the release of methane, which is a green house gas into the atmosphere. Methane is normally released from the animal manure. Also, keeping too many cattle than the carrying capacity also destroys the environment, leaving it bare thus easing degradation.

Cattle rearing in Bondo, Kenya

- ***Burning coal, oils and natural gas***

Burning of coal, oil and natural gas to drive the industry changes the composition of the atmosphere and increases the heat-trapping green house gases like carbon dioxide and methane. This contributes to green house gases that deplete the ozone layer and lead to global warming.

Climate change is therefore principally man-made and is happening faster than earlier assumed according to the International Panel of Climate Change in its 4th Report of climate change. It is therefore the work of educators to impart relevant knowledge to the communities to enable members play a positive role in taking necessary action to conserve the environment.

4. Effects of climate change

Climate change has been seen through change in weather patterns noticed through the following:

a) Irregular rainfall patterns

Irregular rainfall patterns that disrupt planting and harvesting seasons are due to climate change. The occurrence of droughts, floods and unpredictable rainfall patterns have adversely affected biodiversity, plants, habitats, agricultural activities even at local levels. Due to climate change, there is inadequate rainfall in the ASAL. This is a major hindrance to land exploitation, food and cash crop production. The high temperatures also dry up existing ***riverbeds*** and this limits access to drinking water for communities and livestock. Due to these climatic factors, the ecosystem has become fragile with environmental degradation and desertification becoming real and extensive *(Rep. of Kenya, 2009).*

Irregular rainfall patterns have had devastating impact like:

- Drastic ***change*** in vegetative patterns, habitat expansion of crops and species and even to the loss of species.

- ***Extreme climates*** such as severe ***droughts, flooding, heat*** waves and ***snowstorms*** which have been recorded in many parts of the world in 2009. In Kenya, frequency and severity of the weather events were witnessed, particularly in the northern parts *(Orengo, 2009).* According to *Opiyo, (2009),* Kenya also experienced its worst droughts in three years following three successive years of failed rains, leading to massive water and food shortages. Hydrological variability has also led to economic loses occasioned by floods and droughts. The impact of these variables is alteration of wildlife habitats and landscapes. These effects affect wildlife migrations such as wildebeest and birds *(Orengo, 2009).*

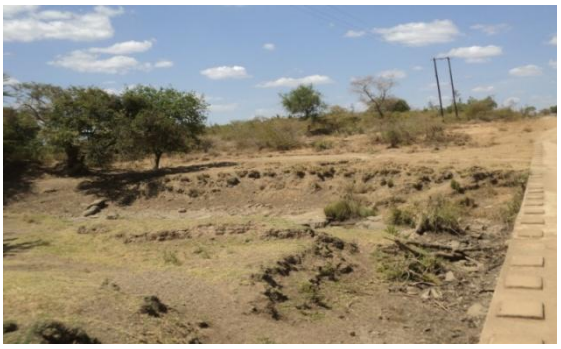
b) Global warming

This is the mother of all development challenges today as the world has to grapple with environmental changes that expose the planet to unmitigated disaster. Global warming transcends geographical and political borders, impacting particularly on poorer nations *(Ng'aru, 2009).* Due to global warming, the year 2009 was ranked as the 5th warmest since the beginning of instrumental climate change recordings in 1850 according to studies by the World Meteorological Organization. This is because above normal temperatures had been recorded, especially in Africa and Asia *(Opiyo, 2009a).*

Global warming has resulted into such unprecedented situations as:

- ***Climate-induced disasters***

The frequent occurrences of extreme events such as ***droughts*** and ***El Niño*** phenomena which is a forebearer of this warming and a signal that global warming is no longer an issue of the future. In Kenya, these have brought the drying up of rivers, untold negative impact on agriculture, the mainstay of the country's economy, leading to famine *(Ng'aru, 2009).*



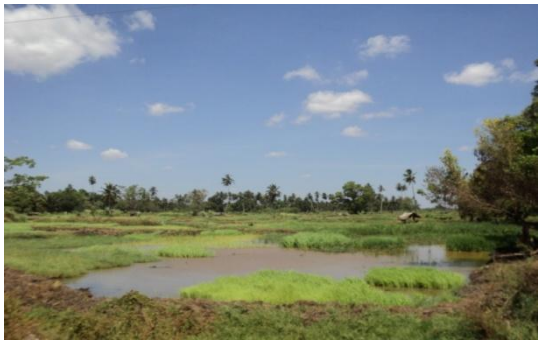
Dried river in Kinango, Kenya.

