partageons les connaissances au profit des communautés rurales

sharing knowledge, improving rural livelihoods

Rural Radio Resource Pack

08/3

RENEWABLE ENERGY IN AGRICULTURE

CTA is funded by the European Union

The Technical Centre for Agricultural and Rural Cooperation (CTA) was established in 1983 under the Lomé Convention between the ACP (African, Caribbean and Pacific) Group of States and the European Union Member States. Since 2000, it has operated within the framework of the ACP-EC Cotonou Agreement.

CTA's tasks are to develop and provide services that improve access to information for agricultural and rural development, and to strengthen the capacity of ACP countries to produce, acquire, exchange and utilise information in this area.

Rural radio
Radio remains, despite all the interest in the new ICTs, one of the most important communication tools in ACP rural communities. CTA began supporting rural radio back in 1991. Every year since then we've produced a set of Rural Radio Resource Packs (RRRPs).

Each pack is on a specific topic – anything from crop storage and cassava to small ruminants and soil fertility. The choice of topics depends on what ACP partners suggest. The number of topics covered has now reached 51. Inside each pack are materials for a radio programme on that topic – interviews on cassette or CD, a transcription and a suggested introduction for each interview, technical information on the topic, advice for how the pack can be used and a questionnaire for users to provide feedback to CTA.

You can find most of the RRRP material on CTA's Rural Radio website http://ruralradio.cta.int/.

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This CD can be played in an audio CD player, and also contains pdf files of the written documents and the feedback questionnaire.

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CTA

Rural Radio Resource Pack – 08/3

Renewable energy in agriculture

Contents Page

CTA

Rural Radio Resource Pack - 08/3

Renewable energy in agriculture

TECHNICAL INFORMATION

Introduction

During 2007 and 2008 the price of oil has risen to record highs. This has had massive knock-on effects in the global economy. It's also had a major impact on the price of food. Oil underpins industrialised agricultural systems. Fertilisers and pesticides are made using oil, and farm operations such as land preparation and harvesting depend on it. Rising oil prices have therefore greatly increased the costs of food production in the industrialised countries.

For small-scale farmers, the rising cost of oil-based farming inputs has put them under increased pressure. Most efforts to increase the production of small-scale farmers have focussed on increasing their use of chemical inputs. And the availability of energy is a key factor for farmers who want to expand their agricultural activities, or add value to their harvests through agro-processing. In this situation, farmers may be keen to adopt farming systems which are not dependent on fossil fuels, but get their energy from renewable sources.

Use of renewable energy in farming systems can mean several different things. For example, fossil fuels such as oil are non-renewable, so finding alternative ways of fertilising the land and controlling pests that do not depend on chemicals, will normally involve the use of renewable resources. Such methods reduce farmers' vulnerability to the rising price of oil.

Renewable energy also includes generation of power to do a number of farm tasks: pumping water for irrigation, for livestock or for domestic use; lighting farm buildings; powering processing operations and others. These forms of renewable energy include solar energy, wind and water power, oil from plants, wood from sustainable sources, other forms of biomass (plant material), and biogas (gas produced from fermentation of manure and crop residues).

Use of renewable energy for agricultural purposes is still quite rare in Africa, although oil prices may drive farmers towards such options. More common, however, is use of renewable energy by farming families in their daily lives. This resource pack also therefore covers several technologies that, while not specifically agricultural, are relevant to rural communities.

This resource pack

This resource pack is a showcase for renewable energy technologies used by farmers in Africa. These include use of wind, water and solar power to pump water, generate electricity and process crops. There are also interviews on production of biogas, and how livestock can improve energy flows on a farm, use of plant-derived oil for lighting, a source of heating for poultry chicks made from waste charcoal dust, and how to boost soil fertility using biomass.

Pumping water using wind power

Colonial farmers introduced thousands of wind pumps to South Africa and Namibia, and lesser numbers to Zimbabwe and Kenya. Some of these are still in use, but many are not, often because local communities cannot get the spare parts or specialised knowledge to maintain the windmills. Later attempts to introduce wind-powered water pumps have often failed, for a number of reasons, including:

- High investment cost – the initial cost of a wind pump is usually higher than for a diesel or petrol pump, even though over the lifetime of the pump it becomes cheaper. With limited funds, farmers or farmer groups will be more likely to buy a diesel or petrol pump.

- Maintenance and service – pumps in remote areas often break down because of a lack of servicing, spare parts or trained people to maintain them.

- Need for water storage – as well as the windmill, farmers must also invest in a large water storage tank, so that water supply can be maintained when the wind is not blowing (and the pump not pumping).

- Low output - depending on wind speed and the depth of the water in the ground, wind pumps deliver relatively small quantities of water, which may be inadequate for irrigation or to service large communities.

In Zimbabwe, many rural communities do not have electricity and face extremely high charges for fuel. Researchers from the University of Science and Technology in Bulawayo are therefore interested in finding out whether wind power could be a viable technology. A newly designed windpump, capable of pumping 60,000 litres of water per day, has been successfully trialled in several communities. The water has been used to grow high value horticulture crops. Community members have also been trained to maintain and repair the windmill pumps. ***Windmills for pumping water*** tells the story.

Pumping water using solar power

Solar panels (also called Photovoltaic or PV panels) are used to generate electricity from sunlight. The electricity can be used to power a water pump, normally used for village water supply, livestock watering and small-scale crop irrigation, e.g. vegetable plants in a home garden. The water is pumped from underground into a tank, which must be large enough to store sufficient water to supply the village needs during cloudy weather.

Installing a solar powered water pump is a fairly expensive option (several thousand Euros or US dollars), although the systems last for a long time and are reliable. Before installing this kind of system, a detailed assessment must be made of water demand (including needs of people, livestock and crops) and availability (e.g. well yield). The site must also be carefully surveyed to ensure the system is designed correctly. Although solar-powered water pumps are generally reliable and need little maintenance, if they do go wrong, skilled technicians are required to carry out repairs. Availability of this expertise is another factor in choosing whether to have such a system.

Because of the costs and expertise needed, solar powered systems are usually associated with either donor-funded projects or government water-supply programmes. In The Gambia, the Japan International Cooperation Agency (JICA) has been working with the government to install solar-powered water pumps in

around 150 large (over 1000 people) communities. Each community must raise US$1000 per year to cover the costs of servicing and maintenance. Night watchmen are employed to protect the panels. In **Solar-powered water pumps**, Acting head of Rural Water Supply, Alhagi Jabbi, says that the provision of pumped water has had a real benefit in reducing incidents of water-borne disease. The success of the project has led JICA to consider scaling up the approach to other African countries.

Drying or curing farm produce

Agricultural produce has been dried by the sun and wind in the open air for thousands of years. In industrialised countries, drying of crops is mostly done by mechanised driers, which are quicker and give a higher quality product. However, these driers are expensive and require large amounts of fuel to work.

Solar driers are more effective than sun drying, but have lower costs than mechanised driers. Designs of solar drier include quite simple boxes with glass covers, or more complex designs where heat is collected in one part of the drier, and then transferred to a box where the crop is placed. While various designs of solar drier have been proven to work, none are in widespread use in Africa. However, they may be in use in certain areas for drying certain crops, such as coffee and rice. For more information on solar driers, including interviews, see the earlier CTA resource pack on **Drying agricultural produce** (RRRP 08-1).

In this pack, ***Solar-powered fans for tobacco curing*** describes how small-scale tobacco farmers in Malawi are using electric fans, powered using a solar panel, to optimise the process of drying or curing their tobacco leaves. The technology allows much better control of the temperature in the curing barn, halving the time needed to cure the leaves and greatly reducing the amount of firewood used in the process. As a result, farmers are producing top quality leaf which sells at higher prices on the auction floor. There is potential that the technology could be used for vegetable and fruit drying.

Rural electrification through solar panels

Across Africa, less than 10% of rural households are connected to a national electricity grid. Extending national grids to remote areas is expensive, so in Cameroon the Rural Electrification Agency – with recent backing from the President – is taking a different approach; solar power.

The need for electric power in rural areas is well-recognised. Currently, the lack of electricity, and the opportunities it brings, is contributing to the rural-urban exodus, particularly of young people. Electricity can power small-scale industries and other income generating activities, improve educational performance by giving children light in the evenings, can power health clinics and schools, and give people access to information through computers and mobile phones.

Installing photovoltaic (PV) solar panels is not a cheap option, particularly as they frequently have to be imported from overseas. Spare parts may also be expensive for the same reason. But the cost of solar technologies is coming down, and the current hike in oil prices may, by boosting the solar market, bring prices down further.

