A Future in Our Hands Cameroon publication

STRATEGIC HUMANITARIAN SERVICES

INTEGRATED ORGANIC FARMING, TRAINING, DEMONSTRATION AND PRODUCTION CENTRE

FIOH is a Movement encouraging the values of sharing, cooperation, fellowship, compassion and truth as the foundation of a better quality of life for everyone and challenges systems that deliver wealth to the few at the expense of the majority.

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Introduction

Here is some basic information:

Land area 480,000 sq km

Arable land 13%

Main resources petroleum, bauxite (from which aluminium is obtained), iron ore, timber and hydro power (a major provision of the country's electricity)

Population approx 20 million

Population growth 2.2%

Life expectancy 53.3

HIV disease 6.9% adult prevalence rate

AIDS - half a million people live with AIDS

Capital Yaounde

Regions There are 10 administrative divisions in the Cameroon

Unemployment 30%

This booklet should ideally be read in conjunction with the FIOH booklet "Environmental Study Guide - Organic Farming and Tree Planting in Africa" which illustrates the importance of organic farming and agro-forestry in the context of major world crises including peak oil and gas and climate change. Also described in that booklet are the problems caused by the widespread planting of eucalyptus trees in the NW Region which have the effect of lowering water tables and reducing crop yields near to where the trees are planted. SHUMAS ran a major programme of replacing these trees with species suitable for agro-forestry. This enabled 9,000 women farmers to gain access to land close to their homes and greatly increase family incomes. Children in 10 schools were educated in the importance of the environment and local tree species. This education programme is expanding. Also included in the booklet is a brief description of nitrogen-fixing tree species, green manures and natural pest control and a comparison between organic and chemical farming.

Agroforestry

People living in the Sahelian regions of Africa have long practised agroforestry or, more properly, agro-silvo-pastoralism, a new term for the practice of growing woody plants with agricultural crops and/or livestock on the same land. Agricultural crops such as millet, sorghum, maize, cowpeas and groundnuts are often grown under a park of Acacia albida (apple-ring acacia, or gao), precisely because the farmers realise that they will reap better harvests when they plant their crops in close proximity.
Agroforestry systems in these challenging environmental situations have also been shown to be efficient in locally modifying temperatures and in intercepting rainfall, facilitating infiltration and maintaining satisfactory soil moisture levels. This, among other benefits, reduces moisture stress in plants and regulates soil temperature fluctuations and soil-water relationships. This assures the survival of critical soil organisms such as nitrogen-fixing rhizobial bacteria. Perennials contribute to the enrichment of the agricultural systems through nutrient cycling and help control wind and soil erosion.

In the past, Sahelian agricultural systems had greater crop diversity ensuring food security. Because of the differing requirements of the various crops and the selectivity of most crop diseases and predators, the magnitude of losses associated with less complex monocropped systems were prevented. Also, because crops in agroforestry systems are harvested at different times, labour inputs are distributed over longer periods. Unfortunately, in many regions of the Sahel, shifts to monocropping and open-field cultivation have resulted in lower productivity, reduced groundwater recharge, disruptions of soil ecology and nutrient cycling and increased soil erosion.

Throughout Africa forest cover is declining, but an encouraging development has been an increase in the numbers of trees being used on farms. Where there are trees, farmers have access to fodder, timber, fruit, fuel and shade for their crops. In Malawi, for example, maize yields have increased nearly threefold where grown under a canopy of Faidherbia albida trees. In Niger 4.8 mil hectares of agroforestry, using the same tree species, enhance millet and sorghum production. Ethiopia has made a commitment to increase agroforests to 15 mil hectares by 2015, particularly focusing on desertified areas with a low density of trees. Preparatory work for national programmes is under way in Tanzania, Mali and 12 other countries.

Dennis Garrity of the World Agroforestry Centre says that “We see evergreen agriculture as nothing less than a radical, but entirely practical, pathway to the reinvention of agriculture”.

Organic agriculture

Most farming throughout the world has become dependent on the use of artificial chemical fertilizers, herbicides and pesticides. Whilst improving crop yields and protecting against attack from insects, fungi, weeds, bacteria, rodents and other pests, they have many harmful effects on the soil that can reduce long-term food security. Also, they are dependent on fossil fuels and the rising costs of production means that they are increasingly unaffordable for poor farmers.

Worldwide, approximately 45,000-50,000 different types of pesticide are being produced. Although they provide short-term benefits for crops, they can also destroy beneficial organisms and the structure of the soil. This creates a vicious circle whereby further application of chemicals is required to maintain yields.

Pesticides can kill useful insects and organisms which predate pests, enhance soil structure or pollinate plants. Run-off from the land where chemical pesticides and fertilizers have been applied, can pollute streams and aquifers. The lack of protective clothing for those applying pesticides and also the spraying of crops, have resulted in many deaths and deformities.

Strategic Humanitarian Services (SHUMAS) in recognition of all the problems associated with chemical pesticides and fertilizers, coupled with other poor farm practices which lead to topsoil erosion and loss of soil fertility, has established a training centre to teach sustainable organic agricultural techniques.