- ***Rise in sea temperatures***

Due to global warming, there has been a rise in sea temperatures. When this happens, the coral reefs are bleached and this threatens marine life and infrastructure. According to World Meteorological Organization, a moderate ***El Niño*** weather system would bring with it warmer sea temperatures and an increased risk of hurricanes. This has been particularly experienced in Southern USA and Central America where fish life and farms have been destroyed *(Opiyo, 2009b).*

- ***Rise in sea level***

Due to the melting of glaciers and ice cap and a rise in sea temperatures, there has been expansion and rising level of oceans. This leads to ***coastal flooding*** and erosion as well as ***loss of wetlands***. A rise in sea level can submerge cities and even low-lying countries. In the Maldives which is situated across the Equator south west of Sri Lanka and formed of 1,190 coral islands that form an archipelago of 26 natural atolls, the average natural land height is a mere 2.1m (2.3m at highest). A slight rise in sea level can therefore be catastrophic. This would also happen to many other cities such as Rotterdam which is located below the sea level, and even to Mombasa *(Opiyo, 2009b).*



Swamps at Vanga due to rise in sea level

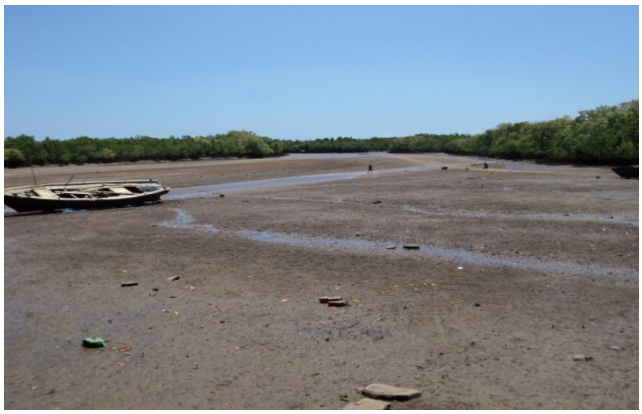
- ***Melting glaciers and ice caps***

In Greenland and Antarctica, ice sheets have lost trillions of tons of ice. Mountain glaciers in Europe, S. America, Asia and Africa are shrinking even faster. In Mt. Kenya, 7/8 glaciers present 20 years ago have all but disappeared now and 4 of the remaining ones have shrunk by about 60-92% of the area of cover. Experts now warn that, around Mt. Kenya where farmers can ***no longer irrigate their crops,*** causing problems even at the Mwea rice scheme due to declining water supply, ice on Mt. Kenya will disappear by 2050 if urgent action is not taken to combat global warming which is basically caused by carbon emissions *(STD, 2009).*

In Tanzania, the total snow coverage on Mt. Kilimanjaro has decreased by 12 sq. km in 1900 to 2 sq.km in 2000. About 85% of total ice coverage had therefore been lost by 2007 and it may disappear altogether by 2020.

- ***Decline in lake water levels***

Due to climate change, global warming and human activities, the levels of L. Victoria have been falling drastically. With receding water levels, acres of land that were lost to the floods of 1960s are being reclaimed, thus creating conflicts between man and wildlife. This has resulted into hippos and crocodiles killing people. The fish population has also drastically reduced. Those who depend on lake water are being forced to go to deep into the lake to draw water, exposing the children and women to waterborne diseases *(Oywa, 2009).*



Decline in water levels, Vanga, Kenya

c) Economic costs

Economic costs associated with climate change and global warming includes the following:

- ***Food shortages***

Sustainable crop production requires judicial use of inputs such as fertilizers. The use of inorganic fertilizers has drastically declined following the energy crisis, hence low crop yield due to deteriorating land productivity *(Maerere, et al, 2001).* Rain-based agro-economy in Africa has almost been brought down to its knees by erratic weather patterns. Also, farmers in some parts of Kenya's Rift Valley and *Ukambani* have experienced ***crop failure***, while livestock continue to die in the pastoral areas *(Opiyo, 2009b).*