With its plentiful supply of sunlight, Africa is well-placed to benefit from solar energy provided it is a cost-effective and sustainable option. For this reason, the Cameroonian authorities are training local technicians to be able to maintain the solar power systems. ***Solar power for rural electrification*** discusses the possibilities and challenges for the technology.

Small-scale hydropower

Many countries now have hydro-electric power stations, with large dams capturing water, which is used to drive turbines and generate electricity. However, small-scale versions of this technology also exist, which provide power to isolated rural communities. The small-scale system taps part of the water from a river and feeds it down a pipe (which is sited on a steep gradient to increase the speed of water flow). The water then drives a turbine, generating a 24 hour supply of electricity, which is typically used for lighting, and for TVs and radios. In some cases, the electricity is also used to power small businesses, for example providing light to a poultry farm, or power for a milk chiller or an agro processing operation.

Small-scale hydropower – also called micro-hydro or pico hydro– is normally more expensive to set up than a diesel-based system of electricity generation, especially if imported equipment is used. However, where local materials are used, it is possible to reduce the cost substantially, and with proper training, all operation and management can be carried out by the community, as well as repairs or replacement of worn-out parts. In the long run, the electricity produced by micro-hydro is very cheap compared to other sources. Assuming a year-round availability of water in the river, a micro-hydro scheme is a reliable source of continual power, suitable for providing electricity to health centres or schools, as well as businesses.

While micro-hydro is a very well established technology in parts of Asia, it is much less widespread in Africa. ***Electricity from water power*** describes a micro-hydro scheme that is bringing electric power to a community living on the southern slopes of Mount Kenya.

Biogas digesters for cooking, lighting and fertiliser production

Biogas is used for cooking and lighting in the home, and is produced from animal manure and crop residues. The technology is most suitable for farmers who practice stall-feeding (zero grazing) of their livestock, as this gives them a regular supply of manure. The manure is mixed with water and then fed into a large tank. Here it is fermented by bacteria, producing gas (usually about 60% methane, plus carbon dioxide and other gases). The gas collects in a reservoir, connected by pipes into the kitchen of the home. Here it is used either in gas cookers or lights, helping families to save money on fuel. The gas also burns cleanly, so people cooking with it do not suffer from inhaling smoke.

Most designs of biogas digester need to be fed with manure on a daily basis. This obviously requires some labour, and also requires an all year round supply of water, which can be a limiting factor. However, as well as providing gas for the home, the system also produces slurry from the digested manure, and this can be used as a fertiliser without needing any further treatment. This saves money compared to buying chemical fertiliser, and is less work than making compost. Biogas digesters also improve on-farm sanitation.

Despite some efforts to introduce biogas technology, e.g. in Uganda, it has not been widely adopted for various social and economic reasons. The cost of installing a biogas digester is a big initial expense for most farming families. Farmers must also be quite disciplined in how they feed their digester in order to maximise gas production. If labour is in short supply, this can be a problem. The digesters are reliable, but need regular checking for leaks, and may need specialist parts, e.g. if pipes or valves are corroded.

In ***Biogas – clean energy from cattle dung*** Ugandan farmer Ruth Musoke describes the biogas system on her farm which provides her with gas for cooking. ***Biogas for cattle farmers*** comes from Ghana, where biogas specialist Elias Aklaku explains the advantages the technology offers to those with cattle herds.

Oil from plants for lighting and machinery

The jatropha plant (*Jatropha curcas*) has seeds that have a high oil content. When extracted from the seeds and filtered, this oil can be used as a fuel, both in modified car engines and also in smaller devices such as lanterns. The oil can also be turned into biodiesel, a fuel which can be used in any diesel engine.

Jatropha trees, which can grow up to 6 metres in height, are found in regions close to the equator and are able to grow in arid or degraded land that will support few other crops. After planting, the trees take three years before they start producing fruit, so farmers are usually advised to grow them in addition to their normal crops, for example as a hedge. Planting the crop can actually prevent soil erosion and deforestation, since at harvest time (which occurs after each rainy season), only the fruit are harvested and the plant remains in the ground.

Typically farmers growing jatropha will not extract the oil themselves, but will sell their seeds to a biofuel manufacturing company. But in Tanzania, the non-profit organisation Jatropha Products Tanzania is training farmers to grow the crop and extract the oil, and also training young people to manufacture lanterns which can burn the oil. This is proving a cheaper and cleaner source of fuel than kerosene. See ***Jatropha oil – an alternative to kerosene.***

Using waste charcoal dust to heat poultry brooders

During their first 30 days, young poultry chicks need to be kept warm. For those with electricity, heating lamps are one option. These can be powered either from the national grid, from a generator or a renewable energy such as solar or micro-hydro. A cheaper alternative may be to use fuel briquettes made from waste products. For example, charcoal dust – a waste product from charcoal making – can be mixed with sawdust, grass and other wastes to produce a fuel briquette that will burn slowly, over several hours.

In Uganda, Godfrey Kiyoge has been using charcoal fuel briquettes to heat his poultry brooders for around seven years, and is now training other farmers to do so. In ***Charcoal briquettes for brooding chicks*** he explains how it is done.

Biomass in the farming system

Biomass, such as wood, straw, crop residues and manure, contains stored energy. In some farming systems, this energy is retained within the system so that little or none is wasted, and little external input of energy (e.g. from chemical fertiliser or fossil fuel powered machinery) is needed. Feeding crop residues to livestock or fish is one example of this. The livestock or fish provide food as well as fertiliser, and in the case of cattle, draught power. Use of biogas digesters takes this a stage further, making use of bacteria on the farm as well!

Mixed livestock/crop farms can be the ideal way of retaining energy within a farming system, but for those without livestock there are still many good energy-conserving strategies. Adding crop residues or compost to the soil recycles their nutrients into the next year's crop. It also boosts water holding capacity and reduces erosion by wind or heavy rainfall. But how much organic matter do

farmers need to supply sufficient nutrients and minerals, such as nitrogen, phosphorus and potassium? At the Fambidzanayi Permaculture Centre in Harare, staff are working to find out an answer – see ***Recycling plant materials***.

Trees for woodfuel and soil fertility

Wood is the most widely used fuel in rural Africa, and will continue to be used in the future. Shortage of woodfuel, caused by widespread deforestation, is a major problem in many areas, so sustainable systems for planting and harvesting trees are essential. This can be done by individual farmers planting trees on their own land – for example along field edges or in woodlots – or by communities establishing a woodlot, or sustainably managing an existing area of forest. If enough trees are planted, to replace those that are cut, wood can be a renewable source of energy.

Increasing the efficiency with which wood is used also helps to reduce rates of deforestation. There are designs of improved stoves that burn wood much more efficiently than if it is simply burnt openly. Such designs could be used in an agro-processing operation.

In some cases, farmers plant trees that not only provide fuel but also add fertility to the soil (nitrogen-fixing trees), for example *Sesbania* and *Tephrosia* trees. Leaves and small branches from these trees can be added to the soil, and act like a fertiliser. Some trees have deep roots which can pull up minerals like potassium and phosphorus and bring them into the surface layer of the soil where they are available to crops. ***Trees for fuel and fertility*** gives more detail on this.

Using this Rural Radio Resource Pack

Windmills for pumping water

Windmills for pumping water can be found in Kenya, Namibia, South Africa, and Zimbabwe. Many of these have fallen into disuse, usually because of a lack of spare parts or local expertise in maintenance. But given the rising cost of diesel, should African agriculture departments be supporting wind power as a way to provide water for irrigation? Are there any other technologies that have been abandoned, but which your listeners think deserve to be re-looked at?

Solar-powered water pumps

The Gambia's adoption of solar-powered water pumps has been supported by the Japan International Cooperation Agency (JICA). Has either JICA or another donor sponsored any similar schemes in your country? A representative of the ministry responsible for energy might comment on that. Do your listeners believe that solar power is something the government should be supporting, for example by policies which encourage local industries that manufacture the solar panels etc?

Solar-powered fans for tobacco curing

Drying or curing agricultural produce can be a way of both preserving it and adding value. Maintaining quality during the drying process is very important, for example to prevent contamination or mould growth. Could a solar-powered fan be a useful addition to drying technologies used in your country, either for tobacco or other crops? Listeners could be asked to phone in on whether these fans could be a useful technology.

Solar power for rural electrification and **Electricity from water power**

These interviews raise the issue of how important it is for rural communities to have electricity. How big a priority should this be? Is it the key to rural prosperity, health and education? And if it is important, what are the best strategies for making it available? Do solar or small-scale hydro power have a place in government energy plans? An interesting topic to discuss with an energy ministry spokesperson. You could also investigate whether any NGOs are working in this sector.