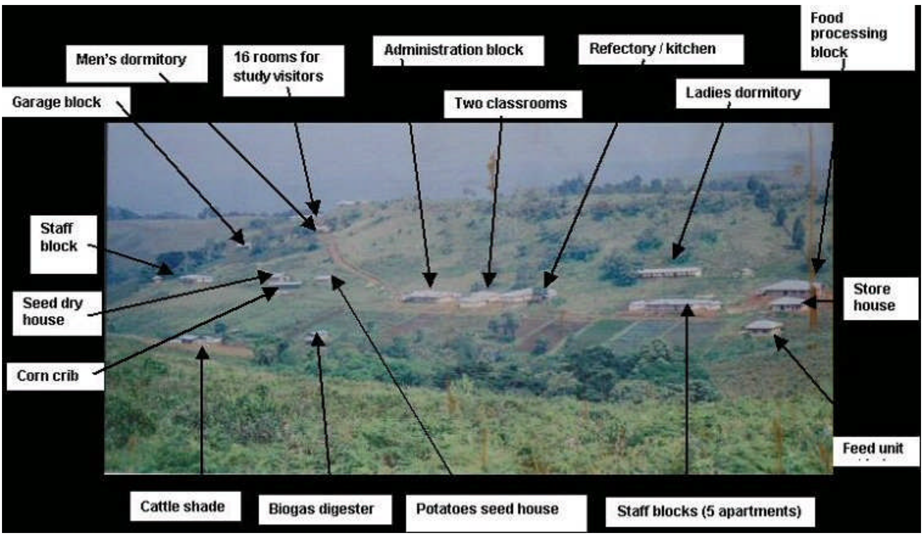
The training includes instruction in the welfare of animals and has both practical and theoretical elements. Although the training is provided for both men and women, it has a particular focus on the needs of poor women for whom agriculture is their only source of income.

This booklet provides an overview of the centre’s facilities, the courses available and what students can expect to learn from them.

The SHUMAS Organic Farming Training Centre

The Centre is situated near the town of Kumbo in the NW Region and the training it provides addresses most of the problems associated with farming and income generation in the surrounding rural areas, which include:

1. A rapid population increase requiring more land for infrastructure, industry and farm land.
2. Hilly land and savannah vegetation, making it particularly vulnerable to soil erosion.
3. Rising costs of chemical fertilizers and pesticides which can mean that farmers are unable to afford school fees for their children and adequate nutrition for their families.
4. Young people believing there is no future in agriculture migrate to urban areas where they have difficulty finding employment.
5. Farmers being unable to sell their produce when prices are low because they have to prioritise the settling of debts.
6. Poor farming techniques, such as planting down slopes rather than along contours, or inadequate pest control resulting in poor harvests.
7. Diseases in farm animals because they do not have sufficient pasture on which to feed. The lack of pasture is often caused by the spread of bracken. Farmers are often unable to treat these diseases. .
8. Conflicts between farmers and animal herders when animals feed on neighbours' crops or with eucalyptus tree owners whose adjacent trees cause loss of fertility and lower water tables.



In order to tackle these often inter-related problems SHUMAS has devised training programmes that can be adapted to a variety of situations and farm environments in the region. Its programme, which it has referred to as **integrated organic farming**, involves crop production, animal rearing, pasture improvement, biogas production and agroforestry in an integrated manner. The Centre's staff carry out research on common pests in the area and devise methods of destroying them without recourse to the use of chemical pesticides. Nitrogen-fixing tree seedlings are also grown on the farm which will provide a natural method of providing crop nutrients.

Both long and short-term courses are run at the Centre to meet the differing needs of students. The short courses are more specialised. All course participants are expected to share the techniques they have learnt with other farmers when they return to their communities in the villages.

Among the many facilities provided at the Centre are areas set aside for improved animal pasture using bracharia and guatemala and for a nursery of the nitrogen-fixing tree seedlings.

Cattle grazing on bracharia grass

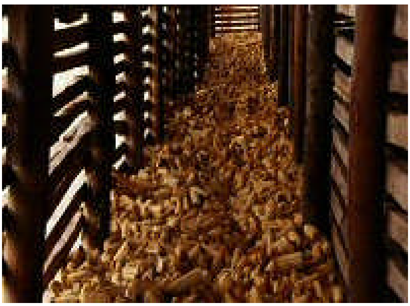
Agroforestry tree nursery

Planting maize

Maize one month after planting

Maize 3 months after planting

Harvesting maize



Maize in barn

Maize drying house


Biogas digester for processing animal waste (cow dung and pig droppings)

Slurry from the biodigester is used as both a fertilizer and a pesticide

Spraying slurry on egg plants

Government senior minister visits

Potatoes

In addition to the crops grown widely in the region, wheat trials have been established at the Centre. The first small trial gave about 40 kg and there are plans for growing wheat over a larger area of the farm.

Wheat

Students during a practical session

Animals are integral to organic farming and their welfare forms an important part of the training at the Centre. Some of the animal units are shown below.

One of the pig units

Cattle in night paddock

Egg collection

Weeding lettuce

Animal production

The farm has a piggery, poultry (layers and broilers), cattle and small ruminants (goats, sheep and rabbits). These animals are reared for the following purposes:

- Training participants on animal rearing;
- Production of animal dung to be used as natural fertilizer;
- Production of animal dung as raw material for biogas production;
- Fattening for consumption and marketing
- Ploughing the fields before crop cultivation.

The animal production unit is focused on dung production and pasture improvement. Fodder, including Guatemala and Bracharia, is spread on newly ploughed fields. Many reared animals lack sufficient pasture despite the availability of large grazing fields. The fields are covered with bracken fern that prevents the growth of good pasture. Cattle production in the North West Region was once one of the highest in the country, but this has dropped due to the increase in bracken fern.

A tractor is used to provide sufficient rest periods for the draught animals and is occasionally hired out to farmers in the region many of whom have copied these methods of improving pasture. The animal dung is used directly as fertilizer or passed through the biogas system to produce biogas and its by-product used as natural fertilizer and natural pesticide. To maximize dung production, some animals are confined. Rabbits, birds and pigs are reared and their waste is collected.

Cattle, goats and sheep are allowed to graze in the field during the day and in the evening they are enclosed for security reasons and also to make sure that their droppings can be easily gathered. The area where the cattle are confined at night is concreted to facilitate the collection of urine which is very rich in nitrogen and is good as fertilizer when kept for about three weeks or added to compost.

Spreading bracharia

Small ruminant building

Tephrosia **Compost manure**

The Biogas Production Unit

Because of the important role played by the biogas unit in the production of bio-energy, bio-fertilizer and bio-pesticide the Centre is commonly referred to as the **Biofarm** [This term is not to be confused with biodynamic farming which is neither taught nor endorsed at the Centre].

