joto afrika
adapting to climate change in Africa

Issue 10 November 2011

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About Joto Afrika
Joto Afrika is a series of printed briefings and online resources about adapting to climate change in sub-Saharan Africa. The series helps people understand the issues, constraints and opportunities that poor people face in adapting to climate change and escaping poverty.

Joto Afrika is Swahili; it can be loosely translated to mean 'Africa is feeling the heat'. Please tell us what you think about this issue of *Joto Afrika* and what you would like to read about in future issues. Contact details are on **page 8**.

Kabete youth group members working in their kitchen garden in Kenya © ALIN/Tony Kimathi, 2011

Climate-smart agriculture for food security in Africa

Editorial

Agriculture in developing countries must change significantly to meet the related challenges of food security and climate change. In Africa, there are numerous proven, low-cost, climate-smart agricultural innovations that smallholders can adopt. But the potential for these to play a significant role in increasing the climate resilience of food production systems has largely not yet been realised.

Climate change and variability are likely to severely compromise agricultural production and food security in many African countries. Yields could fall by up to 50% by 2020, while net revenues from crops could drop by as much as 90% by 2100. Small-scale farmers will be most affected.

There are growing calls from leading agricultural science and policy institutions for 'climate-smart' agriculture – agriculture that sustainably increases productivity, enhances resilience to climate change, reduces emissions, and enhances achievement of national food security and development goals.

Agricultural technology is traditionally transferred by National Agricultural Research Systems (NARS), with an emphasis on public sector research and extension and educational organisations generating and disseminating new technologies. This model has made significant contributions, but is now challenged by the changing and increasingly globalised context in which sub-Saharan African agriculture is evolving. Africa's vulnerable farmers and pastoralists need a more flexible and inclusive model for developing and transferring environmentally-sound agricultural technologies.

Expanding the range of innovations available for climate risk management is imperative. This edition of ***Joto Afrika***, using Kenya as a case study, identifies some of the prerequisites for developing and diffusing climate-smart agriculture to improve food security.

Cecilia M. Kibe's article about a cassava project demonstrates an agricultural innovations system in which people participate to develop climate-risk management strategies. The community groups that form the Mutomo Cassava Production and Processing Association (MUKAPA) are researchers in their own right, working with the non-governmental organisation Revitalization of Indigenous Initiatives for Community Development (RINCOD) and researchers at the Kenya Agriculture Research Institute (KARI) to develop adaptation strategies.

John Wanjii's article describes alternative indigenous fodder options, such as acacia pods and tubers, which are harvested and preserved for use during droughts. This demonstrates the significance of building on local – and indigenous – knowledge in developing sustainable adaptation strategies.

Most projects end at the pilot stage and do not go full scale, lacking funds to propel them forwards. There is a need to identify bankable projects for scaling up; the example of how the Kyatune Women's Group in Mutomo District worked with the Equity Bank to increase access to greenhouse and drip irrigation technologies is an example of how to design sustainable, climate-smart projects.

Several articles highlight the significance of farmers' groups. These provide an institutional framework through which capacity building and communication can be delivered. And farmers' groups can help to make research more relevant to the needs of small-scale farmers, increase the efficiency of technology development and dissemination, and widen the adoption of agricultural technologies by resource-poor farmers.

Recommendations

- The public sector needs to help agricultural innovation systems to form and thrive, remove barriers for farmers trying to supply commodity markets, and improve access to agricultural resources in rural areas.
- NARS should promote participatory action research and work with communities and extension workers.
- Communities should embrace this participation through farmer research groups, and gathering and documenting traditional knowledge on adaptation technologies.

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Farmers integrate greenhouses agriculture

Women farmers in Mutomo tend their tomatoes in a greenhouse © ALIN, 2011

Innovative farmers are increasingly using greenhouse agriculture to increase food production. In some cases they integrate this practice with drip irrigation to use their limited water supplies efficiently. Growing crops in controlled conditions allows farmers to increase crop yields while using less land, and harvest throughout the year in dry and wet weather conditions.