Biogas – clean energy from cattle dung and **Biogas for cattle farmers**

With firewood becoming more expensive in many areas, rural families may be increasingly keen to look for alternative, cheaper sources of fuel. For those who keep some livestock, biogas could be a good option. But the technology needs to be installed by trained workers, and this is likely to be done through either a government or NGO scheme. Is there any scheme to encourage adoption of biogas in your country? If so, how successful has it been? If not, is this something your listeners would like to see?

Jatropha oil – an alternative to kerosene

One of the exciting things about jatropha is that it is drought-resistant and will grow in dry areas which may not support many other crops. Are there any organisations promoting jatropha cultivation in your country or area? Could a representative be invited to give more information about the crop and how people can benefit from it? Another aspect you could explore is the health risks from kerosene smoke. Are there any ways to reduce the dangers?

Charcoal briquettes for brooding chicks

This technology of fuel briquettes from waste charcoal dust and sawdust is wonderfully simple and could be possible anywhere that charcoal is made. Some of your listeners may have experience making fuel bricks, either from these or other materials, which they could share by phoning in.

Recycling plant materials

This is a much bigger topic, which could probably be the subject of a whole resource pack. Farmers will have heard many times about the value of using manure, crop residues etc to fertilise their fields. One problem is for them to obtain enough organic matter to have a meaningful impact on their fields. Inviting an organic or permaculture expert to your studio to answer listeners' questions, put by pen, in person, on the phone or by text, could be a way to give listeners some new ideas about how they can manage this.

Trees for fuel and fertility

This interview concludes by advising farmers to seek local advice before they plant trees, in order to choose the right species. That would give an excellent lead in to a guest from a forestry department, who could give some locally specific recommendations for tree planting.

Other aspects of renewable energy in agriculture not covered in this pack

Renewable energy policy

This pack has largely concentrated on specific technologies that rural communities might use. But widespread adoption of some of these technologies may depend on government policies that either directly promote them, or offer incentives to private sector industries.

Solar cookers and driers

Sunlight can be used to cook food or to dry agricultural produce. There is more information about solar driers in the earlier Resource Pack 08-1 – Drying agricultural produce.

Plant oil for agricultural machinery

The interview on jatropha describes how this plant oil can be used in a simple lantern. On a bigger scale, jatropha oil can also be used to power agricultural machinery.

Renewable power for agro-processing

Most forms of agricultural processing are dependent on energy. In this pack, technologies such as micro hydro and use of solar panels have focussed on supplying domestic needs (e.g. electric light, drinking water), but they could also be used to power small agro-industries.

Further information

Useful websites, online articles and fact sheets available:

LEISA magazine – Energy on the farm
The editorial gives a useful summary of the issues, and there are detailed articles on several technologies featured in this resource pack.
http://www.leisa.info/index.php?url=magazine-details.tpl&p%5breadOnly%5d=0&p%5b_id%5d=71250

Practical Action
This website offers detailed, practical factsheets on several renewable energy technologies, including solar, wind and hydro power.

http://practicalaction.org/practicalanswers/index.php?cPath=21&osCsid=e8qpmcdbqk315jn02vh5phr756

Biogas for better life

This documents an initiative to promote biogas digesters in Africa, and has lots of useful information about the technology.
http://www.ted-biogas.org/Biogas_for_Better_Life_Brochure1.pdf

Appropriate Technology

This magazine features many articles on renewable energy. An online archive is available to hard copy subscribers.
http://www.appropriate-technology.org

CTA Knowledge for Development website

Pros and cons of developing biofuels in African, Caribbean and Pacific countries.
http://knowledge.cta.int/en/content/view/full/4405

Books

If you belong to CTA's network of broadcasters, you can receive, free of charge, books from our catalogue. For more information, send us a request at radio@cta.int

The preparation and use of compost – Agrodok 8: by Inckel, et al. CTA, 2002, 66pp, ISBN 90 77073. CTA no. 186, 5 credit points

Non-CTA titles:

Energy options: An introduction to small-scale renewable energy technologies: by Drummond Hislop. 120pp, ISBN 9781853390821. Available from http://developmentbookshop.com/

Solar energy for rural communities: the case of Namibia: by Yaron et al. 160pp, ISBN 9781853392429. Available from http://developmentbookshop.com/

Electricity in households and microenterprises: by Clancy and Rebedy. 112pp, ISBN 9781853395017. Available from http://developmentbookshop.com/

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Renewable energy in agriculture

Windmills for pumping water

Cue:
Using wind power to pump water from the ground is something that has never really taken off. The high cost of building and maintaining windmill pumps has put people off. The other problem is that you may also need to build a large water storage tank so that you will have enough water to use even on days when there is no wind blowing.

But a lot of wind enthusiasts always believed windmills can be cheaper than using a diesel or petrol powered pump.

Now, two engineers in Zimbabwe are trialling a new design of windmill pump, which they believe could be an answer to rural water supply. Busani Bafana reports:

IN: "Windmills, a common feature in farms…"
OUT: … try to work towards a branding."
DUR'N: 5'47"

BACK ANNOUNCEMENT: William Goriwondo and Nicholas Tayisepi from the University of Science and Technology in Bulawayo, Zimbabwe, talking with Busani Bafana. The interview comes from a resource pack produced by CTA.

Transcript

Bafana *Windmills, a common feature in farms across Zimbabwe, especially before independence, are making a comeback as an icon of ingenuity for farmers in harnessing wind energy to help operations on the farm. A team of researchers at the National University of Science and Technology in Bulawayo, Zimbabwe, have developed a cost-effective windmill pump system which they have just tested in the field. In today's programme, research team members and engineers, William Goriwondo and Nicholas Tayisepi, share with our listeners how the windmill pump system works and its benefits for farmers. William, I'll start straight away with you. Some of our listeners may not be familiar with the windmill powered pump. How does the pump system work?*

Goriwondo The pump system is a submersible pump which is put in the borehole and then the windmill would actually be harnessing the wind energy, convert it into the sprocketing motion that will then pump the water.

Bafana *Is the water then pumped into a storage tank from where the water is drawn for use?*

Goriwondo Yes. There is an option of putting a storage tank. The tank would actually be raised above ground so that we have got the pressure when we need to use the water. But otherwise you can have the windmill pump pumping directly to your source of use. But in that case there would be excessive water which may be lost.

Bafana *We are talking about a windmill pump system. Does it only work when it is windy?*

Goriwondo It uses wind energy but our design would actually improve on it to harness the smallest amount of wind flow which is there.

Bafana *Does the speed of the wind then determine the amount of water that can be pumped at certain times of the day?*

Goriwondo Yes. The speed of the wind determines. As the wheel moves faster the pump will also be pumping faster. But when it is completely windy it doesn't turn.

Bafana *How does this pump that you developed provide a solution to the water needs of the community, particularly farmers?*

Goriwondo In most farms around here there is no electricity. So this pump would actually be using the wind energy and it would provide for the energy that is required to pump water for domestic use, as well as for animals and other farming activities.

Bafana *I would now like to actually turn to Nicholas to actually describe to us about the capacity of this pump. For example, on average how much water can you pump over on a typical day or during the typical week?*

Tayisepi On average we are looking at up to 60,000 litres of water per day. Working on a 40 per cent effective wind day period. Otherwise it can generate a bit more than this, provided we have sufficient storage capacities for harnessing the water for the period it is pumped.

Bafana *Looking at the community where you actually installed this pump, how can you use that water?*

Tayisepi They have a cooperative garden. That water is meant to provide the horticultural activities watering needs.

Bafana *Can this pump system be used for any other on-farm activities?*

Tayisepi Yes. From the household use to livestock, to irrigation, to market gardening, you name it. Most farming activities require water; that gadget can be used for that.

Bafana *What kind of challenges did you meet in designing the wind pump?*

Tayisepi In terms of the challenges we are looking at the costs associated with the installation of the wind pump. Like this design that we have at the moment was going for US$13,000, that's for the whole process, labour and materials included. And this is a product that can be used at community level. But then also one of the challenges we have at the moment is the aspect of the material costs, due to the inflation we are experiencing.

Bafana *You have already mentioned that it cost you something in the region of US$13,000 to come up with the design and to install it. I would then want to find out, how do you maintain this pump?*

Tayisepi In our process we included community cadres out there, that is community members who will remain and are taught to maintain those gadgets. That way we, I think we believe it will ensure the windmills will always be working because they know how to maintain the basic parts.

Bafana *Does this pump then meet local conditions?*

Tayisepi Yes it does. The countryside of Zimbabwe's communal lands mainly is quite windy for a good part of the year. Like William had indicated, the design we came up with uses very low energy from wind. So you find with the average wind speed we experience in Zimbabwe, it is said that it can pump water perennially.