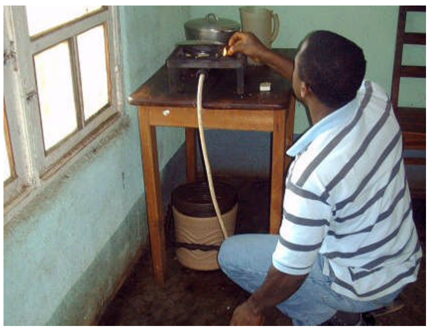
Integrated organic farming

SHUMAS's integrated approach to farming has resulted in increased crop and animal yields and the provision of energy. The animal dung produced has been used as natural fertilizer and also as raw material for the biogas plant to produce energy that is used for cooking and heating. The slurry by-product from the biogas plant has been found to act as natural pesticide.

The corn that is grown is used for preparing animal feed and also for consumption in the Centre. After corn harvest, the corn stems and leaves are harvested and preserved for consumption by animals in the dry season when there is little pasture. Agro-forestry techniques are used to improve soil fertility and ensure high crop yields. Tephrosia and Scrotin are seen all over the farm and play many roles in crop production. Tephrosia enriches the soil in nitrogen and Scrotin's leaves enrich the soil in nutrients, provide shading to crops and also serve as wind breaks. Bee farming is practiced in the gallery forest found in the valleys. This activity produces honey and the bees are useful insects as they help in pollination. Pasture is improved by planting Guatamala and spreading Bracharia leaves and stems. There are plans to engage in more integrated livestock rearing and management as this has proved to be less expensive than more commonly used methods.

SHUMAS plans to use fowl droppings to feed fish in ponds (still to be established) and pigs. The animal dung from pigs and cattle can be used to culture earthworms for fish food and the slurry (by-product) from the biogas plant could also be sent directly to the pond to promote the growth of plankton. The slurry and other animal waste could be used as bio-fertilizer

Inverted drum on biodigester raised by the presence of biogas



Biogas being used for cooking

Biogas production rationale

The Centre is located in an area where the population faces a lot of problems getting energy for cooking, heating and lighting. The area is far away from the national electricity grid. This area is covered by grass fields and has small patches of forest found in some of its valleys. The peasant farmers have to walk long distances to fetch firewood, especially from these small patches of forest, for cooking. This has caused deforestation in the area. When firewood is used for cooking it produces smoke that causes indoor pollution and this has been responsible for a large number of respiratory diseases world wide as sited by World Health Organization. Those most affected are women and their children who spend much time in the kitchen preparing food for the family.

Prices of petroleum products are increasing rapidly and rural people can no longer afford to use products like kerosene to meet their energy needs. SHUMAS was going to face the same problems in its Centre and hence sought an alternative solution by producing biogas energy for cooking and heating. In collaboration with a research student from the University of Dschang, Cameroon, Tize Koda Joell, SHUMAS developed a biogas plant that has been producing biogas in the Centre. This is used to prepare food for the staff and participants doing the nine months course. Some of this energy is used for heating the poultry. The awareness of biogas technology for use by the surrounding population is another step that needs to be taken by SHUMAS to meet its mission of "Improving lives, reducing poverty and empowering people so that they can meet their needs, without compromising posterity from meeting theirs". This will help preserve the patches of forest which have been over-exploited, reduce poor peasant drudgeries in fetching firewood and provide a clean source of energy to the rural population. This technology is suitable for the population around the Centre because every family around engages in animal rearing (sheep, goat, cattle). The surrounding population needs to be trained in how to build and operate biogas plants.

Slurry tank, digester and mixing chamber

Compost

Principles of biogas production

Biogas production is the creation of bio-fuel using the anaerobic decomposition of organic materials from plant or animal origin. Anaerobic decomposition of organic materials occurs when biodegradable matter from living or once-living organisms decay with the help of micro-organisms in an oxygen-free environment. Biogas is often celebrated by environmentalists for its relatively low carbon output. It can act as a substitute for fossil fuels as an energy source for heating, cooking and moving vehicles.

A biogas plant has two principal components - a digester and a gas holder. The digester is an airtight container in which the organic waste is dumped and decomposes and the gas holder is a tank that harnesses the gases emitted from the digester. Bacteria within the digester tank breaks down the waste and, as it decomposes, gases such as carbon monoxide, methane, hydrogen and nitrogen, are released. Through a pressurized system, the gas holder conducts the flow of these gases upward into a hole in the drum of the holder. The hole is specially designed to allow gases to pass freely into the holder while preventing any gases from escaping back into the digester. When the gas is ready to be used the gases are put in contact with oxygen in a controlled environment to create a combustion reaction. This combustion produces an energy source for such processes as heating, cooking and vehicle propulsion.

Biogas production can occur in different types of plants, depending on the amount of gas needed, the amount of waste at hand, and whether the digester is designed for batch feeding or continuous feeding. Batch feeding systems decompose mostly solid wastes that are added to the tank in instalments, while continuous feeding models feed mostly liquids to the digester. Biogas production can be achieved in above or below ground plants. Both models have advantages and disadvantages. An above ground biogas plant is easier to maintain and able to benefit from solar heating, but needs more care in construction. A below ground biogas plant is cheaper to construct and easier to feed, but more difficult to maintain. Anaerobic digestion will occur best within a pH range of 6.8 to 8.0. The bacteria responsible for the anaerobic process require nitrogen and carbon elements, as do all living organisms, but they consume carbon roughly 30 times faster than nitrogen. Assuming all other conditions are favourable for biogas production, a carbon - nitrogen ratio of about 30:1 is ideal for the raw material fed into a biogas plant. A higher ratio will leave carbon still available after the nitrogen has been consumed, starving some of the bacteria of this element. These will in turn die, returning nitrogen to the mixture, but slowing the process.