- ***Loss due to floods and droughts***

The annual loss from periodic floods and droughts were estimated at $ 0.5bn during the 1997/8 floods which affected 1m people in Kenya. This cost the economy some $ 1.2bn in infrastructure damage, public health effects and ***loss of crops*** *(Aluang'a, 2009).*

Crop failure in Makueni, Kenya

Due to Kenya's vulnerability to extreme weather events, especially during the 1997/8 floods followed by 1998-2000 droughts, the economy lost some $ 4.8bn. A weather shock of this magnitude is a severe challenge to the capacity of the government and private sector to maintain economic growth *(Michuki, et al, 2009).*

Animal deaths due to extreme droughts in Turkana, Kenya

Scientific evidence gathered by the University of Nairobi and the UNDP also links water shortages, energy crisis and famine to climate change *(Orengo, 2009).*

- ***Diseases***

Our children and those yet to be born deserve to live in a world that is healthier, more equitable and which offers sustainable future. However, climate change has had big implications to the livelihood system of the local communities, the poor and marginalized groups, with women and children being more vulnerable. With several thousand children daily dying from waterborne diseases and increasing uncertainties about the link between carbon and climate change, people are exposed to waterborne diseases like typhoid, malaria, cholera and diarrhoea *(www/bbc/climate change: what price to pay. 23/11/09).* Also, while climate change may not resonate largely with the average person to warrant an urgent action, the loss of snowcaps on Mt. Kenya due to climate change has allowed diseases like malaria that used to be restricted to hot and humid climates to be common now in high altitude areas like Nairobi, Central Kenya. This has resulted into *highland* malaria affecting even other non-malaria zones like Uasin Gishu and Gusii highlands *(Okulo, 2009)* as the areas where the climate did not favour the breeding of mosquitoes are getting warmer and ideal for malaria that invariably affect the farming communities in these agriculturally-rich areas. Climate change therefore encourages the breeding of mosquitoes and shortens their gonadotrophic cycle, so they take shorter time to produce eggs.

- ***Insecurity***

Climate change has invariably resulted into loss of resources that used to support livelihoods. Due to dwindling resources such as water, land and pasture, there have been raising cases of insecurity due to intercommunity conflicts over the diminishing resources. Where there are conflicts like happens regularly in the rift valley, food production is often reduced. Also, as climate change have led to food and water shortages, and there are bound to be more wars and conflicts between communities as some have already predicted that the next wars will be fought over water *(www/bbc/climate change. 23.11.09).*

5. Mitigation and adaptation

Climate change is already happening and it represents one of the greatest environmental, social and economic threats to the very survival of humanity. *Farmers need to adapt climate-friendly farming although farming emits 15-30% of greenhouse gases. Farmers can therefore be helped to cut carbon emissions if through education, they get knowledge and skills and actually use practices that increase yields especially in degraded areas and protect crops from extreme weather. These include tilling less and applying manure and crop waste (Campbell, 2010).*

Mitigation and adaptation can best be done through:

a) Policies

Policies must exist for increased reliance on renewable energy sources. However, despite attempts for increased use of renewable energy technologies in a policy vacuum, successful stories have been few *(Hankins, 1991),* hence continued rampant environmental degradation. Policies will give the environment agenda renewed relevance and promote initiatives that effectively arrest environmental degradation, while promoting social and economic development that rely heavily on environmental resources which need to be exploited sustainably *(Michuki, et al, 2009).* In Kenya, to adapt and mitigate climate change, the government has been working towards developing a comprehensive climate change policy and a full-budgeted national climate change response investment. This policy will among others make it mandatory for housing developers to fit new houses with solar heating systems to scale up renewable energy use especially in towns.

This will help to reduce the demand for electricity from the national grid *(Senelwa, 2009).* Such a document can be used by educators in institutions, groups, societies and public places to educate citizens on climate change mitigation and adaptation.

b) Awareness Creation

To ensure that the citizens are aware of the impact of climate change and the consequences of their activities on the environment and its contribution to global warming, definite measures have to be taken to raise their awareness through educational programmes, seminars, groups, *barazas* and workshops and dissemination of banners, posters and brochures to enable them do the following:

- ***Promote afforestation***

One of the bold prescriptions for mitigating climate change is that every person who owns land be encouraged to put up to 10% of it under trees. This can best be done with policies supported by action campaigns and groups where individuals are encouraged to also start tree nurseries. Trees have to be planted to combat climate change.