Bafana *What are the future prospects for commercialising this windmill pump system?*

Tayisepi There is quite a future in it as long as we keep on improving on the design and especially the storage capacity. Like we had indicated, this windmill can pump up to 60,000 litres a day. But in terms of the storage arrangement we have at the moment, most of it will not be stored. So if we improve on the storage side of the process we are going to have quite an enhanced capacity as well.

Bafana *I thought I could as well ask you, does your pump system have a name?*

Tayisepi That's ok. It is called a windmill, that's all. We will brand that shortly, now that you have suggested it. That sounds very interesting, we will definitely try to work towards a branding. *End of track*

Renewable energy in agriculture

Solar-powered water pumps

Cue:
Pumping water by hand can be a time-consuming, laborious job. Using a diesel-powered pump is an easier alternative, but high fuel costs are making this an increasingly expensive option. So what about renewable energies? Are their environmentally friendly and affordable ways to pump water?

Our next report comes from The Gambia, a country which is taking the lead in solar powered water pumping. Alhagi Jabbi, Acting Head of Rural Water Supply explained more to Ismaila Senghore.

IN: "Compared to periods when we were…
OUT: … Ismaila, thank you very much."
DUR'N: 5'24"

BACK ANNOUNCEMENT: Alhagi Jabbi of the Department for Water Resources in The Gambia, speaking to Ismaila Senghore. The interview comes from a resource pack produced by CTA.

Transcript

Jabbi Compared to periods when we were using diesel generators the price of diesel fuel was going up from period to period and communities could not afford to buy diesel and also buy spare parts for the running of these generators. Then the use of solar energy was highly welcome in the Gambian communities and it is very, very successful.

Senghore *Now what were the criteria you used to install the solar pumps in the localities where they are?*

Jabbi For example we say a community of at least 1000 people should be able to raise enough funds per year - this is roughly about $1000 - to maintain a system all year round and this is even enough to pay for the bills, for maintenance and for other charges, the running costs of the solar system.

Senghore *You say these projects are all very successful by your standard. Now how can you explain this success?*

Jabbi All their communities have their bank accounts, all the communities are connected to private companies for maintenance and this is actually the thing the water policy is asking for. The water policy is encouraging private involvement in the maintenance of water supply facilities and now we have succeeded in that virtually we say it is 100% successful.

Senghore *Now how many villages or communities have you already supplied?*

Jabbi We have supplied something like 150 large communities with solar powered water supply facilities and about 10 others provided on cattle drinking points across the country.

Senghore *What kind of equipment have you put in place in these localities?*

Jabbi We have installed solar panels and then we have also installed submersible pumps so that they can raise water to the overhead tank, which is connected to the distribution network within the communities.

Senghore *Was it expensive in the first place?*

Jabbi No, we tried to make the installations very simple and we tried to harmonise equipment. So if you get equipment from various sources it makes maintenance a little bit complicated. But we tried to harmonise equipment so that the supply of spare parts, the supply of skilled labour is also adequately met at community level.

Senghore *Now what do the villages use the water for, basically?*

Jabbi About 90% of the water is for use for drinking and cleaning purposes plus cooking purposes, domestic use. And then the other 10% say for light gardening behind their homes. Also a trough for small ruminants and other domestic animals that loiter about within the community.

Senghore *Are there any threats for example to the equipment, say from thieves or from children loitering around or from domestic animals?*

Jabbi Actually domestic animals and children are not normally major concerns because communities are normally sensitised and they include children and women and everybody within the community are sensitised. Sometimes we have threats from thieves but we try to circumvent these with intensifying security around the solar system, especially night watchmen. But during the day everybody is a watchman over these systems.

Senghore *And how cost effective is the whole system?*

Jabbi The investment is worthwhile. The supply of safe drinking water has a direct bearing on the health. When you go to some of these clinics, the amount of waterborne diseases or water related diseases affecting children and women have reduced drastically because of the supply of clean drinking water. And we reduce the time the woman has to spend collecting water. That has a direct economic benefit for the community, so that they can spend their time on other activities.

Senghore *And finally Mr Jabbi would you say or would you advocate for the extensive propagation of this kind of solar water pumping projects throughout the Gambian rural communities and elsewhere in the developing world?*

Jabbi Exactly Ismaila. During our last evaluation JICA was using the Gambia as one of the models so that they can transfer these experiences Gambia has with solar to other countries they are supporting. Because JICA did not go into solar initially but with this success story in the Gambia, now JICA is so much convinced to translate this utilisation of solar into other African countries.

Senghore *Who is JICA?*

Jabbi JICA is Japan International Cooperation Agency.

Senghore *Thank you very much Mr Jabbi.*

Jabbi Ismaila thank you very much, I am also very pleased because I have a lot of experience with this solar to share this with the communities is a pride for me Ismaila, thank you very much. *End of track*

Renewable energy in agriculture

Solar-powered fans for tobacco curing

Cue:
Using solar panels to generate electricity is not a new technology, but there are still relatively few examples of it being used in Africa. Major drawbacks include the cost of installing solar systems and also problems with theft.

But in Malawi, a project working with tobacco farmers is proving that solar-generated electricity can play a useful part in agricultural production. The project is focusing on the curing of tobacco; this is the process by which green tobacco leaves are carefully dried under controlled conditions, in order to preserve the aroma and the valued chemicals in the leaves, ready for sale and manufacturing into cigarettes.

Curing of tobacco often requires large quantities of firewood, and has been blamed for deforestation. So could the solar-powered process be a more environmentally friendly method?

To find out how the system works, Excello Zidana went to the Ministry of Energy and Mining to meet Chief Energy Officer, Lewis Mhango. Mr Mhango began by explaining how the tobacco curing process works.

IN: "The normal way of curing tobacco …
OUT: … the properties of those fruits."
DUR'N: 5'01"

BACK ANNOUNCEMENT: The interview comes from a resource pack produced by CTA.

Transcript

Mhango The normal way of curing tobacco, especially flue-cured tobacco, is they dig a hole in the wall and then they stock firewood in a fire chamber, and then the normal flow of air takes the flues into the flue pipes, and then the heat is emitted in the room and then the tobacco gets cured. But the use of solar fans has revolutionised the process of curing tobacco, especially for smallholder farmers. Because what it does is that you have a solar panel, and then that solar panel is connected to a battery, and then the power is preserved in the battery during the day. And then at night you plug in, it is connected to a solar fan, which is a DC fan. So this fan is put at the fire chamber. So the fan drives the flues into the flue pipes from the fire chamber. Now that forced draught into the flue pipes, you can control the temperature very easily, one. Two, you can dry the tobacco very fast, since you are able to control the temperature it means you reach the required temperatures very easily, and then you control at that particular time, so the tobacco that maybe takes one week to cure, you can do it in three days. So the time is also reduced, and then the amount of firewood is also reduced. The savings are phenomenal, that's why farmers have liked the solar fans. So the process is a combination of a solar powered fan and a little firewood.

Zidana *So in the process, the function of the fan is to regulate the heat?*

Mhango Yes, definitely. To regulate the heat, and to regulate the heat in such a way that if you want higher heat quicker, you can attain it very fast with a solar fan. While if you use the natural flow, it means you have to keep on stocking and stocking the firewood and then your heap is finishing, you need more firewood. But with this one, with the little firewood that you have, you force the draught quickly, the draught is going out in there, in the process the solar fan is also keeping the fire always burning, so that you generate the heat faster.

Zidana *Is there any difference in quality of tobacco between the two systems, the one that uses the solar powered energy and the other one that uses maybe the fuel without the solar powered energy?*

Mhango Yes, the difference is quite phenomenal. The target is to get a gold leaf, which is favoured on the auction floors. So with a solar powered fan, because you are able to control the temperatures, then you can maintain the temperatures for sometime, and then the colouring, the gold colouring, you can even monitor using a thermometer in terms of the temperature. So you attain the required temperature very easily using the solar fan.

Zidana *And what are the probable advantages or disadvantages of this system?*

Mhango The major advantage is, as I say, it reduces your cost of curing the tobacco, one. Two, the amount of firewood people are using is reduced, therefore you are also reducing deforestation. The third advantage is that the quality of leaf is excellent, and then the farmer fetches higher amounts of money at the auction floors, because he is able to produce good quality tobacco. But there are also some disadvantages. The major disadvantage is the initial cost of solar is quite high, although if the farmer plans properly he can still recover the cost within a short period of time, because the quality of the tobacco will fetch higher amounts of money, and therefore he can recover his money quickly. And again, if you have solar, when you are through with your tobacco curing, the solar you can also connect to lights in your house, you can also play your radio, you can also have your TV.

Zidana *So you kill several birds with one stone?*

Mhango With one stone.