Greenhouse agriculture and drip irrigation are examples of climate-smart agricultural innovations that will be increasingly necessary as the effects of climate change take hold in Kenya and elsewhere in Africa.

In Kyatune, Mutomo District, 25 women have formed an agricultural group to farm using both greenhouse and a drip irrigation system. The group received funding from GOAL, an Irish humanitarian agency, and set up a greenhouse to grow tomatoes on land owned by one member. "We used to grow vegetables on our own land, but in the open they use much more water because the sun evaporates most of it," explains Ms Christine Mumbe Ndisii, a group member. "We have not had good rains here for two years, so needed to find a method that used less water."

Greenhouse cultivation

Yields of fruits and vegetable crops can increase up to four times if grown in a controlled greenhouse environment, in comparison to rain-fed fields. And drip irrigation, which only releases drips of water, allows farmers to use only one-third the amount of water needed for crops grown in fields. The plants also grow quicker under greenhouse conditions.

Before planting in a greenhouse, farmers should consult agronomists or soil experts about the type of soil and which crop to plant. The water must be tested so the farmer may clear it of any organisms that can negatively affect the crop.

The system has to be installed properly, otherwise leaks and water loss can occur and lead to crop failure; the crops will suffer from this and may die. The pipes connecting the tank to the plants can get clogged with residues from unclean water due to the filtration process, so maintenance is essential.

Can the practice be replicated?

Droughts and floods are predicted to increase in East Africa. Greenhouse technology can help protect crops from these extreme events. The main issue preventing farmers from adopting the technology is the initial cost of buying and constructing greenhouse and drip irrigation systems; the cheapest kits cost around Ksh 150,000 (US $150).

In Kenya, the Equity Bank and the company Amiran Kenya established a partnership to help small-scale farmers obtain loans to buy greenhouse kits from Amiran Kenya. As a result, the technology has been widely adopted in many parts of Kenya, both by individual farmers and farmers' groups. Other regions will need to set up similar systems to provide farmers with loans.

Farmers in Tanzania and Uganda have also started to use greenhouse technology. In Uganda, the technology is being promoted by the Nile Fresh Produce company in partnership with Israeli and South Korean firms, aiming to produce vegetables for export.

Recommendations

Research and extension have a key role to play in facilitating adaptation to climate change in the agricultural sector. With significant investment to provide poor farmers with start-up capital, integrated greenhouse and drip irrigation systems could help many farmers in East Africa increase their production. Designing bankable projects is key to attracting finance from community development banks and micro finance organisations to help poor farmers with initial costs.

- Governments can create the enabling legal and policy environments for private sector financing of these projects to encourage scale up from pilot projects to wider adoption.
- The set-up and installation of a greenhouse and drip irrigation is very technical; governments, entrepreneurs and non-governmental organisations must train farmers and disseminate information on how to construct these systems.
- Sharing technology and finances among communities can provide more people with access to greenhouse technology, as they are more able to invest in materials.

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See also

Amiran Kenya Ltd
http://bit.ly/ppZXXR

Kenya Horticultural Development Programme
http://bit.ly/piuNHh

Contribute to Joto Afrika

Do you want to tell people about how your community is adapting to climate change? Are you involved in a programme, project or research that is helping people to find practical ways to cope with the effects of climate change? We want your contributions for Joto Afrika – especially contributors from regions beyond East Africa.

We are looking for research work, community case studies, videos, audio clips and photo essays about climate change adaptation across sub-Saharan Africa. The case studies need to be short (no more than 500 words), easy to understand, and provide practical information for other people facing these problems. If you would like to contribute, please contact the editor at **jotoafrica@alin.net.** We welcome contributions in French and English.

Water harvesting from Kaseva rock catchment

Women harvest water from Kaseva rock catchment in Mutomo, Kenya © ALIN/Noah Lusaka, 2011

In Kenya's arid and semi-arid areas, it is vital to collect water during the rainy seasons in order to have enough for dry periods. With projected increases in water insecurity from long-term climate change, water harvesting will become even more critical for enhancing the resilience of vulnerable communities to climate stress. One way to harvest water is to collect rainwater running off rock outcrops.