Anaerobic breakdown of waste needs temperatures lying between 0°C and 69°C, but the action of the digesting bacteria will decrease sharply below 16°C. Production of gas is most rapid between 29°C and 41°C or between 49°C and 60°C. This is due to the fact that two different types of bacteria multiply best in these two different ranges, but the high temperature bacteria are much more sensitive to ambient influences. A temperature between 32°C and 35°C has proven most efficient for stable and continuous production of methane. Biogas produced outside this range will have a high percentage of carbon dioxide and other gases than within this range. Microbial diversity in biogas digesters is great and about seventeen fermentative bacterial species have been reported to play important roles in the production of biogas. Furthermore, it is the nature of the substrate that determines the type and extent of the fermentative bacteria present in the digester.

Systems intended for the digestion of liquid or suspended solid waste (cow manure is a typical example of this variety) are mostly filled or emptied using pumps and pipe work. A simpler version involves using gravity waste liquid or suspended organic solid waste that is fed to the tank and the digested slurry is allowed to overflow the tank. This has the advantage of being able to consume more solid matter as well, such as chopped vegetable waste, which would block a pump very quickly. This provides extra carbon to the system and raises the efficiency. Cow manure is very rich in nitrogen and is improved by the addition of vegetable matter.

Biogas production is often preferred to fossil fuel energy sources, such as oil or coal, for environmental and economic reasons. The rising concentration of carbon, a greenhouse gas, in the atmosphere has become a central issue in the problem of global warming. Though both biogas and fossil fuels emit carbon, fossil fuels release carbon that has been buried for many years in ancient biomass and eventually removed from the carbon cycle. Carbon released during biogas production and use has been stored in the form of organic matter only recently and is still part of the cycle. Therefore it does not cause as much carbon concentration in the atmosphere.
Proponents of biogas production also prefer biogas to fossil fuels because it is a low cost, renewable source of energy, and it uses waste materials. Biogas production can take place on a small scale and this makes it a viable option for many regions of developing nations. Critics of biogas argue that food crops grown for the purposes of biogas production will create a global food shortage. However this criticism usually relates to the use of crop land to grow biofuels such as jatropha and palm oil. In many regions of the world tropical forest has been cleared to grow palm oil as a cash crop for both processed food and fuel. In addition to deforestation this may also cause

water pollution, soil erosion and have a negative impact on oil producing nations. In some cases, especially in the USA, food crops have been grown to provide ethanol as a transport fuel. SHUMAS is using animal waste and not food to produce biogas.

The biogas production process

Activities in the biogas plant of the Centre are carried out on a daily basis. Every morning animal waste, mostly from cattle, is mixed with water and fed into a mixing tank in a 1: 1 ratio. After feeding into the mixing tank it is stirred to promote its movement by gravity to the digester. In the digester there exists an anaerobic condition that leads to the formation of methane gas and other gases. The produced methane (biogas) is collected in an inverted drum above the digester. The walls of the drum extend down into the slurry to provide a seal. The drum is free to move to accommodate more or less gas as needed. The weight of the drum provides the pressure on the gas system to create flow. The produced biogas flows through a small hole in the roof of the drum. A non-return valve here is a valuable investment to prevent air being drawn into the digester, which would destroy the activity of the bacteria and provide a potentially explosive mixture inside the drum. The drum is slightly smaller than the tank, but the difference is small to prevent loss of gas. The biogas is transferred through the pipes to the kitchen where it is used to prepare food and to the poultry where it is used for heating.

Slurry collecting tank

Mixing tank

The daily feeding of animal waste through the mixing tank pushes the old animal waste in the digester out by gravity to the discharge tank. The biogas by-product in the discharge tank (slurry) is collected and used as bio-fertilizer in the crop areas and also to act as a natural pesticide. This fertilizer is better than other organic manure in that mineralization has occurred and nutrients are directly available to crops. The biogas by-product contains no infectious bacteria as they are unable to pass through the digester without being killed.

Use of biogas slurry for soil fertility and pest control

The biogas is produced mainly from cow dung. Slurry resulting from cow dung anaerobic digestion in the biogas plant is composed of 1.8 - 2.4% nitrogen (N2), 1.0 - 1.2% phosphorus (P2O5), 0.6 - 0.8% potassium (K2O) and 50 - 75% organic humus. The anaerobic condition involved in biogas production mineralizes organic matter through the increased incubation period. The application of slurry improves the physical, chemical, and biological characteristics of the soil. The anaerobic digestion decreases the C:N ratio and increases the concentration of immediately accessible plant nutrients. The slurry could be sold as fertilizer, used in crop fields to improve soil fertility, be sprayed on pastureland as liquid fertiliser, or used as a nutrient medium for aquaculture. The slurry is used on vegetable (huckleberry and cabbage) plots to increase soil nutrients. High yields have been recorded in these areas due to the application of slurry as manure. The presence of nitrogen, phosphorus and potassium in slurry, needed by plants in various concentrations, is responsible for the high crop yields.

The slurry is collected in another tank. This tank is always free from flies and insects, whilst many flies are seen in the tank where the cow dung is mixed with water. This slurry has been noticed by the farm staff to contain some special characteristics that could be used to fight pests in crop fields. The huckleberry fields were seen at one time to be affected by a certain pest and the staff of the farm decided to continuously water it with slurry which they had discovered to be free from flies. After some time it was discovered that the pest had disappeared. Since then, the staff of the Centre have been using slurry for pest management in the vegetable fields. There is still need for more research on the possibility of producing a natural pesticide from this slurry. This will provide an opportunity for it to be sold to other farmers.