Zidana *Now, does this system need to be for large-scale curing or drying, or would it be possible to have a smaller scale version of the technology?*

Mhango Yes, when we started the project we were trying to look at the possibility of having large farms to use the solar, because of the cost. But we did discover that the amount of tobacco that goes through large farms is quite huge, that the solar fan would not be ideal for large farms. So we are targeting smallholder farmers. These are the farmers who produce between 5,000 and 10,000 kg of tobacco a year.

Zidana *And what other crops might this kind of system be relevant for?*

Mhango It could be relevant for preserving vegetables, and probably there is also the possibility of maybe preserving fruits, but for fruit preservation we need a bit more research to make sure that it will not denature the properties of those fruits. *End of track*

Renewable energy in agriculture

Solar power for rural electrification

Cue:
If you live in a rural area, the chances are you are listening to this programme on a battery powered radio. In fact, across Africa, less than ten per cent of rural families have access to a national electricity grid. Yet all African countries are fantastically rich in one source of power – solar energy. And technologies exist to turn this power into electricity.

Despite this, however, the use of photo-voltaic cells to generate electricity from sunlight is almost non-existent in most African countries. Very few energy ministries have taken solar power seriously, and while in the northern hemisphere, governments offer subsidies to solar power companies and consumers, the same has rarely happened in Africa.

One reason for the poor spread of solar power is that governments have typically seen it as a donor-driven technology. Recently, however, Cameroon has taken a different view, as Martha Chindong found out when she spoke to Nsangou Bouba Aliyu from the Rural Electrification Agency in Yaoundé.

IN: "Considering the high prices of fuel …
OUT: … there to give back the energy."
DUR'N: 4'48"

BACK ANNOUNCEMENT: Nsangou Bouba Aliyu, a technician in Cameroon's Rural Electrification Agency. The interview comes from a resource pack produced by CTA.

Transcript

Chindong *Considering the high prices of fuel what then prevents African countries from using renewable energy technologies in agricultural production? Take solar energy for example. That is what motivated Martha Chindong to stop by at the Rural Electrification Agency in Yaoundé, Cameroon to find out what can by done. One of the technicians working there was at the standby to answer my questions.*

Bouba Solar energy, it has a big potential in the African continent because energy is everywhere in Africa, there is enough sunlight. So for the obstacles, since the material for solar systems is imported from overseas and materials are expensive so companies can come and install here in Cameroon so as to bring down the cost.

Chindong *What are some of the advantages of taking electricity to the rural communities?*

Bouba There are so many advantages. I will take for example the improvement of the living conditions of the rural masses. There is the fight against rural exodus. There is also the creation of income generating activities if these projects are done in the villages.

Chindong *Does installing solar energy have any advantage over the national electricity?*

Bouba It solves specific needs which does not entail heavy cost, for example in health centres, schools that are very far off from the network. Secondly this energy is some sort of clean energy, a silent type of energy and is not dangerous and is very practical because the costs of operating and maintenance is virtually nil.

Chindong *Are there specific uses of solar energy for farmers?*

Bouba Yes for farmers there are specific uses. Let me say it can be used for water

supply, for drinking and even irrigation. It can also be used to transform and conserve agricultural produce.

Chindong *When you say solar energy is silent energy, what do you mean?*

Bouba I mean that solar energy does not make any noise like when you start generators which make a hell of a noise, it disturbs.

Chindong *What factors do you look for when you want to install solar energy in a rural community?*

Bouba First of all and which is very much important, we have to carry out good studies. We see the options and the material that the villagers will use like radios, fridges, machines. Then we will match it up with the energy needed. The second factor is a good maintenance of the equipment. There should be somebody there to maintain this equipment.

Chindong *What of the users when they use the energy for these activities, do they need to pay a price?*

Bouba This depends whether it is an individual installation. If it is an individual installation they don't need to pay a price because it is for the home and nobody else. But if it is something like a collective installation it entails an operator who manages the running of the installation and for this case people have to pay some price for him to sustain the management cost.

Chindong *Let me know from you, the villagers can they keep the project running without the help of technicians?*

Bouba For this case the project cannot be run like that. It needs a technician or let me say local technicians to carry out the running of the installations.

Chindong *And for maintenance too?*

Bouba Yes and for maintenance and that's one mission of rural electrification agencies, to assist the rural population, train local technicians who will look after these installations.

Chindong *For now the funding of solar energy is done solely by the government. Is it only the government that can fund or are there other possibilities of having funds?*

Bouba Normally it is not only the government, you have individuals or communities which can regroup to acquire their own solar systems.

Chindong *What is the hope for the future?*

Bouba I think we should be hopeful because following what we are seeing now concerning the fuel prices, you see that the prices are going higher and higher for fuel and everything, but the prices of solar systems they are gradually coming down as the other prices are going up. So we should be hopeful that in the coming years the prices are going to fall very low.

Chindong *So Mr Bouba, before we go I do not know is there any last word?*

Bouba I just want to emphasise that solar energy is good because it is a clean type of energy and it is renewable. And by renewable I mean that the sun is always there. The equipment can go off, get bad or something but they will replace it. Meanwhile the sun is there to give back the energy. *End of track*

Renewable energy in agriculture

Electricity from water power

Cue:

For most people, particularly in rural areas, kerosene lamps and battery powered torches are essential sources of light once the sun has gone down. But kerosene and batteries have costs, and not only financial ones. Smoke from lamps can cause eye and breathing problems, and batteries can damage the environment if they are disposed of carelessly. And with rising oil prices, just lighting a home is requiring more and more of household income.

In Kenya, the NGO Practical Action, also known as ITDG, has been supporting rural communities to set up small-scale water-powered electricity generators. These work by piping water down a steep gradient and onto a turbine, which spins at high speed, generating electric power which is then supplied to homes. The system is known as Pico hydro. In Kathamba village, on the southern slopes of Mount Kenya, Eric Kadenge met with Silas Muchira Gachoki, Secretary of the village Pico hydro project.

IN: "The project has got about …
OUT: … with 5 bulbs and 2 sockets."
DUR'N: 3'20"

BACK ANNOUNCEMENT: Silas Gachoki, hoping that electricity from a small-scale water-powered generator, or Pico hydro, can be supplied to more villagers in Kathamba, Kenya. The interview comes from a resource pack produced by CTA.

Transcript

Gachoki The project has got about 172 members, and the Pico has already served 58 households, which is benefiting around 1,500 people. We start by contributing a small amount of money. After getting the money, we started building a reservoir, that's a dam. From there we bought pipes, then we have the gradient where we build the powerhouse down here. We get the turbine. Then we had someone who came with all those technologies and after getting power that's when we started supplying to those few members you have heard.

Kadenge *What are the benefits of this project to the local people here?*

Gachoki In fact to mention a few, my neighbour is used to buying paraffin. He has children who are in school. Every week he is using five litres. A litre is costing now 85 shillings. You can see it is more than 400 shillings per week. These dry cells for a radio or a torch are now lasting for one week and it is costing 45 shillings. So per month you are using a lot of money. Whereas whoever is using the power, it is just 80 shillings or 50 shillings the whole month.

Kadenge *What kind of geographical environment do you need for you to construct this kind of facility?*

Gachoki For someone to have power, first you need water flowing, and it should be flowing yearly, not seasonally. This is not a seasonal stream; it runs all the year round. You need a gradient area, so people has to work hard to get some money because a project like this needs some money to construct a powerhouse. Cables are now costly. You need pipes, generators, the turbine. We need security. You can see we have used the metal doors.

Kadenge *And the parts that you have mentioned, the turbines, the motor, is there anything that you need to import or everything is available?*

Gachoki Now the turbines and whatever are now locally found. Like ours here has

never broken down for those years. So mostly you have to grease the machine. So after every three to four months we have to come here and maintain the machine, you grease it, you look whether the turbines are working well. So for sustainability we don't have a problem.

Kadenge *What are your plans in the future? Do you intend to extend it?*

Gachoki Our future plan, as you can see downstream here, we have a big river here, just 800 metres from here, from this powerhouse. We want to extend; we have already bought in fact some materials. We have bought pipes, we have bought blocks, because we have to construct a powerhouse there, which we are going to get about 10 kilowatts there, whereby we will now be able to supply our 172 members with 5 bulbs and 2 sockets. *End of track*

Renewable energy in agriculture

Biogas for cattle farmers

Cue:
What form of energy do you use to cook your food or light your house? You probably use more than one kind: kerosene, firewood and perhaps electricity as well. But for those who own livestock, there is another possibility. Biogas, a combination of methane and carbon dioxide, is formed when organic matter, such as animal dung, decomposes by the action of bacteria. If this gas is captured and stored, it can be a useful fuel, powering lamps and cookers. It is a popular technology in parts of Asia, but few people in Africa have adopted it.