Mangrove forest at Vanga, Kenya

The Kenya Wildlife Services is already promoting alternatives to forest-derived fuel and fodder for animals. It is also promoting non-destructive Income-Generating Activities (IGAs) such as ***bee*** keeping, ***silkworm*** rearing and planting of ***medicinal plants*** *(Obala & Okwayo 2009)*.There has also to be clear attempts to recover formerly forested areas that have been lost due to logging, charcoal burning and poor farming practices. This is because agriculture in developing countries is often associated with massive deforestation as farmers often clear forests to create farmlands. Agro-forestry presents an opportunity for carbon sequestration that will reduce global warming. It therefore helps to improve forest management *(Oywa, 2009).*

- ***Change in lifestyle***

For real change to happen, people have to change their lifestyles. The communities need to be trained to ***recycle,*** reduce consumption of energy and conserve trees. Curbing pollution and better wastes management would lessen the impact of climate change *(Ayodo, 2009).*

- ***Mobilizing stakeholders***

To effectively combat climate change, stakeholders have to be mobilized to invest in climate change mitigation and adaptation measures. The drivers of the economy- the women, have to be used through specially formed interest groups as models to teach others that poverty and famine can be overcome with a bit of innovation *(Ombuor, 2009)*.

c) Limiting green house gas emissions

High concentration of green house gases such as ***methane, carbon dioxide, Nitrous Oxide*** and ***fluorocarbons*** in the atmosphere form a blanket on planet earth, keeping it 33oC warmer. The excess concentration of these gases therefore has adverse effects on the environment. Limiting global warning at 2oC would help to avoid dangerous change. This means no more than an estimated 1,300bn tons of CO2 emissions *(Opiyo, 2009b)*

In the USA, to limit methane emission, the farmers in the dairy industry are trained and encouraged to capture methane gas from cow manure by using an anaerobic digester to convert ***cow manure to electricity***. This prevents methane from being released into the atmosphere *(Oywa, 2009).*

d) Using eco-friendly technology

With human activities known to impact on global warming and climate change, certain measures have to be employed to reduce the emission of green house gases into the atmosphere. These include:

- ***Using green energy***

Green energy refers to low-carbon option sources of energy that are eco-friendly such as ***biomass, wind*** and hydro-thermal power *(Ayodo, 2009).* With droughts and receding water levels leading to irregular supply of electricity, green energy is the alternative that is both eco-friendly and cheaper. It is the answer to African governments to better achieve sustainable development *(Otieno, 2009).*

- ***Solar***

As petroleum and electricity demand rises in homes, schools and cottage industries to power light, TVs, vaccine refrigerators and small appliances, solar electricity is a realistic alternative to costly extensions of grid power or generators *(Hankins, 1991).* Solar lantern is cheap to maintain and can save about 10-30% of household incomes spent on hazardous and low quality fuel-based lighting products that emit green house gases. Solar lighting provides quality, affordable and safe lighting to the people living in areas not connected to the electric grid. It can also be used to charge mobile phones and torches *(Mugambi, 2009).*

e) Sustainable agriculture

In Kenya, ¾ of the land is semi-arid and the climate is becoming hotter. Necessary action must be taken to train the populations to cope with climatic changes that have already happened. Appropriate technologies have to be adopted by citizens while making use of the most traditional knowledge and practices and diversifying their livelihood to cope with emerging climate change-related issues and its implications *(Michuki, et al, 2009).*

To mitigate climate change through sustainable agriculture, the following can be utilized:

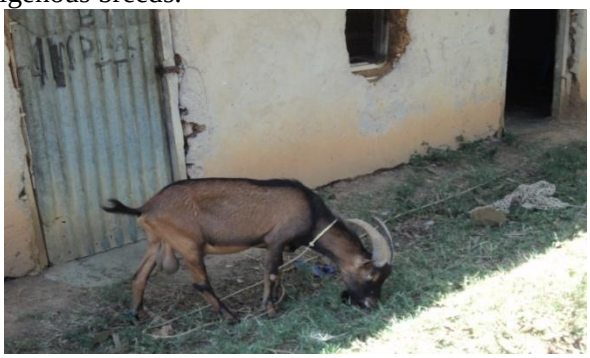
- ***Organic agriculture***

Sustainable crop production requires judicial use of inputs. As the use of inorganic fertilizers has drastically declined due to energy crisis, the ***organic, especially animal manure*** has to be promoted. This helps to increase microbial activities, hence increased soil fertility. Poultry manure, followed by goat manure then dairy cow manures increase taproot growth and dry root weight. They significantly increase ***crop yield*** and soil properties due to increased availability of N and P (Maerere *et al,* 2001). This may be undertaken by organizing communities to make study visits to successful farmers who are already using these modern methods.

- ***Sustainable animal production***

In response to climate change, communities will find it difficult to keep their livestock as a harsher climate will reduce the amount of water and pasture available. They will therefore try to keep fewer high grade animals that they are able to cater for. Farmers may have to be encouraged to try to keep hardy varieties or species of livestock that are somewhat drought-resistant. These may include ***camels*** or ***goats*** *(Walubengo 2009).*

Hybrid male goats may also be kept to help improve the local herds into bigger and healthier animals that fetch more when sold than indigenous breeds.



Grade goats in Magombe, Bondo

Goats also give ***milk*** which help to improve the health of families as goat milk is more nutritious and has medicinal value *(Ombuor, 2009).* Goat keeping is therefore a contingency measure to cushion against drought and food insecurity.

- ***Sustainable crop production***

The key to coping with climate change is to invest in sustainable agriculture to raise productivity. This also helps in diversifying the economy to create employment opportunities. In Kenya, official statistics indicate that some 10m people were facing food shortages in 2009 due to drought that occasioned massive crop failures in 2008 and 2009 *(Opiyo, 2009b).*

To ensure sustainable agriculture, the farmers have to given necessary skills to enable them:

- prevent soil degradation that is a significant problem that limits agricultural productivity and
- use early maturing and drought-resistant crops like cassava which do not need large quantities of water.

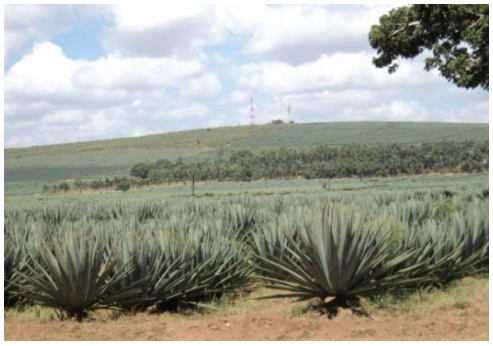
Cassava farm in Teso, Kenya

Sustainable crop production also involves the use of ***innovative irrigation*** and other appropriate farming systems.

- ***Aloe farming***

In drier areas, besides engaging in crop farming, the growing of vegetables and fruits, farmers can also grow ***Aloe vera*** which is used for manufacturing medicated soap, detergents, hair conditioners, body lotions and other products in a micro-industry.

Aloe farming in Baringo

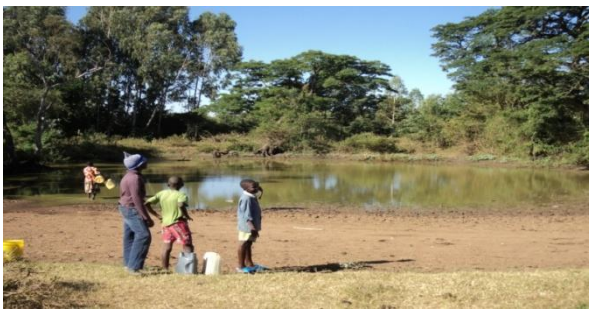


Sisal farming at REA Vipingo, Kenya

Other products that farmers may be encouraged to grow include gum Arabic and bio-diesel or *Jatropha (Ombuor 2009).* Farmers may also plant sisal to fetch them money to buy food.

g) Water harvesting

Global warming is taking a toll on water bodies and sources. Sustainable water ***management*** and ***harvesting*** is therefore a key mitigating factor. Quality clean water is a basic necessity, which enhances the quality of living by curbing water-borne diseases. Water for domestic use can be harvested by digging or constructing pans or building sand dams on seasonal rivers to use for ***watering livestock*** and even for domestic use or irrigation *(STD, 2009a).* Rainwater may also be harvested using various sizes or types of containers. The rain water is especially clean and good for domestic use.