Use of biogas energy in the Centre

Cow dung is used to produce biogas in the Centre. About one cubic foot of gas may be generated from one pound of cow manure at around 28°C. This has been known to be enough gas to cook a day's meal for 4-6 people in India. About 1.7 cubic metres of biogas has the energy equivalent of one litre of gasoline. The manure produced by one cow in one year can be converted to methane which is the equivalent of over 200 litres of gasoline. The energy value of biogas varies between 4.5 and 8.5 kWh/m3, depending on the relative amounts of methane, carbon dioxide and other gases present. Both methane and carbon dioxide are odourless.

The biogas is used for cooking food for the course participants and staff - usually about 50 people. The biogas is connected to the kitchen where food is prepared. It is the only source of energy used for cooking at the Centre except for staff who prepare their own food using cooking gas from fossil fuel.

The biogas is also used for heating the poultry. Bamdzeng in Kumbo where the Centre is located, is at the top of a hill and is very cold for the survival and proper growth of poultry. Biogas has been used to provide the birds with the heat that is necessary for their growth and well being.

Participants queue for meals prepared using biogas fuel

Chicken house heated using biogas

Research at the Centre

The Centre provides opportunities for research into various aspects of agroforestry and organic farming. A former course student, Wirsiy Emmanuel Binyuy, has carried out research to determine the yields of huckleberry (*solanum scabrum*) obtained from different applications of biogas slurry. The research method and results are described briefly below:

Huckleberry (sometimes called Njama-jama) is a commonly grown indigenous vegetable in the western and north western region of Cameroon. Cooked leaves and fresh shoots are consumed with cornfufu, plantains, sweet potatoes, yams, maize and pounded cocoyams.
The objects were to:
1. Assess the physico-chemical characteristics of biogas slurry;
2. Assess the physico-chemical characteristics of a composite soil sample taken from the same site;
3. Assess the effects of biogas slurry on huckleberry growth.

Method:
1. The research plot was divided into 3 equal blocks and each block had 10 beds;
2. Each bed measured 3m in length and was 1m wide;
3. The applications of slurry onto each bed was done through a complete block randomised design method;
4. The biofertilizer slurry applications were 0.5 Kg/m^2, 1.0 Kg/m^2, 1.5 Kg/m^2, 2.0Kg/m^2, 2.5Kg/m^2, 3.0 Kg/m^2 and 3.5 Kg/m^2;
5. Urea (0.06 Kg/m^2) and NPK (0.12 Kg/m^2) were applied on some beds. One bed in each block served as control;
6. To control pests the plot was fenced and scarecrows erected

Layout of beds in the plot

Soil sample collected

7. 10 soil samples were collected using a zig-zag method and a composite sample prepared for laboratory analysis;
8. Biogas slurry was collected, thoroughly mixed and the composite sample taken for laboratory analysis;
9. Samples were analysed to determine their content in carbon, nitrogen, phosphorous, potassium, calcium, magnesium, sodium, conductivity, PH and carbon-nitrogen ratio.

Collecting, drying, mixing, weighing and distributing biogas fertilizer

Method used to nurse, transplant and measure huckleberry growth

1. Huckleberry seeds were nursed and healthy ones transplanted after 4 weeks;
2. Seedlings were spaced 20 cm apart with 4 seedlings on the bed's width and 12 on the bed's length;
3. The seedlings were watered every evening for 2 weeks after transplanting and once every 2 days thereafter;
4. 10 plants in the middle row of each bed were selected for measuring the growth rate;
5. The plants were harvested at 6 weeks and 8 weeks after transplanting and weighed.

Weighing harvested crop

The number of leaves and branches in the stem reduces from plant base to the top

Measuring height of plant

Plants develop more branches and leaves after main shoots are cut during first harvest

Results of biogas slurry and soil sample analysis

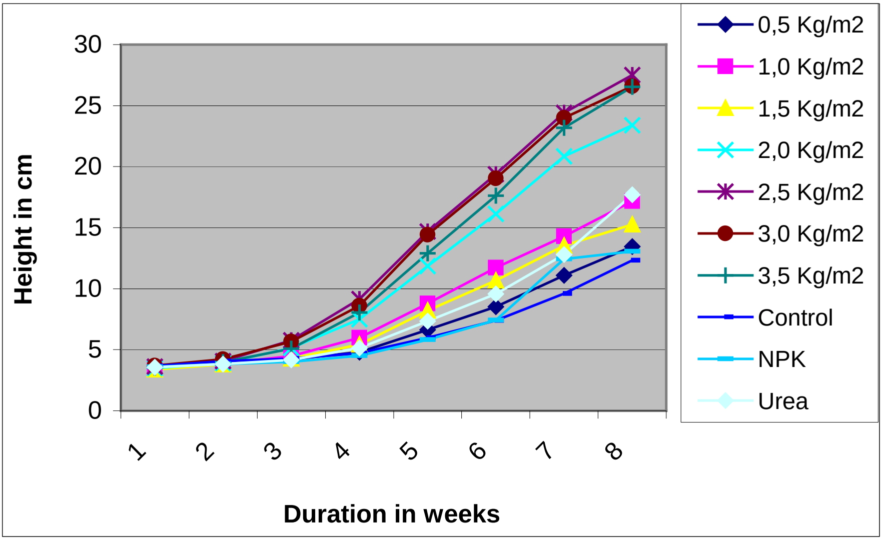
	N (g/Kg)	P (g/Kg)	C/N	TOC (g/Kg)	Na (ppm)	Mg (ppm)	Ca (ppm)	K (ppm)	pH (water
Biogas slurry	2.1	1.4	13.6	28.6	0.41	0.04	0.14	0.51	7.85
Soil	0.7	0.6	41.2	29.3	0.043	0.01	0.06	0.38	6.27