What you need to produce biogas is a large, cement chamber, usually underground, and known as the digester. You need to regularly – usually twice day – feed in manure for the microbes to work on. As the biogas forms, it collects in a reservoir tank from which pipes lead to lamps or a stove in the farmer's home.

Setting up a biogas system is not cheap, and it needs daily attention to keep up gas production. But for farmers with sufficient livestock to provide the necessary dung, it can be a good, long-term source of energy. Dr Elias Aklaku is a biogas specialist from the Kwame Nkrumah University of Science and Technology in Kumasi, Ghana. He spoke recently to Adu Domfeh about the potential of biogas for livestock farmers.

IN: "Biogas will become very important …
OUT: … or large-scale farmers."
DUR'N: 5'12"

BACK ANNOUNCEMENT: Dr Elias Aklaku, discussing the potential of biogas energy for cattle farmers. The interview comes from a resource pack produced by CTA.

Transcript

Aklaku Biogas will become very important and crucial if you are using the so-called zero grazing system. That is, we don't allow our animals to go wild and be grazing around, but we confine them and we bring the fodder to them. So if you confine your animals and you bring the fodder to them and they defecate around, they soil the area, you must get rid of this. That is the sanitation aspect of it; that is animal hygiene. But in terms of agriculture also, those who have cattle which even go around and come back, they do deposit something around them and this can even be utilised. It may be enough to give them light. They can cook with it instead of cutting down trees for firewood.

Domfeh *In a sense livestock are very important in improving energy flows around the farm.*

Aklaku Well that is it. Livestock are very important. So if you have large stocks of animals around you, the best thing to do is to go into this aspect of biogas technology. And not only that; farmers even in the oil palm industries, shea butter industries, where you have organic waste that is both from plant and animal origin, it can be handled to produce biogas.

Domfeh *So how best do the farmers collect, store and use the manure to improve their farming practices?*

Aklaku Manure is already in use in Ghana. In northern parts some of them, they dry it and even burn it as fuel. Some collect it and throw on the field. But if you have a kraal and the animals are in and they are in a large quantity, both their droppings and their urine, if all this will be gathered then it

means you have a permanent head. You know I have twenty cattle permanently, or I have thirty cattle, and then you can know that you will have, for example, eight cubic metres of biogas out of this per day. And then you know that this can do this lighting system for you, or can cook these meals for you. A better way is to organise them, as you know they also use energy in roaming about, especially during the dry season. If you organise them very well you can bring the fodder to them. Then instead of using their energy walking about, they use energy to give you foetus or give you milk or give you meat. But once you have enough, then you can make use of the biogas technology.

Domfeh *So what do you mean by enough?*

Aklaku You must have about ten or more cattle, or better twenty, forty. But to have one or two cattle, and then you allow them to roam about the whole day and then you keep them overnight. I don't know, sometimes they may not give you much dung at all to do anything with. So for a family of say four to six, if you have ten to twenty cattle, that must be able to give you one or two lights – a biogas plant about eight cubic metres will give you one or two lights and cook about two or three meals for you in a day. And I think that should cater for your energy demands in terms of kerosene, or in terms of firewood.

Domfeh *Is fish farming another good form of energy generation?*

Aklaku Yes. With fish farming the whole issue is about feeding. You need to have enough feed for them because they are multiplying, we are harvesting them, they are multiplying, we are harvesting them. This is why, for example, if you have a large inflow of liquid waste, after treating it in a biodigester, the effluent which is a biofertiliser, if you allow this to seep into where the fish ponds are, if the sun shines, this helps algae to grow, and the fish feed on the algae and you can be harvesting the fish. So this treatment of organic waste can also become a source of feed material for fishes growing in ponds.

Domfeh *What practical tips can you give a farmer who rears livestock, to make better use of the livestock in terms of supplying farm energy?*

Aklaku You see, even if you can't make use of all the droppings of all the animals, out of a hundred cattle you may have about one-tenth of them which are female ones about to calve. Normally you can seclude these ones. Cement an area, or have an area for them with a gentle slope. You can use a rake down the slope. When they drop their faeces, and their urine too drops, it washes along these rills into a container and that will be the entrance point for your biodigester. And with those ten cattle that are housed there overnight, before you are aware you have enough energy for you, and then the effluent which comes out, you can even grow your gardens around your place there. And before you are aware, you wife doesn't depend on kerosene, and she doesn't go to fetch firewood. So I would advise, maybe there should be a biogas programme for small-scale farmers, or large-scale farmers. *End of track*

Renewable energy in agriculture

Biogas – clean energy from cattle dung

Cue:
The burning of animal dung as a source of energy is often criticised for removing valuable nutrients from farming systems. However, there is a way that farmers can get energy from livestock manure and still use it as a source of fertility on their fields. When manure decomposes it releases a natural gas – a mixture of methane and carbon dioxide – which makes an excellent and clean fuel for cooking and lighting. In India and China this 'biogas' is used by millions of small farms, helping to improve farm sanitation as well as providing a low cost source of energy.

In Africa, Uganda is leading the way in the adoption of biogas. Even here, however, it is still quite rare. Wambi Michael recently travelled to Mukono district to meet Ruth Musoke, one of Uganda's biogas pioneers.

IN: "Madam Musoke, you are one …
OUT: … delay the less fire you get."
DUR'N: 5'23"

BACK ANNOUNCEMENT: Ruth Musoke, one of Uganda's biogas pioneers, talking to Wambi Michael. The interview comes from a resource pack produced by CTA.

Transcript

Michael *Madam Musoke, you are one of the few farmers within Mukono who are using a biogas digester. How did you learn about the biogas digesters?*

Musoke We have a friend called Pastor Kakembo, he came and visited our place, he suggested to us that we can install a biogas system at our place because we had cows and he had the same system at his place. So we went to his place and we admired the system. So he is the one who gave us the technical person who did the work for us.

Michael *When did this begin?*

Musoke That was almost 8 years back.

Michael *And has it been working throughout 8 years now?*

Musoke Yes, very successfully. We normally use it for cooking and lighting. We get light from biogas and then fire.

Michael *So let's go back to where the process begins. I can see this hole here, what is it for?*

Musoke This one is for the collection of urine from the main building where the cows stay throughout the day, but it was not enough, the urine was a lot so we had to construct another pit where the urine collects up. And that one it is more comfortable because it is where we do the mixing.

Michael *How do you mix the cow dung into the digester?*

Musoke At that system, there are two bowls which are prepared for the mixture. So we get urine from the pit and then we collect cow dung from the place where we keep the animals, and then we mix it up, pour it in the main digester. That is how it is done.

Michael *We have heard reports that you need 19 kgs of cow dung daily to feed a digester. Where do you get the 19 kgs of cow dung?*

Musoke Me, I have almost 9 animals and I normally use 2 wheelbarrows of cow dung to get the biogas I need for my home consumption.

Michael *Do you have some excess of cow dung which you don't use because you have many animals?*

Musoke Yes, I have a lot of it. Because what I have, I can't mix it up on a daily basis. We collect cow dung in the morning and in the evening. So we have a reserve pit again, where we keep this cow dung, the one which is not used up for biogas system, and it is normally taken up by those farmers and other people who have the system and don't have access to cow dung.

Michael *Can we go to the fireplace and see how it works?*

Musoke Yes.

Michael *In most times when you come to a kitchen like this in rural areas in Uganda, you see a lot of soot, but I can see here it's very clean.*

Musoke Yes and it's because I'm using fire from biogas.

Michael *Because normally entering such a kitchen would mean that maybe we would see some tears coming out of you!*

Musoke I don't think it's so clean, but that's how it is.

Michael *OK. I see very clean fire coming out of the gas plate. Where is the fire coming from?*

Musoke It is coming through the other pipe and these are the switches.

Michael *Which means you can cook two saucepans of food on this same gas plate?*

Musoke Yes, according to your plates. It can go up to three or four, it depends on what you want.

Michael *So can you switch it back on? So how long does it take to boil such water?*

Musoke It depends on the amount which you want, because now it is at the maximum. You can reduce, depending on the type of fire you want and on what you are cooking.

Michael *How clean is the biogas?*

Musoke Whatever you prepare is so clean, even the saucepan, they don't get stained. Blue flames only, which doesn't stain. And the maintenance is so low, just to repair the other plate, because they get stained. That thing is done in Katwe.

Michael *Does it rust?*

Musoke *Yes. For instance you are cooking something, what you are cooking pours on it and then that metal part of it rusts. That is the main problem with it. But I have changed it ever since it was there only two times.*

Michael *What about the digester, does it require some maintenance?*

Musoke Ever since we installed it we have never done any maintenance, but what you need to do, you have to be committed in mixing this. You become so smelly on the day when you do the mixing. That's why some people don't want that business. But here it is done, we regularly do it. I do it, my children do it, everyone who is on duty does it. We don't employ someone to mix for us.