Dried pond in Bondo

6. Importance of community education in mitigating climate change

According to UNESCO (1997), education confers a wide range of benefits such as human, social, cultural and economic returns to individuals, families, community and the country. It is also a fundamental requirement if individuals are to develop their full potential, and if societies are to progress purposely and progressively.

Getting educated implies much more than merely dealing with the problem of ignorance. It involves the acquisition of basic skills, knowledge, values and attitudes that should lead to fostering coping, survival and even environmental conservation skills, use of modern technologies and empowerment of the whole society. Getting basic skills is therefore the prerequisite for further development and to ensure that individuals function fully and effectively in their various roles. Basic education in the community provides life-skills beyond the ability to read and write as people need to meet requirements of daily life. Acquiring functional knowledge and skills is therefore an effective measure of an individual's capacity to cope with the practical challenge of a given environment (*UNESCO, 2004).* In filling this broad mandate of education means raising incomes, investing in improving health, building sustainable agriculture for improved food production, empowering local communities to preserve natural resources and generally placing the people at the centre of their environment and providing the means for them to effectively participate in community life (UNESCO, 1995).

In an evaluation commissioned by the World Bank in Uganda in 1999, it was found that even the mere literacy programme had equipped the learners with practical knowledge, especially in areas of agriculture, crop and animal husbandry and artifacts. Other benefits included adoption of better health practices especially through better personal and improved sanitation, environmental conservation and better agricultural practices. Technologically, functional education should help to infuse scientific and technological culture into society if we have to cope with changes in areas like climate change, environment, energy resources, food security and sustainable development. It should help citizens to apply the knowledge and skills acquired to the general purpose of fulfilling specific needs. Further, it should provide elementary knowledge, skills and motivation essential for people to participate in the solution and anticipation of environmental problems and make their own contribution to sustainable development and economic growth (World Bank, 1980).

According to *Ayodo et al* (1991), the positive relationship between education and socio-economic development makes investment incurred in education justified. This is particularly so with the role it plays in the improvement of the quality of life of the people, hence the concern of T.W. Schultz with the investment in human beings in the form of education and how the stock of human capital is reflected in the returns to growth in national income. Investment in human capital should lead to greater rate of return and should contribute substantially to environmental conservation and management, which are important in climate change mitigation and adaptation as well as in food production. Training and education is considered to be the transfer of technical skills and knowledge and it is a common activity in all development projects. According to Verma and Acharyan (1996), education should contribute to creative and critical thinking and generation of understanding and awareness. It should be participatory and based on value premise and lead to intervention where people participate in rebuilding their own future, in this case by producing enough food for their families. The beneficiaries of education should relate their learning to the needs of their societies and use the knowledge to improve their lot through practical development abilities like sustainable agriculture.

REFERENCES

Anyuor, N. (2011). "Group basks in global glory over conservation". *The Standard*, 29.1.2011. p.24.

Ayodo, H. (2009). "Students add their voice to climate change". *The Standard.* 11th Dec. 2009. Pg. 38.

Ayodo, T.M.O., Gatimu, K. & Gravenir, F.Q. (1991). *Economics of education.* Nairobi: Nairobi University Press.

Campbell, B. (2010). Farming must wait in line at stalled talks. Seminar paper at Cancun. Climate conference, Mexico. *The Standard. Dec. 7.2010. pg.20.*

DAE (2000). *Kenya post-literacy project: Post literacy curriculum.* Nairobi: DAE.

Hankins, M. (1991). *Small solar electric system in Africa: A guide for planning and installing solar lighting systems in rural Africa*. Nairobi: UNESCO. http://en.wikipedia.org/wiki/climate *change*. March, 2009.