Crop yield for 38 crops in each bed after 6 and 8 weeks of transplanting

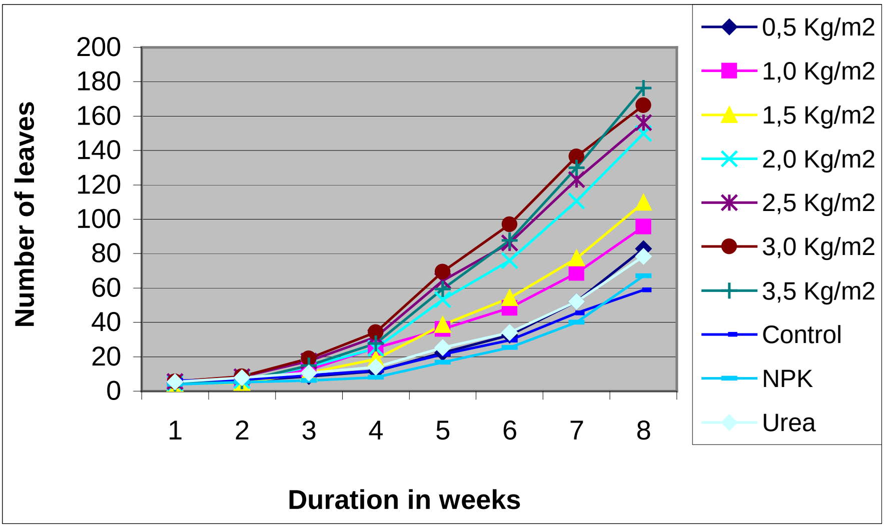
Applications on 3m beds	Yields after 6 weeks	Yields after 8 weeks	Total yield
3.5 Kg biofertilizer	0.27	0.53	0.8
3.0 Kg biofertilizer	0.25	0.4	0.65
2.5 Kg biofertilizer	0.22	0.4	0.62
2.0 Kg biofertilizer	0.2	0.33	0.53
1.5 Kg biofertilizer	0.12	0.22	0.34
1.0 Kg biofertilizer	0.1	0.18	0.28
0.5 Kg biofertilizer	0	0.15	0.15
Urea	0.02	0.13	0.15
NPK (20-10-10)	0	0.18	0.18
Control	0	0.12	0.12

The application of 2.5 Kg/m^2 produced the greatest plant heights, but an application of 3.5 Kg/m^2 provided the highest leaf count.

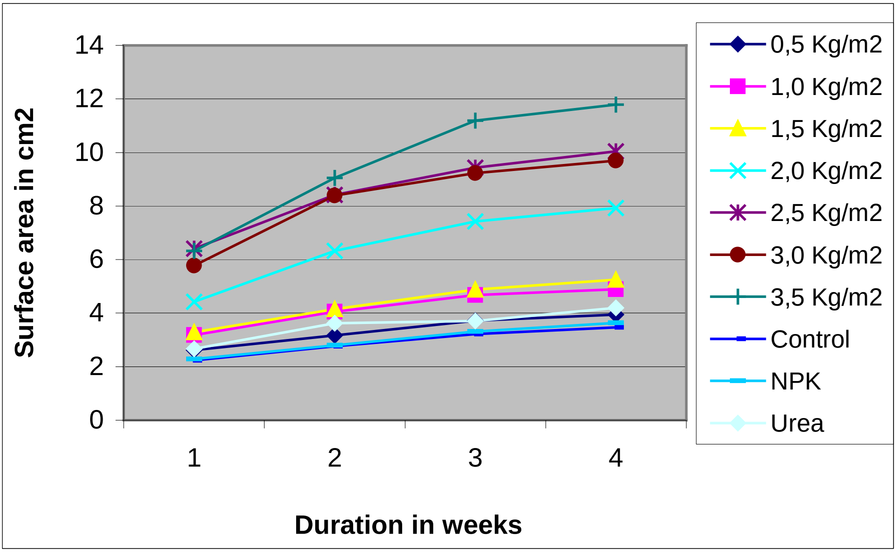
Growth rate indicated by plant height measurement



Growth rate indicated by counting number of leaves



Growth rate indicated by leaf surface area



A 3.5 Kg/m2 application of biofertilizer gave the highest yield in terms of weight, leaf count and leaf surface area. The application of 2.5 Kg/m2 produced the greatest plant height. The optimum application recommended is 2.5 Kg/m2 because of the additional cost of a higher application.

The results of the chemical analysis indicated that:

1. The soil is acidic while the biogas slurry is basic;
2. the main growth elements (N,P,K) had a higher concentration in biogas slurry than the soil;
3. The conductivity of the biogas slurry was higher than that of the soil;
4. The biogas slurry was richer in secondary growth elements (Na, Ca and Mg) than the soil.
5. Urea and NPK (20-10-10) applied was not enough to produce good growth rates.

Recommendations

That further similar research be carried out for other plants and suitable quantities of urea and NPK that might improve yields and good produce.

The role of the gallery forest

The Centre has some patches of forest in valleys found on its land. These forests host a wide range of useful trees, plants and wildlife and provide the following services:

- A source of beneficial insects. Honey bees and other insects found in this forest are involved in pollination for crop fertilisation;
- Bee farming for honey production is also practiced. Participants in training courses learn about bee farming;
- A beautiful scene or tourist site for both volunteers and visitors. This forest is rich in different types of trees;
- Sources of water that is used by the Centre for agriculture and drinking;
- A source of agro-forestry seeds (seeds that are important in soil fertility improvement) and seeds for trees that provide wind breaks, shade and pest control. Many of the forest trees and plants are very useful in agriculture. Seeds of certain trees are dried and nursed for planting in the crop fields. Many of the trees and plants enrich the soil with nitrogen. This forest is known to be a good seed bank for agroforestry;
- Serve as a wildlife refuge for many animals. SHUMAS decided to preserve all forest galleries found on its land. Unlike other forests in the vicinity that undergo destruction from bushfires, animal encroachment and exploitation for firewood, the forest at the Centre is free from these problems. Many animals have found refuge in them, especially in the dry season when bushfires are so common. The forest hosts some monkeys that are hardly seen but are noticed to be present only through the chewed remains of certain tree fruits known to be their favourites. Many animals around these forests can be heard chattering, mainly during the night.

