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Moringa/jatrofa agroforestry application as poverty alleviation strategy for rural areas in Sudan

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Agroforestry: A Livelihood Strategy of Survival. Implications for Sustainable Development

Introduction

The most serious environmental concerns in Sudan are land degradation, desertification and the spread of deserts. Poverty, malnutrition, food insecurity and degradation of the natural resource base are major problems afflicting many parts of Sudan. About 75% of the population live in rural areas that account for over 80% of the total extreme poor. Due to degraded soils, lack of inputs and unfavourable weather conditions, most of the **resource-poor farmers** grow their crops in degraded soils without inputs such as chemical fertilizers or pesticides. Rainfall is highly variable in amount and distribution, making rainfed agriculture risky and thus preventing farmers from investing in inputs that enhance productivity.

Poor market access is a result of many factors such as the lack of a functioning marketing system that links the many small producers with domestic and international buyers. Several highly dispersed small producers supply non-homogenous products to local markets. Given the low productivity, the volume of marketable surplus is very low. Thence the transaction costs of marketing for individual farmers are high. Varieties currently grown by farmers fall below the quality attribute required by diverse markets. The proposed activity is to work with small scale farmers on an agroforestry intervention, planting vegetables cereals and raising animals.

Materials and Methods

The project started in 2007 when *Moringa olifera* seeds were brought from India. Although the same species grow naturally in different parts of the Sudan, the Indian species has better seed yield. It was grown in different types of soil and proved to be well adapted to different soil types. *Jatrofa cucras* grows naturally in different parts of Sudan and is used as life fence in western parts of the country. Agro-forestry model farm was established in Khartoum peri-urban area on three acres of land. This area was found to be the maximum a farmer family can manage. Two acres are divided into four quarters where different types of vegetables are grown, the remaining acre is divided into two halves, and one is planted with a cereal crop preferred by the poor farmer. The other is planted with Moringa grown intensively, cut after 90 days and thereafter every 35 days. The leaves are sold as green tea while the shoots are fed to animals. Alongside of the irrigation canals, 1800 Moringa are allowed to mature to full size with the purpose to be manually harvestable for seeds; the pods are fed to animals. The farm is surrounded by a life fence of 520 Jatrofa trees to keep animals away. The farm is irrigated by a ground water. Five goats or sheep are raised. The model was submitted as a project to sustain one poor family to the Microfinance department of the Bank of Khartoum. The economic study made by the bank for income of the farm from selling vegetables, after calculation for post-harvest losses and family consumption, showed a high internal rate of return, in addition to selling Moringa leaves and seeds and Jatrofa seeds. For implementation in the rural areas, ten families are grouped in one Farmer's Association. They share one well dug on 30 acres.

Results and discussion

Socio-economic impacts

The primary users are small-scale farmers in all states of the Sudan. For every ten families organized as farmer cooperatives, a well is drilled to provide drinking water and for irrigation. Five heads of animals are provided. Different vegetables grown on two acres of land will produce 16 tons of vegetables per year, accommodating for both harvest losses and farmer family consumption, 10 tons of vegetables are left to be sold. One the farmer gained 50,000 SDG (5,000 USD) in one year. The farmer's income increased after the second year and could meet the microfinance repayment. Extra income was from selling Moringa leaves. One tree produced one kg after six month which increases two and three kg for the second and third years, reaching a maximum 7 – 8 kg in the fifth year (the life span 20 years). This means the scaling up of farmers' income from Moringa seed alone. Jatropa tree produces ½ kg in the first year which increases two kg in the second and third year. More income will come from selling male animals and milk.