Water can be harvested from rocks by channelling it using gutters made of small rocks attached to the outcrop. The water is then piped into storage tanks, from where community members collect it. These rock catchment systems are often owned, maintained and managed by self-help groups.

Rock catchments are extremely efficient. Even with as little as 500 mm of rainfall a year, a rock catchment with an area of 10,000m^2 can yield 5,000m^3 of water. This is enough to fill 250,000 jerry cans each year – supplying water for 130 families for more than six months during dry periods.

Rainwater harvesting from Kaseva rocks

The Kaseva Water Point Project (KWPP) harvests a rock catchment in Mutomo District, in Kenya's Eastern Region. The catchment provides up to 5,100 m^3 of water per year. KWPP members pay a membership fee of Ksh 100 (US$ 1) and contribute labour to maintain the rock gutters on the outcrop. The water collected is sold at very low rates – Ksh 5 (US$ 0.05) per 20 litres – to generate money for maintenance. Members get the water at a lower price than non-members – Ksh 2 (US$ 0.02) per 20 litres. But this is not enough to pay all maintenance costs, meaning some storage tanks are not well maintained.

The first rock catchment system in Kaseva was built in 1956, and the collection tanks had a storage capacity of 3,000m^3. In 1989, these were enlarged to 5,000m^3. In 2007, two tanks with a capacity of 50m^3 each were added, with funding from Danida. "But this is still not enough to harvest all the water running off the rock during rainy periods," says Mr Julius M. Musauli, secretary of the KWPP. "We have plans for expansion, but we lack finances."

What are the challenges?

The Kaseva rock catchment is a good example of the effectiveness of these rainwater harvesting projects; since 1956, it has only dried up five times. There are a further 120 rock catchment systems in Mutomo District alone, suggesting the technique could be developed in other dry regions.

See also

Water for Arid Lands
http://bit.ly/oEDYDC

Water from rock outcrops: a handbook for engineers and technicians on site investigations, designs, construction and maintenance of rock catchment tanks and dams, Erik Nissen-Petersen, Danish International Development Agency (Danida), 2006
http://bit.ly/rmECDS

Kenyan Ministry of Water
www.water.go.ke

There are challenges, though. Due to the exposed surfaces in the rock gutters, a lot of the water that falls on the outcrop is lost through evaporation – up to 50%. Roofing the dams and more water tanks can reduce evaporation, but these are expensive solutions and the project lacks funding and government support.

The open water in the tanks is also a breeding ground for the *Anopheles* mosquitoes that transmit malaria. Introducing fingerlings to the tanks can fight this, as they eat the eggs and larvae. The fish can also be harvested.

Recommendations

To make rainwater harvesting from rock catchments more sustainable, there is need to include support for initiatives in Kenya's National Integrated Water Resources Management Strategy.

- Kenya's Ministry of Water and Irrigation, and the Water Services Boards, should support the construction and maintenance of rock catchments. These should be part of Kenya's Climate Change Response Strategy 2010, as they are an effective way of ensuring access to water and reducing the distance needed to collect it.
- Community ownership of rock catchments helps to ensure their acceptance and preservation. To manage rock catchments effectively, communities need statistics on how much water is sold and how much income generated. This allows them to plan for times when rainfall is predicted to be even more unreliable.

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You can subscribe by sending an email to **jotoafrica@alin.net**.

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Cassava: a reliable crop amid climate variability

Cassava fields in Mutomo, Kenya © ALIN/Rhoda Musili, 2011

Many people in Kenya grow their own food, selling their surplus to earn money. But in arid and semi-arid areas, seasonal rainfall patterns result in water scarcity during dry periods. This can leave communities dependent on emergency food relief.

After the severe drought in 2008/09, many farmers reverted to traditional crops such as cassava, millet and sweet potatoes. These crops take little time to mature and can sustain families during long droughts.