Nurseries for trees, vegetables and spices

As of August 2012 approximately 10,000 tree seedlings were being raised at the Centre, half of which were nitrogen-fixing species for agroforestry. They included Acacia, Leukena, Tefrosia, Glyricidia and Sesbania.

Animal Welfare

Veterinary facilities are available at the Centre to treat the common diseases of farm animals. At present animal pests are controlled using chemical dips.

Student and staff facilities

The Centre has separate accommodation facilities for male and female students, clinic, lecture hall and a canteen and kitchen where meals are prepared and distributed. There are also separate buildings for accommodating visitors and a separate office building with computer, a book library and facilities for re-charging mobile phones.

Female

Male accommodation

Guest rooms for visiting

Kitchen

Prior to 2007, SHUMAS had trained many target groups in organic farming techniques using an integrated farming approach. Although improving outputs for many farmers, it was then realised that a more extensive approach was required in order to reach out to a greater number of poor farmers.
Subsequently, in 2007, with funding from Manos Unidas, a Spanish NGO, SHUMAS, set up its 'Integrated Organic Farming Training and Demonstration Centre' on 50 hectares of land donated by Kumbo Council.

Here farmers can now be trained in fertility conservation and regeneration farming systems. The integrated organic farming approach is apparently the best alternative to the chemically-based conventional farming methods, as most farming inputs are locally obtainable and affordable by everyone.
This Centre, although principally targeting rural populations and farmers in particular, will also serve many researchers, students and volunteers from other parts of the Cameroon and Africa and also students from other parts of the world.

Completed in 2008, admissions courses began and the first batch of 36 students completed their nine month organic farming course in 2009.
Animal drying and nursery sheds are all in place and were stocked at the end of 2008. A biogas digester is complete and 3 wind turbines are up and running. It is hoped the Centre will become self sufficient in energy although 4 or 5 turbines are required to achieve this.
All cooking on the farm is done using biogas from animal waste and there are plans to introduce a small hydroelectric power scheme using small affordable technology. Courses cover: animal, plant and biogas production and utilisation, bio-fertilizers and pesticides, agroforestry farming systems and farm management, output management and marketing. In 2010, the first extensive generally affordable short course programmes were offered with tuition in pig husbandry, biogas production, composting and all aspects of growing organic crops. Water catchment and pasture improvement were also covered.

As well as catering for local students, the Centre is attracting international visitors, many of whom work as volunteers for up to 6 months. SHUMAS welcomes both local and international volunteers with practical knowledge in any of these domains or others considered beneficial to the effective training of peasant farmers. The short courses started with training on organic Solanum (Irish) potatoes cultivation, natural pest management, integrated animal rearing and biogas production and making these techniques widely understood and accepted by the general public. These selected short courses will meet the needs of many practicing farmers.

Local farmers have been coming to the Centre to request information and training on how to grow potatoes, manage animals and plants, control animal pests and diseases, improve on animals' yields and know more about the biogas plant. This call for assistance has persisted and SHUMAS decided to solve this problem by organizing more short courses to meet the specific needs of local farmers in domains where demand has been high.

Activities at the Centre have been represented on the local Kumbo Radio to sensitise the public on the role of integrated organic agriculture in promoting food security, fighting economic and environmental crises. This programme was carried out successfully created an impact in communities. There has been a lot of positive feedback and comments followed the programmes a. The programme was recorded and copies are available.

The self reliant programme

The Centre is far from the national energy grid system and now uses biogas for cooking and heating. Energy for lighting the Centre comes partially from fossil fuel to run the generator. The Centre has the vision of becoming self reliant in biogas, wind and solar energy in the future thus contributing to the fight against climate change. The Centre has two windmills that provide energy for lighting the administrative block, classrooms and some residential areas. Energy from the windmill is also used to charge the telephones of participants and staff. In 2014 volunteers from Energy Without Borders (Spain) supervised the construction of additional windmills and a hydro power installation on a local stream.

During the period of internship in the nine month course participants present their theses in front of the various assessment panels at the Centre in partial fulfilment of an award of a diploma in organic farming. Practical work accounts for 60% of the marks and 40% for the theory.

Interview panel

Interviewee

Practical work

Graduation

Details of training courses

There are 3 types of course available :

1. A long course programme over a two year period
2. A long course of 10 months duration
3. Short courses of duration from 1 day to 1 month depending on the module.

The 10 month course is divided into 4 blocks from October to August. These blocks and the corresponding breaks have been arranged according to the agricultural calendar. The breaks allow participants to practice the techniques they have learnt on their own farms. The 10 month course takes a maximum of 35 students.

Block 1: October to December

- Understanding rural life and communities
- Rural development planning
- Gender and principles of organic farming.

A short break after this block allows participants to start land preparation on their own farms and enjoy end of year festivities with their own families and friends.

Block 2: January to March

- Organic crop cultivation
- Principles and concepts of organic farming
- Renewable energy
- Ecoliteracy
- Pasture improvement.

The break allows participants to return to their farms to start planting and other farm activities

Block 3: April to June

- Sustainable livestock and poultry production
- Processing organic foodstuffs
- Natural pest control
- Integrated farm management systems
- Organic soil management and crop nutrition
- Project writing.

During the break participants will return to their farms to engage in weeding, moulding and pest control. SHUMAS staff will visit all trainees on their own farms during this period.

Block 4: July and August

- Complete the courses in sustainable livestock production (cattle, pigs and small ruminants)
- Certification of small holder organic farmers
- Presentation and evaluation of projects and final course evaluation.

Graduates will receive a certificate of sustainable agriculture.