Ishumi, A.G.M. (1981). *Community education and development: A study in the problems of harnessing community education and development among rural and peri-urban communities in Tanzania.* Nairobi: Kenya Literature Bureau.

Jamah, A. (2010). World Bank gives Kshs. 28m for conservation. *The Standard. Dec.6.2010. p.10*

Maerere, A.P., Kimbi, G.G & Nonga, D.L.M (2001). "*African Journal of Science and Technology'.* ISSN No.1607-9949. Vol.1 No.4 Jan. 2001. Nairobi: UNESCO.

Malassis, L. (1966). *Economic development and the programming of rural development*. Paris: UNESCO.

Michuki, J.N., Lenayapa, L.N. & Chuma , A. (2009). "Scaling up to meet the climate change challenges". *The Standard.* 27th Oct. 2009. P……

Mugambi, K. (2009). Solar Lanterns set for mass roll-out in Rural areas. *The Standard.* 17th Nov. 2009. P…

Ng'aru, I. (2009). "Climate change to shift competitiveness. *The Standard.* 17th Nov. 2009. p.19.

Obala, R. & Okwayo, J. (2009). Echoes of Mau complex rattle Western Kenya. The *Standard.* 10th Dec. 2009. p. 18.

Okoth, D. (2009). Governments have one last chance for deal on global warming.*The Standard:* 23rd Nov. 2009. p.15.

Okulo, A. (2009). Action needed right now. *Daily Nation.* 2nd Dec. 2009. p.13.

Ombuor, J. (2009b). Warmer climate gives malaria new hunting ground. *The Standard.* 10th Dec. 2009. p. 21.

Ombuor, J. (2009a). Turning to bees and goats to fight drought effects. *The Standard.*23th Nov.2009. p. 15.

Opiyo, D. (2009b). 2009 the 5th Warmest Year Ever. *Daily Nation.* 10th Dec. 2009. p.6.(2009). Africa bears brunt of climate change as snow on key mountainsmelts away. *Daily Nation.* 7.12.2009. p.4-5.

Orengo, P. (2009). Economy at risk of climate change. *The Standard*. 10th Dec. 2009. p.10.

Otieno, S. (2009). Politics stealing the show at global warming summit. *Daily Nation.*10th Dec. 2009. p.13.

Oywa, J. (2009). Sharp decline in lake water level. *The Standard.* 17th Dec. 2009. p. 11-27.

Psacharopoulos, G. & Woodhall, M. (1985). *Education for development: An analysis of investmentchoices.* New York: Oxford University Press.

Republic of Kenya (2009). "*Report on the One Kenya One Dream: The Kenya We Want Conference",* 4th-6th Feb.2009. Nairobi.(2003). *Economic recovery strategy for wealth and employment creation 2003-2007.* Nairobi: Ministry of Planning.

Republic of Kenya (1997). *National Development Plan. 1997-2001*. Nairobi: Government Printer.

Senelwa, K.(2009). Fitting new Houses with Solar heating to be Mandatory. *Daily Nation.* 10th Dec. 2009. p.30.

The Standard (2009). Global warming's Impact worsened since Kyoto. *The Standard.* 24th Nov. 2009. p 31.

UNESCO (2005). *Literacy for life: EFA Global Monitoring Report 2006.* Paris: UNESCO._(2004). *The Literacy decade: Getting started: UN Literacy Decade 2003- 2012.* Paris: UNESCO. (1995). The EfA teacher training package Vol.2. United Kingdom: UNESCO. (1997). *Adult Education. The Hamburg declaration: The agenda for the future. Hamburg:* UNESCO.

Wagner, D.A. (2000). Literacy and adult education: an Executive Summary. *Adult Education and Development.* Issue No. 55. Bonn: IIZ/DVV. Pp. 129-139.

Walubengo, D. (2009). Impact of climate change in Kenya's dry lands. *The Standard,*11th Dec. 2009. p.46.

Wolfensohn, J.D. (2000).A time for action: Planning education at the core of development. *Adult Education and Development.* Issue 55. Bonn: IIZ/DVV. pp. 67-92.

World Bank (1980). *Education: Sector policy paper.* Washington. D.C: World Bank.

www/bbc/climate change: what price will future generations pay?. 23rd Nov. 2009.