Farmers are now really valuing their lands looking at them as assets as the land is now the land is giving a good support to their lives and children, their life style has changed being involved in agricultural activities all the year round, they are growing winter and summer crops. They can feed their livestock from Moringa shoots. They can now think together about providing services to their societies as building of schools, dispensaries or even spot clubs. The farmers are no longer dependent on emergency relieves. They feel the confidence in contributing to the national economy and may even be partner with developed countries providing commodities of organic food and red meat. The youngsters are learning to become self-reliance and more children will sent to school. Women are relived from workload of fetching for fuel wood; they are now working in healthy condition, as they can use jatropa oil as fuel cooking which odorless and without smoke. They have better nutrition for them and for their children, and they can also be involved in activities making cheese, ghee, jam, dried vegetables. In areas where such enterprises would flourish, will attract other professionals looking to improve their income e.g, tailors, blacksmith, barbers, doctors etc. Many of the displaced people around cities will have the strong motivation to go back to their land. Also this model could solve conflicts over natural resources.

Moringa benefits and uses

A single Moringa tree can provide leaf for nutrition, oil for cooking and healthy skin, seed cake for water purification and wood to build shelter. Moringa leaves are perhaps equally valuable and provide powerful benefits to anyone who is conscious of their nutrient intake (Morton, 1991). The leaves of the Moringa tree are among the most protein-dense leaves of any plant species, and contain every essential amino acid required for a whole source of protein. Moringa leaves contain high levels of Vitamin A comparable to carrots, calcium comparable to milk, and vitamin C comparable to oranges, as well as high amounts of other vitamins and minerals. The leaves are easily digested when put into capsules and provide high levels of available nutrients. Moringa leaves can also be used for tea, either alone or in combination with other teas (www.TFLJournal.org). The pods are extremely nutritious, containing all the essential amino acids along with many vitamins and other nutrients. The immature pod can be eaten raw or prepared like green peas or green beans. Moringa seeds are a popular table food in many cultures around the world. The seeds can be steamed or boiled, either in the pod or shelled, much like peas or green beans. Moringa seeds can also be seasoned and roasted for a snack food. Moringa oil is clear and odorless, and never becomes rancid. The oil a very desirable for the formulation of cosmetics as it has many anti-oxidants and documented skin-rejuvenating properties. Moringa oil contains an amazing 72% oleic acid content and penetrates deeply into the skin, bringing vital nutrients and helping the skin retain moisture. The seed cake remaining after the extraction of oil has also been demonstrated to be a very effective flocculent/coagulant for the clarification of turbid water. It is highly effective for the removal of sediment and bacteria (www.TFLJournal.org).

Jatropa benefits and uses

Jatropa biofuel production could be especially beneficial to poor producers, particularly in semi-arid, remote areas that have little opportunity for alternative farming strategies, few alternative livelihood options and increasing environmental degradation (Henning, 2007). There are clear advantages to using plant oil instead of traditional biomass for cooking. These include the health benefits from reduced smoke inhalation, and environmental benefits from avoiding the loss of forest cover and lower harmful GHG emissions, particularly carbon monoxide and nitrogen

oxides (Richard and NeBambi, 2010). Leaves applied to wounds and in decoction, they are also used against malaria and to treat hypertension. The leaf sap is used externally to treat hemorrhoids. The oil-rich seeds and seed oil are used as a purgative and to expel internal parasites. The oil is applied internally and externally to induce abortion, and externally to treat rheumatic conditions and a variety of skin infections. *Jatropha* oil has molluscicidal properties against the vector snails of the *Schistosoma* parasite that causes bilharzias. The emulsified oil has been found to be an effective insecticide against weevil pests and houseflies, and an oil extract has been found to control cotton bollworm and sorghum stem borers commercialized (Gubitz *et al.* 1999).

Environmental benefits

1-Local benefits

The overall goal is to remove the constraints currently faced by the traditional small-scale producers so that they can increase their crop and livestock production, gain food self-sufficiency and improve their livelihoods by having additional source of revenues while conserving the resource base. This would be achieved through implementation of conservation agriculture technological packages in place of current conventional tillage, integrate crop and animal husbandry and forestry management. Organic farming has a sustainable and accepted concept in competition to other food production systems.