The **two year course** follows a similar format, but in the second year participants will specialise in specific aspects of organic farming such as sustainable livestock production, organic food production, renewable energy, etc. There will be intensive practical lessons and participants will present a project they intend to carry out after the training to a panel composed of staff and government representatives.

Short courses

Short courses are organised during the breaks . A one day course can accommodate up to 100 persons and a two day course can accommodate 50.

Application process and fees for overseas students

Requirements:-

- ✓ An application letter
- ✓ A completed application form
- ✓ Photocopy of highest diploma
- ✓ Photocopy of national identity card
- ✓ An attestation from a sponsor.

Qualification:-

- ✓ Anyone who can read or write with at least ordinary level certificate or its equivalence
- ✓ Minimum age 18 years and maximum 35 years for 2 year courses
- ✓ Medical fitness for activities on the course
- ✓ An interest in farming and has practiced farming
- ✓ Valid ID card

Fees for overseas students:-

- Long course of 10 months 1,000,000 CFA
- Long course of 2 years 2,000,000 CFA

Staff

The Centre has 23 staff who teach both practical activities and theory. Lessons are run in the form of workshops.

Lodging and rules

- All participants are lodged at the Centre.
- Beds and mattresses are provided but participants must provide their own bedding
- The rules and regulations of the centre must be respected
- Participants are responsible for arranging their own transport to and from the Centre
- Participants are responsible for providing their own training materials (writing materials, farm wear, official wear, boots, etc)
- Participants must present a project proposal after training
- Participants must establish their own farms after completion of the course.

Course	Theory period	Practical period	Description
Sustainable agriculture	8 hrs	12 hrs	Concepts of sustainable agriculture
			Definitions
			Sustainable agriculture
			Organic farming
			Why sustainable agriculture
			Difference between sustainable and organic agriculture
			Factors that degrade the environment
			Benefits of sustainable agriculture
Integrated farm management systems	4 hrs	8 hrs	Rotation design
			Cash crops
			Managing waste
			Permaculture
			Polyculture
Organic crop production	4 hrs 30 mins	7 hrs 30 mins	Introduction
			Shifting cultivation
			Continuous cropping
			Crop protection
			Monoculture
			Sole cropping, inter cropping or mixed cropping or poly-culture
			Alley cropping
			Integrated farming(animals and crops, mixed farming)
Understanding rural communities	8 hrs		Introduction to rural development
			Social studies
			Environmental analysis
			Rural economy
			Development institution (development associations, village administration)
Rural development and planning	8 hrs		Economic development and planning (definition, development theories, stakeholders - communities, leaders, groups, NGOs, government, churches)
			Definition planning
			Co-operatives development
			Participatory approach to development
			Resource mobilization and management

Useful contacts and references

Organisations:

PRACTICAL ACTION, The Schumacher Centre, Bourton-on-Dunsmore, Rugby, Warwickshire, CV23 9QZ Tel: +44(0) 19 2663 4400; Fax: +44(0) 19 2663 4401.; Email: enquiries@practicalaction.org.uk Website: http://www.practicalaction.org
International development agency using technology to challenge poverty in developing countries. Through technology we enable poor communities to build on their skills and knowledge to produce sustainable and practical solutions. We focus on renewable energy, water and sanitation in urban areas, disaster risk reduction and sustainable food and agriculture. Practical Answers is our free to download knowledge bank of technical information and Practical Action Publishing publishes books on a wide range of issues appropriate to developing countries.

CABI, Nosworthy Way, Wallingford, Oxfordshire, OX10 8DE
Tel: +44(0) 14 9183 2111; Fax: +44(0) 14 9183 3508; Email: enquiries@cabi.org
Website: http://www.cabi.org/
International not-for-profit organisation that improves people's lives by providing information and applying scientific expertise to solve problems in agriculture (e.g. food security) and the environment (e.g. biodiversity).

TREE AID, Brunswick Court, Brunswick Square, Bristol, BS2 8PE
Tel: +44(0)11 7909 6363; Email: info@treeaid.org.uk Website:http://www.treeaid.org.uk/
Charity enabling communities in Africa's drylands to fight poverty and become self-reliant, while improving the environment. Current strategy focuses on forest management and income, food and medicines from trees.

WATER AID, 47-49 Durham Street, London, SE11 5JD
Tel: +44(0) 20 7793 4500; Fax: +44(0) 20 7793 4545.;
Email: wateraid@wateraid.org Website: http://www.wateraid.org.uk/
A charity which focuses on self-help, low cost water schemes for sustainable development, providing safe water supplies, sanitation and hygiene education.

CENTRE TECHNIQUE DE COOPERATION AGRICOLE ET RURALE
(Technical Centre for Agricultural and Rural Cooperation), Galvanistraat 9, Postbus 380, 6700 AJ Wageningen Netherlands;
Tel: +31(0) 317 4 67 100; Fax: +31(0) 317 460 067; Email: cta@cta.int
Website: http://www.cta.int/en
Promotes agricultural and rural development in African, Caribbean and Pacific (ACP) countries, mostly by facilitating exchange of information. Publishes Spore magazine - bi-monthly .

WORLD AGROFORESTRY CENTRE
Regional Office, P.O. Box 16317, Yaounde, Cameroon, Central Africa.
Tel + 237 22 2150 84; Fax +237 22 21 50 89; Email: icraf-aht@cgidr.org
With over three decades of work with smallholder farmers in Africa, Asia and Latin America, and strategic alliances with advanced laboratories, national research institutions, universities and non-governmental organizations, the World Agroforestry Centre is uniquely positioned to address global challenges of food production, biodiversity and to improve the livelihoods of poor smallholders and the sustainability and productivity of agricultural landscapes.

You can help create a better future for everyone and a fairer system of distributing the Earth's wealth and resources whilst ensuring that future generations are able to meet their needs.

FIOH Cameroon Network

shumas_ngo@yahoo.com

http://www.fiohnetwork.org/fiohnet/fioh-cameroon-network.htm

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