Cassava, which is high in carbohydrates, feeds many families. It is very versatile; the root can be eaten raw or cooked, milled into flour for *Ugali* and bread, or processed into chips. And the leaves can also be eaten, providing proteins, vitamins A and B and other minerals. Cassava can grow in low nutrient soils because of its massive leaf production; the leaves drop to the ground, forming organic matter and recycling soil nutrients. It also uses less water than maize.

Farming cassava in Mutomo

Rainfall in Mutomo, Eastern Kenya, has been scarce over the last few years. Under these conditions, maize – the primary crop – failed and left many families without food or income.

The organisation Revitalization of Indigenous Initiatives for Community Development (RINCOD) carried out needs assessments in 2009. During these, community groups agreed to start the Mutomo Cassava Production and Processing Association (MUKAPA). The project involves more than 100 households and has established high-yielding, disease- and drought-resistant cassava varieties developed by the Kenya Agricultural Research Institute (KARI). These have several benefits:

- The new varieties yield over 20 tonnes per acre, twice the yield of other varieties.
- The roots can be left in the soils for up to 24 months, so they can be harvested all year round.

Cassava farming has been replicated widely; for example, over 300,000 households now grow improved cassava in Western Kenya. Fresh cassava tubers and processed cassava products are now available in local and urban markets in the region.

What are the challenges?

- Cassava has the stigma of being a 'poor man's food' in Eastern Africa. However, this view seems to be gradually changing as its advantages over maize become known more widely.
- Cassava has a short shelf-life once harvested. To make it marketable, it has to be processed to last for longer period. This requires investment in processing plants such as solar drying and grinding machines; these are already adding value in some areas.
- Cassava plantations can be affected by cassava mosaic disease – a seed-borne viral disease which is not treatable. This can be avoided through using clean planting materials certified by research institutions.
- Cassava contains cyanide and, if prepared poorly, can cause cyanide poisoning. The new varieties developed by KARI have lower cyanide levels than previous varieties, reducing this risk considerably.

Recommendations

The extraordinary hardiness and drought tolerance of the new cassava varieties make them a reliable crop, even with rising temperatures and an ever-drier climate. MUKAPA's experience shows cassava has huge potential to enhance food security, especially if scaled-up to reach Kenya's very dry areas. To achieve this will require several actions:

- The Kenyan government should introduce policies to support post-harvest technologies, capable of processing large quantities of cassava; this will need funding facilities and financial incentives for cassava enterprises to develop.
- It should also establish a legal framework that allows farmers to buy and use land for large-scale cassava farming.
- Farmers need access to both new and proven technologies for efficient cassava production, processing and use. These include using disease-resistant varieties and value-adding technologies such as grinding cassava into chips or flour; capacity building programmes to enhance expertise in enterprise management; and training in the skills required to develop cassava-based agro-industries.
- Reliable market information systems will improve market access opportunities for cassava farmers, increasing their incomes and people's access to cassava during hard times.

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Wikwatyo wa Kandae

Mrs Ruth Ntheeu is a member of *Wikwatyo wa Kandae*, one of MUKAPA's founding groups. In 2009, she planted her first cassava cuttings; after six months, she had her first harvest. "There isn't water here to grow maize; the rain usually stops before the maize flowers and then it fails. But cassava needs very little water," says Ruth. "Even if the cassava fails, at least you have the seeds to grow new plants, not like with maize, where you are left with nothing." Ruth sells some of the roots for Ksh 60/kg (US$ 0.60) and processes some at the MUKAPA processing centre. She has earned more than Ksh 20,000 (US$ 20) from selling her cuttings.