2-Global benefits

In regards to climate change, agroforestry advocates building and storage of soil organic matter, which is important for storage (carbon credit in soils) and/or sequestration of carbon. Carbon is derived from the atmospheric CO₂ taken up by the plant and added to the organic matter when the plant dies. In a world concerned with the buildup of atmospheric greenhouse gases, agroforestry presents an opportunity for reversing the green house gas build up. Carbon sequestration is a recognized method in the removal of CO₂ from the atmosphere under international treaties, such as the Kyoto Protocol. Using cultivated and non-domesticated plants for energy needs instead of fossilized plant remains such as mineral oil and coal reduces the net addition of CO₂ to the atmosphere. In addition, biodiesel produces fewer particulates, hydrocarbons, nitrogen oxides and sulphur dioxides than mineral diesel and therefore reduces combustion and vehicle exhaust pollutants that are harmful to human health.

Using *Moringa* and *Jatropha* trees as 'fertiliser trees' that capture nitrogen from the air and transfer it to the soil can reduce the need for commercial nitrogen fertilisers by 75 per cent while doubling crop yields. If combined with other soil fertility management, such as conservation agriculture, fertiliser trees can significantly boost sustainable soil health and increase food security. A diverse tree cover can also increase agro-ecosystems' resilience towards drought, pest and disease and other threats on food production induced by climate change (Fuglie, 2001)

Research topics already done using *Moringa* in Sudan

- Anti-cancerous effect of moringa leaves extracts on A549 lung cancer cells.
- Effect of some natural products (*Moringa oleifera*, *Citrus aurantifolia* and *Coriandrum Sativum*) on the level of thyroid hormones in rats.
- A comparative study of the effects of (*Moringa olifera*) aqueous extract of leaves and seeds paste as supplements on lipids profile in rats.
- Nutritional value of *Moringa oleifera* leaves feed meal supplement for broiler production
- A note on the potential use of *Moringa oleifera* tree as animal feed.
- Use of moringa leaves extracts as meat extender .
- Use of moinga leaves as food supplements for elderly, lactating and pregnant women.

Conclusions and Outlook

Rural poverty is reduced through agricultural diversification and emerging opportunities for high-value commodities and products. The project will contribute to:

- 1- **Enhance livelihood and ecosystem resilience:** Mitigating the impact of acute drought, desertification, degraded environments, and pests in smallholder agriculture with a view to facilitate long term recovery and enhance self-reliance
- 2- Nourishing families and agro-enterprises: Improving food and nutritional security and human and livestock health through increased agricultural productivity, and better food/feed quality
- 3- Reduce child mortality by providing more nutritious foods.
- 4- Improved maternal health by ensuring that poor pregnant and lactating women get the right quality of food.
- 5- Financial benefits: by better access to markets through farmer associations.
- 6- jatropha oil is one of a number of strategies that may be used to address energy poverty in remote areas and could be part of production systems or part of a “living fence” to control livestock grazing.
- 7- **For women** using jatropha oil as a replacement for traditional biomass cooking fuels is also healthier, as cooking is done in a smoke free environment, and women do not have to spend time gathering fuel wood. The decreased need for fuel wood also relieves pressure on forest resources. Using jatropha oil to fuel irrigation pumps can increase agricultural efficiency.

The target communities should recognize the economic benefits that the ecosystems-based approach brings the need for collective responsibility and be able to support a shared equity of resource between the various stakeholders (farmers, forestry, livestock, soil scientists etc). On the other hand it is imperative that governments must facilitate change by supporting bottom-up initiatives to make the top-down decisions based on realities on the ground. Similarly, businesses (private sector) and communities need to strengthen and see the advantage of partnership that will bring to both parts. Only by collectively addressing the multiple issues of poverty, sound ecosystem management, food security, and reducing carbon foot print, in taking this integrated approach, will provide synergistic solutions can be feasible.

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