Michael *Many Ugandans have heard of the biogas but many fear the installation costs. How much did it cost you to install this system in this farm?*

Musoke We used almost 2.5 million to install the system.

Michael *And you think you have reaped some money from the 2.5 million shillings that you initially invested here?*

Musoke A lot, I have saved a lot, because what gets out of the system? They come here, those ones who are doing the business of the gardens and what, they get that waste from me and they give me some money. What matters most is for someone who is using this biogas to be active in mixing. The more you mix the more fire you get, the more you delay the less fire you get. *End of track*

Renewable energy in agriculture

Jatropha oil – an alternative to kerosene

Cue:
Every evening, millions of families across the world light up kerosene lanterns, especially in rural areas not connected to a national electricity grid. In some countries, kerosene is also widely used as a cooking fuel, and may be subsidised by governments, to reduce dependence on firewood. But in Tanzania, a locally produced alternative to kerosene is gaining in popularity. Jatropha oil is produced from the seeds of the jatropha tree, a plant found in regions close to the equator, which can grow up to 6 metres in height.

Jatropha Products Tanzania Limited is a non-profit organisation which is promoting the use of jatropha oil in the country. Farmers, for example, are being trained in how to extract the oil and use it to meet some of their energy needs. Albert Mshanga explained more to Lazarus Laiser, about how the oil can be used.

IN: "Jatropha oil, essentially, can be used …
OUT: … energy at our household level."
DUR'N: 5'30"

BACK ANNOUNCEMENT: Albert Mshanga of Jatropha Products Tanzania Limited. The interview comes from a resource pack produced by CTA.

Transcript

Mshanga Jatropha oil, essentially, can be used in different ways. It can be used to light a small lantern like the jatropha lamps that we have in front of us here. Also it can be used in a small stove which has been modified to use plant oil. Jatropha oil can also be transformed into biodiesel and used in cars which use diesel oil.

Laiser *Now Mr Albert, focusing on the small lantern which is just before us, will you just describe how it is made?*

Mshanga This small lantern is made up of a recycled coffee tin. The coffee tins have been thrown away after the coffee inside has been used. Also we have a glass on top of it which is put there to radiate the light, to increase the illumination of the lamp. And we have the wires which are used for making handles and a frame for the glass. The fabrication of this lantern is quite simple. It is just a coffee tin, wire, and a glass and a copper tube at the middle of the lantern. The copper tube is used as an area where you fix or you put your wick, and the copper tube is used to warm the oil around it, so it makes the oil thinner so it can increase the capillarity of the oil.

Laiser *So the tube which is going down there, you say that it helps to heat the oil to make it thinner?*

Mshanga It is true that the copper tubes go inside the oil in the tin. The copper tube is used because it transmits heat inside, and plant oil is thicker than kerosene, so you have to warm it so that you reduce the viscosity of it, and hence you increase the capillarity of the oil.

Laiser *So you think that this lantern is more cheaper to use than the kerosene lantern?*

Mshanga Yes, the lantern is cheaper compared to the kerosene lantern. We did a study on the use of the jatropha oil and the kerosene in the same type of lamp. In jatropha oil, the amount of oil that was consumed in a month was only a litre, but for the kerosene we found that in a month it used three or four litres. And in lighting the lamp, the amount of oil that is used in ten hours, we did a study and found that for the jatropha, only 50 cc went out, while for the kerosene lamp, 180-220 cc of kerosene was used in the same period. So economically, this jatropha lamp seems to be more economical

compared to the kerosene lamp.

Laiser *What also if you compare the smoke which is coming out after burning the oil?*

Mshanga As you can see here, the jatropha lantern does not produce smoke. There is smoke but the smoke is very small, you can't even see it or you can't detect it.

Laiser *I just want to test it. I have a paper with me. Then I would like to test if it has smoke. Ah yes, I have my paper just close to the lantern, on top of the glass, and, how long was it? But not yet, I cannot see any smoke. So compared to kerosene, yes, it is wonderful. What else would you like to tell the listener, about the price of this lantern? How much is it sold for?*

Mshanga Currently the price of this small jatropha lantern is 3,500 Tanzanian shillings. But we do encourage in areas where we promote the production of jatropha, we do encourage farmers to produce oil and various other products on their own. So essentially what we do at JPTL, we teach the farmers how to process the oil and also we teach youth in those areas how to fabricate the lamp. So you will find that, even if you see now the prices are 3,500, but farmers can be taught how to fabricate the lamp, and they can fabricate the lamps for themselves and also sell to other householders within the community. And also, by teaching them how to fabricate the lamps, we create some sort of employment to the youth, and we do also conserve the environment by recycling the tins. The other thing is you can produce your energy at a household level. Instead of travelling long distance in search of oil; you know that a lot of villages in our country, the infrastructure is quite poor. Carrying kerosene from town to villages, the price goes higher compared to the oil which can be produced at local level, at household level. And you can have your energy for cooking, for lighting, at your vicinity, instead of going outside and depending on oil from outside, we can have energy at our household level. *End of track*

Renewable energy in agriculture

Charcoal briquettes for brooding chicks

Cue:
Minimising costs is an essential part of any successful business. For those who rear poultry, feed is normally the biggest cost. Farmers may be able to reduce this cost by making use of waste products from certain agro-industries, such as brewing. In the right mixture, these can make excellent poultry feed.

But as well as feed, poultry farmers also have to spend money on providing heat, particularly to the young birds. Here too, however, it may be possible for them to reduce their costs by using a waste product from a local industry – charcoal making.

In Uganda, trainees at the Katende Harambe Rural Urban Training Centre are taught how to use waste charcoal dust, mixed with other ingredients, to make fuel bricks, called briquettes. Trainer Godfrey Kiyoge explained more to Pius Sawa.

IN: "If you are a poultry farmer …
OUT: … to combat the what? The desertification."
DUR'N: 4'52"

BACK ANNOUNCEMENT: Godfrey Kiyoge with a cost saving way to brood poultry chicks which could also have a reduced impact on the environment. The interview comes from a resource pack produced by CTA.

Transcript

Kiyoge If you are a poultry farmer, there is what we call a brooder. It's the place where we put young chicks to provide heat and light for the first 30 days or one month. So there, it requires you to get either bulbs, that is if you have power, or you need to get the charcoal, that is what most people use too. They put on a charcoal stove, they burn it, so that they can provide heat and warmth in the brooder. But at this moment we don't need to use such because they are expensive, we just use the charcoal dust, we use the sawdust as an alternative, or we can use the silt, that fine soil, plus the grass and water. We mix and we make balls; then we sun dry it so it can dry thoroughly, then we use it in pots to burn it and get heat.

Sawa *You mean using in pots made out of clay?*

Kiyoge Yes, pots made out of clay. So you find the production cost is low, because what you have used is got from the farm. We are promoting things which are locally available so that our people can use what is within their reach. And you know, when we talk of charcoal briquettes and other techniques in farming, we look at things which are cheap, which a farmer can adopt. Most of our farmers are poor, they are very poor, they can't raise too much money to put in such a business. But when you talk of these, they are very cheap. They can get or sell their cabbages which are grown, say, on the veranda, and then able to buy the other ingredients, like the sawdust, something which needs money to buy.

Sawa *How many chickens can you brood in a period of time using charcoal briquettes, and how many charcoal briquettes do you need to brood those number of chickens?*

Kiyoge Like in a square metre, 2 square metres, you can get something like 4 or 5 big sized charcoal briquettes that can burn for the first 6 to 8 hours.

Sawa *Five of them is enough for how many number of chicks?*

Kiyoge Like a hundred chicks. If it is drought season you don't need too much heat. But during rainy season, even during day there are times when you

need to provide heat.

Sawa *So you mean in a drought season you use less charcoal briquettes because there is enough heat?*

Kiyoge Yes, there is heat from the sun and then the environment is hot, and then you don't need too much. But during the rainy season, because the environment is cool, you need to provide heat.

Sawa *For how long have you been using charcoal briquettes in poultry?*

Kiyoge For over 6, 7 years I've been using charcoal to brood – especially here we have the programme for hatching. We use the local chickens to hatch the chicks, instead of using the brooders, exotic brooders and what. So once they are hatched we normally collect them together and then we brood them. To make it more cheap, we use the briquettes, and this is what we have been promoting to our farmers who come here to train.

Sawa *Has this technology been adopted by many farmers in Uganda?*

Kiyoge Yes, many farmers now are adopting, and farming industry people are now copying, because this is now the only way how people can get income. Because after the getting the product, like if you are keeping poultry you are targeting two or three things. You are targeting what comes out as waste, which is dung or droppings, which is fed to fish and other animals like goats and cattle, plus pigs. And then you look at the eggs. So if people can use low cost inputs, they can still get more income out of it.