See also

Kenya Arid and Semi Arid Lands programme
http://bit.ly/nR3zBX

RINCOD: enhancing food security
http://bit.ly/r4TMdV

KARI Katumani brochures, including some on cassava
http://bit.ly/p9g3hP

A farmer's action to combat climate change

Cereals and vegetables dried in Francis Kiarahu's solar dryer © ALIN/Mwangi Mumero, 2011

Francis Kiarahu, a 64-year-old smallholder farmer, has lived through many droughts in his 34 years in Laikipia County in Kenya's Rift Valley. But through a range of new and varied farming techniques Francis has managed to be self-sufficient during dry periods, when many are reliant on food aid. His actions demonstrate how resourceful farmers are finding ways to cope and sometimes thrive in the harsh climate of semi-arid regions. Responding to climate change will require building on the innovative efforts of farmers like Francis.

Laikipia, a semi-arid region in northern Kenya, experiences regular droughts that have led to crop failure and livestock deaths. "We experience drought every three to four years," observes Francis. "This leaves many households poor and in need of relief food." This increasingly dire situation has led to inter-ethnic conflicts within farming and pastoralist communities, with many murders during cattle raids.

The main challenges for farmers are the lack of an adequate water supply, poor farming methods and, in some areas, low soil fertility. As one of the most experienced smallholder farmers in the region, Francis has adopted several ways of coping with climate stress.

Solar food dryers
Francis developed a way of drying vegetables and cereals and packaging them for use when food is scarce. Using a homemade drier, he can dry kale and amaranthus leaves, as well as sorghum, millet and cassava. "When my donkey died, I had to make good use of the donkey cart. I thought it was wise to use the cart as a solar drier, so I bought additional materials like wire mesh, a plastic bag, paper and some timber and converted it into a drier,'' he says.

While this drying technology is effective, it is labour intensive, as farmers have to peel and dry the vegetables and then package them. And home-based grinding machines are often unavailable due to the cost of these, making the process more manual (as grinding must be done by hand) and less profitable.

Recommendations
Kenya's Ministry of Agriculture should map innovations by smallholder farmers like Francis, to identify those which can be replicated through its extension services.

- Modelling and testing different solar dryers can improve their performance. More work is needed regarding the drying characteristics of common foods; the best system components; and the best overall drying systems.
- Further research should be conducted on sustainability and the contribution of dryers to food security.

Surface run-off water harvesting
Francis harvests surface run-off on his farm and stores it in a rectangular underground pit measuring 9 metres by 8 metres with a depth of 6 metres. In order to harvest the water, he has dug a series of tunnels to direct water from the nearby road to his farm, through which it flows by gravity to the pit. "When full, the pit can sustain my irrigation water needs for two to three years. At present, it still holds water harvested in April 2009," he says. He has introduced water hyacinth in the pit as a way of reducing water loss through evaporation.

To draw out the water, Francis has to use a manually operated 'Money-Maker' pump, which can take water over a distance of 300 metres from the pit located at the centre of his farm.

To ensure that as much water is stored in the soil for as long as possible, Francis has planted bananas within tunnels that are then filled up with mulch from maize straw.

Francis also grows drought-tolerant food crops, mainly cassava, millet and cow peas.

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See also

Preserving greeny leafy vegetables
http://bit.ly/q4xS3n

Climate change adaptation and mitigation options for Africa
http://bit.ly/qymWPr

Kenya agriculture news and features
http://bit.ly/pHOmzb

The power of documentation

Over the last 34 years, Francis Kiarahu has documented all major activities on his farm in photographs. These provide visitors with an amazing visual chronology. He says documentation has helped him monitor crop rotation and he can tell which crops were grown in which plot and in what year. The photographic record also gives a good visual impression of the weather situation in the preceding years, documenting the rainy years and the drought-affected ones.

Pictorial documentation has proved useful in having a permanent record of the farm's history, providing information to visitors and monitoring the farm's progress over the years.

Biogas: an alternative energy source for farmers

A woman feeds her Plastic Tubular Digester in Nguruman, Kenya © ALIN/Noah Lusaka 2011

More than 80% of Kenya's rural population relies on wood, agricultural waste, charcoal and paraffin for cooking and lighting. These energy sources are linked to serious development impacts: families suffer from health problems because of indoor smoke, wood supplies are under pressure, and fuels like paraffin are expensive. Women and children walk long distances in search of firewood.

Deforestation is also a significant contributor to climate change through the release of carbon dioxide. Alternative energy options like biogas are safer, more cost-effective and efficient, and climate-friendly. As well as helping farmers adapt, Kenya needs to find alternative energy sources to play its part in mitigating climate change.

Plastic Tubular Digester (PTD) biogas technology uses organic waste to produce fuel for heating, cooking and lighting. The organic waste, which includes cow dung and goat and chicken droppings, is mixed with water (at a 1:3 ratio) and kept in anaerobic environment – a large tube made of sheet plastic.

Reducing firewood consumption through biogas

Mrs Lucy Ndung'u runs a small hotel in Nguruman, Kajiado District. "Since ALIN brought us this technology through the Nguruman *Maarifa* centre in 2011, my family activities have changed. I have reduced firewood consumption and the money I used for buying firewood I now save for family projects," she says. "I am also able to serve my customers with clean food, cooked in a smoke-free environment. Before using biogas, I was having recurring chest congestion, but this problem has ceased. I attribute this to using biogas, since it doesn't produce smoke. I have always been worried when I see changing rainfall patterns; I now feel good to be a player in mitigating climate change."

Benefits

A 2009 study by the Kenya Agricultural Research Institute (KARI) assessed the socio-economic and environmental impacts of PTD technology:

- The adoption of PTD reduced household energy costs and labour requirements, as well as reducing deforestation.
- PTD increases crop productivity because the waste slurry can be used for farming.
- 80% of respondents in the study said it improved the cooking environment since it is smoke-free.
- PTD is more affordable for small-scale farmers than other sources of biogas. Installation costs vary, but 'two cow' units cost around Ksh 6,500 (US$65) – about 10% of conventional floating or fixed-dome biogas units.

Can the practice be replicated?

PTDs were introduced to Kenya in the 1990s, but adoption was low until 2005, when KARI re-launched the technology at Embu in Eastern Kenya. Since then, individual initiatives and organisations such as ALIN and Daraja Kenya have been spreading the technology. KARI's 2009 study shows that demand increased tremendously, from 15 units in 2005 to over 600 four years later. Some farmers also installed PTDs with help from other farmers, so the number now is likely to be even higher.

Challenges to wider adoption

A key challenge is the lack of adequate expertise, both to install PTDs and to train people how to use them. There is an over-reliance on a small pool of experts in Kenya. There is also a lack of technical information for farmers on dung requirements, installation, costs and expected benefits; this is partly due to poor information-sharing among farmers.

There is a need to build the capacities of non-governmental organisations, government extension workers, and local community members; these people could then train others, disseminate information and provide feedback to experts. Farmer-to-farmer exchange visits could also increase technology transfer at the community level. But communities must take collective action to get training in installing the technology.

Other challenges include:

- Donor-dependency syndrome: some farmers expect free installations.
- Durability: the digesters' polythene tubes last only two years. A butyl-rubber digester would last longer but make the digesters more expensive.

Further research is needed to identify a plastic tube with a longer lifespan, as well as further testing using different digester materials and in different agro-ecological and ecological zones. The Kenyan Government also has a role to play; it should provide further subsidies for biogas to encourage investment.

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See also

Daraja Kenya
http://bit.ly/v7d5qP

KARI notes on biogas digesters
http://bit.ly/pXLfOs

GTZ compost and biogas plants for small-scale farmers in Kenya
http://bit.ly/qlJwSJ

Kenya National Domestic Biogas Program
http://bit.ly/p1V5Du

Joto Afrika resources

Watch 'Responding to Change' videos

Climate stress is a reality in Kenya and many rural communities are witness to this. Building community resilience to climate change is more urgent than ever.

The tubular biogas technology and Kaseva rock catchment water-harvesting projects are examples that demonstrate communities responding to climate change. These were made possible through localised initiatives – managed by community members and done for the community's long-term benefit.