Sawa *And how sustainable is this technology?*

Kiyoge The sustainability of the technology, as we know here in Uganda, most of the people are in the business of selling charcoal. So that you find that you have a lot of dust produced. So if one was to collect such, you can get sacks and sacks. Provided that people are still making charcoal as a source of energy for cooking there is sustainability in getting charcoal dust.

Sawa *And we are talking about environmental protection, and if you say charcoal is to be burned so that people can get the dust and make briquettes. Don't you think that is one way of impacting on the environment?*

Kiyoge As an environmentalist I can honestly say that it is not good to make charcoal. People are still making it because that is the only way. And if they are still doing so, we also look at how we can utilise whatever they produce. And this will also help us, if they are to utilise also the dust which is wasted, that means they will reduce on the way people have been cutting trees to combat the what? The desertification. *End of track*

Renewable energy in agriculture

Recycling plant materials

Cue:
As oil prices reach record levels, chemical fertilisers are also becoming harder to afford. But crops need nutrients to grow and if left without fertiliser, soils soon become depleted and unproductive. Using organic matter found on the farm, such as crop residues and animal manure, can be a low-cost alternative to chemical fertilisers. It can also help to build longer-lasting soil fertility and healthier crops with fewer pest and disease problems.

At the Fambidzanayi Permaculture Centre in Harare, Zimbabwe, researchers have been investigating how much organic matter, or biomass, crops need to grow well. Edwin Mazhawidza, a research officer, explained more about this to Sylvia Khumalo, and how the system of using organic matter as a fertiliser, known as biomass transfer, works.

IN: "Biomass transfer is a technology …
OUT: … system can now replicate itself."
DUR'N: 5'21"

BACK ANNOUNCEMENT: Edwin Mazhawidza, on how energy stored in plant matter, known as biomass, can be used to increase crop production. The interview comes from a resource pack produced by CTA.

Transcript

Mazhawidza Biomass transfer is a technology that has been used long back by many farmers. And in the system of biomass, we will be mainly concentrating on the use of things like stover, animal manure in the farming system. These things: straw, crop residue, manure, they contain energy, and also they contain a lot of nutrients which are needed by the plants. So it is a form of renewable energy which is used in the farming system.

Khumalo *Tell me, are there any geographical limitation or considerations that a farmer has to make before they venture into this type of practice?*

Mazhawidza There are no geographical restrictions. What is important in this farming system is that a farmer has to do all conservation techniques. Because a farmer may need trees, he may need also grass, and animals must also be integrated in the farming system. So in terms of geographical restrictions, this practice can be applied anywhere, and even in the desert, even in the rainforests or even in the savannah woodlands, provided that a farmer has access to crop residues to straw or even to manure. And if that farmer has access to those things, he or she can retain them. So there are no geographical restrictions when one wants to engage in this biomass transfer as a way of maybe fertilising the soil or even pest and disease management in the farming system.

Khumalo *Is there any special type of knowledge that a farmer has to have in order to establish this system and also are there any financial implications?*

Mazhawidza In terms of knowledge, we shall find out that the knowledge which we are using is that knowledge which is local, which is indigenous to the people at a particular place. We then enhance that information with the research which are currently being done now. For example, we can now know the nitrogen, phosphorous, potassium ratios in all those crop residues and in manure. So we are just blending that information with the indigenous knowledge system that has been there.

Khumalo *I see you have already done some breakdown of the nitrogen, phosphorous and potassium. Of what use is this information to the end user?*

Mazhawidza When we are talking of this nitrogen, phosphorous, potassium ratio, it benefits the user because we are now talking about plant nutrition. Plants need certain minerals for them to produce food. For example, when we are talking of a crop like maize, maize needs around 200kgs of nitrogen per hectare, 90kg of phosphorous per hectare and also potassium, it needs 70kgs. So the NPK ratio can actually assist a farmer, knowing how much to apply. So that is the reason why we are breaking down these various biomasses, knowing the NPK ratio so that we can recommend the farmer what to use so that they can have a higher yield.

Khumalo *So how sustainable is this system?*

Mazhawidza This system is very sustainable. It is economically viable, because a farmer would be using available resources. Like for example cow manure, leaf litter, straw, wood, all those things may be available at the farm. So he may have higher profits because the inputs would be less. So that system is also sustainable in the sense that there is interdependence of elements. For example, animals may depend on plants and plants may also depend on animals so it actually replicates itself, the system.

Khumalo *Right and Eddie you have also been telling me about your outreach programmes in the community. Can you tell me how that works?*

Mazhawidza We have got outreach programmes around Zimbabwe, in Mashonaland district, in Matabeleland district, where we are implementing these techniques with farmers. And we are working with around, more than 1,000 farmers. So we are carrying researches with these farmers on biomass transfer. We target specific plants, for example there are plants which have got high nitrogen such as the leucaena species, and we also do research with farmers using their organic manure so that the farmers can have that hands on approach by observing the results. And after observing the results they can know the best technique for them to use. And it appears as if most of them are adopting this biomass transfer because they feed the soil, then the plants can absorb the nutrients from the soil. Unlike chemical fertilisers which can feed the plant directly, but in this biomass they actually work for an average of four years. So although it is labour intensive for the first year, but after the first year the system can now replicate itself. *End of track.*

Renewable energy in agriculture

Trees for fuel and fertility

Cue:
When we talk about renewable energy, we may think first of technologies like solar panels or hydroelectric dams. We probably don't think of firewood, not least because much of the firewood we use is not from renewable sources; trees are felled but not replaced, and in time the land becomes deforested and barren.

But given responsible harvesting and replanting, trees can be an excellent source of renewable energy. And for farmers, some tree species not only provide fuel, but also boost soil fertility, contributing energy that crops need to grow.

Hellen Wangechi, who works for the Tropical Soil Biology and Fertility Institute in Nairobi, Kenya, works with farmers to promote tree planting. Visiting her on a windy day at her field station in Laikipia, Winnie Onyimbo learned more about how to make better use of trees on farms.

IN: "When advising farmers on tree …
OUT: … and you can do very well."
DUR'N: 3'00"

BACK ANNOUNCEMENT: Hellen Wangechi with some sensible advice for tree planters. The interview comes from a resource pack produced by CTA.

Transcript

Onyimbo *When advising farmers on tree planting does a choice of tree vary between different locations?*

Wangechi Wow, yes it does and it varies with agro-ecological zones. When you look at the rainfall, for example, when you look at the soil, the soil type, it varies. Like the tree you will plant in Mombassa at the moment is not the same tree that will do well in Nyeri which is cold. So the tree varies with the region. So the farmer has to be advised.

Onyimbo *Are there trees that are good for both fuel and also for soil fertility?*

Wangechi Yes, like sesbania, it takes about 3-5 years, it is very good in nitrogen fixing and also good in fuel wood. We also have Cajanas cajan, that it is the pigeonpea. It also provides fuel wood and nitrogen, as well as food: the pods, we eat the pods. And quite a number of other trees, like tephrosia also provides both of them, among many other trees.

Onyimbo *Do you encourage farmers to plant one species or do you encourage them to plant a mixture of species?*

Wangechi Most of the time we tell them to mix the species because there is a bit of compatibility. Even when you look at maybe disease outbreaks and all that, if you have a mixture of trees there is a tendency that some trees will resist of course and some will die, some will remain. And also when you have a mixture of trees, also you know the products that you get from the trees, they vary also. You will be able to get maybe edible pods, fuel, timber, from a variety of them. So we advise them to plant as many varieties, as many types as you can on your farm.

Onyimbo *What are good practices for harvesting fuel wood?*

Wangechi Personally I would not encourage a farmer to cut a whole tree but I encourage people to prune the trees. Pruning removes the side branches and if you have enough trees on your farm you can be pruning trees every now and then and you get enough supply of fuel wood.

Onyimbo *Ok what are good practices for increasing soil fertility?*

Wangechi You can use trees. The nitrogen can be added into the soil when the leaves fall and they decompose. Or the same trees can be cut and they can be incorporated into the soil so they add nitrogen. But for other nutrients like phosphorus and potassium, there are some trees that have been found to mine. Mining is the sourcing of the nutrients from deep into the soil and it is recycled, brought up into the upper soil layers or the soil surface where the plants or the growing crops can take it up.

Onyimbo *Ok one last thing, what would you advise African small-scale farmers on planting trees, both for soil fertility and for fuel wood?*

Wangechi Seek for information first before you plant. Be advised by the experts on what to plant, where to plant and how to plant it, and the best type for your particular region because not all trees do well in that particular region and again not all trees supply the same amount of nitrogen. Seek information and it is there, we have institutions dealing with that and you can do very well. *End of track*