Watch our videos of these two projects:

Tubular biogas technology
http://bit.ly/uQqWI1

Rock catchment water havesting
http://bit.ly/vUHpAJ

We welcome your feedback on this issue of *Joto Afrika*. Please send us your thoughts using the contact details on **page 8.** Please include your full contact address or email. A selection of letters will be printed in the next issue.

This issue is supported by the Climate and Development Knowledge Network (CDKN).

About the Climate and Development Knowledge Network (CDKN)

CDKN aims to help decision-makers in developing countries design and deliver climate compatible development. It does this by providing demand-led research and technical assistance, and channelling the best available knowledge on climate change and development to support policy processes at the country level.

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http://bit.ly/aMNLth

Joto Afrika Eldis Community Group
http://bit.ly/bM3ESo

ALIN videos

Watch ALIN's videos on climate change at **http://televisheni.blip.tv.** The videos show how various communities are adapting to climate change.

Feeding livestock during droughts

A farmer in Kyuso with a Kithunzu tuber, which she feeds to her cows © ALIN/Noah Lusaka, 2009

Since the mid-1970s, Kenya has experienced a reduction in annual rainfall of more than 100 millimetres. With experts predicting even less rainfall in future, many farmers are turning to alternative fodders that can withstand prolonged periods of drought.

In Mivukoni, Kyuso District, Kenya, several farmers use alternative animal fodders. "In 2009, we lost 16 of our cattle because of drought," explains Julius Matei. "We realised we had to look for alternative sources of fodder. We changed to using acacia pods, *Kithunzu* tubers, and *Mukau* fruits and leaves to feed our cattle and goats."

Alternative fodders

Thurnbegia guekeana (Kithunzu) tubers are found in many arid and semi-arid lands. The tubers are highly nourishing and hold a lot of water, providing some of the 60 litres cows need each day.

Melia Volkensii (Mukua) grows in Ethiopia, Kenya, Somalia and Tanzania. The leaves can be harvested towards the end of the dry period, making them a valuable source of fodder during drought. They are rich in protein and crude fat, so good for livestock.

Acacia trees also shed their leaves during the dry season, and the pods can be dried and stored for several months. This allows farmers to store fodder for when other sources have been used up.

Julius and other famers learned about these through Kyuso's *Maarifa* centre and from the Ministry of Livestock Development. "These fodders have traditionally been used in this area, but the management of them is new to us," he says. The most popular new fodder is the root tuber, with more than 750 households now using them.

What are the challenges?

Alternative fodders have enabled several farmers to save the lives of their animals during drought, but there are problems:

- Harvesting tubers can take two to three hours a day, adding to farmers' workloads.
- Cattle take time (up to seven days) to adapt to new fodders.
- Tubers rot three to four weeks after being harvested, so cannot be used as a reserve supply.

Further fodder sources could give farmers more options. In Kenya, many people feed their animals on sorghum straws, benefitting from the plant's ability to grow with only a small amount of water.

Recommendations

- There is need for further understanding of the social, economic and environmental consequences of fodder production in dry-land areas, particularly the interactions with changing food prices and food aid.
- Improving links between fodder suppliers and arid areas may stimulate the production and marketing of fodder.
- The Kenyan government should include fodder production in emergency and contingency plans for arid areas, and create fodder reserves for use during dry periods.
- Strategic fodder banks for communal reserves should be promoted by local governments via field schools.
- There is a risk that overharvesting tubers for livestock will reduce supplies; a programme to plant more tubers would provide a regular supply.
- Farmers should also be trained on how to harvest tubers sustainably.
- The impacts of tubers on animal health are relatively unknown; further research on the effects is needed.
- Knowledge on alternative fodders needs to be shared amongst communities so that the fodders become locally available.

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See also

World Agroforestry Centre information on *Melia Volkensii*
http://bit.ly/nZE4uV

KARI: coping with feed shortages
http://bit.ly/p8bbPv

Disaster risk reduction website
http://bit.ly/vqL18s

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