World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES
03

Policybrief

Agroforestry options for Tanzania

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Agroforestry offers robust options to improve agricultural productivity and achieve environmental sustainability.

Never before have so many governments, and multilateral and international organizations been so interested in the agricultural sector.

At a recent high profile event, where the World Bank launched a global food crisis response facility, the problems in the agricultural sector were likened to a silent tsunami (Zoellick, 2008). Ranking low in economic and human development indicators, Tanzania is at high risk of failing to feed herself, with over 70% of its people depending on rain-fed agriculture for their livelihood.

Tanzania is listed among the thirteen African countries worst affected by climate change impacts and vulnerability, and having the least adaptive capacities (Thornton *et. al., 2006*). A review of the status of Tanzania's Agricultural Sector Development Program notes that the country is lagging in achieving its targets on reducing poverty and food insecurity, and in achieving the Millennium Development Goals. Tanzania faces the challenge of revitalizing her agricultural sector by improving the natural resource base: soil, water and biodiversity. Agroforestry, the integration of trees in agricultural landscapes, offers robust options to improve productivity and achieve environmental sustainability.

Tanzania National Agroforestry Strategy

The 2004 National Agroforestry Strategy envisions four million rural households adopting and benefiting from agroforestry practices by 2025. Its goal is that by 2020, agroforestry technologies are adopted and contribute to improving the livelihoods of 60% of the country's resource-poor households. This goal complements the national development strategy "MKUKUTA", which aims to increase household income while conserving the environment.

Trees and/or shrubs deliberately retained or planted on farm land; agricultural crops, including food and cash crops; and livestock, create a web of resilient land use practices that mitigate and adapt to climate change, halt land degradation and conserve on-farm biodiversity. Agroforestry is a powerful tool for tackling emerging local and global challenges.

Tanzania is home to several traditional agroforestry systems that have been in practice for hundreds of years. Some have been documented: the Chagga home-gardens, the related Mara region home-gardens known as *Obohochere* and the traditional *Wasukuma* silvopastoral system called *Ngitili*. One outstanding aspect of these traditional methods is the use of multi-layered systems with a mixture of annual and perennial plants, which imitate natural ecosystems.

Agroforestry research and development work in the country has been going on for more than 30 years. National institutions, including research centres and universities, have conducted trials to screen exotic and indigenous tree and shrub species for suitability for different agroforestry technologies. Over the past 20 years, the World Agroforestry Centre (ICRAF), collaborating with national research institutions, government extension services, NGOs and CBOs, has developed several technologies that now benefit thousands of farmers in Shinyanga and Tabora Regions, and elsewhere in the country.

Proven technologies include: fertilizer trees and biomass transfer for soil fertility improvement, rotational woodlots, indigenous and exotic trees for food and health security, trees for livestock feed and trees for reclamation and enrichment of traditional land use systems. These technologies are already transforming lives in many parts of the country.

Agroforestry for improving soil fertility

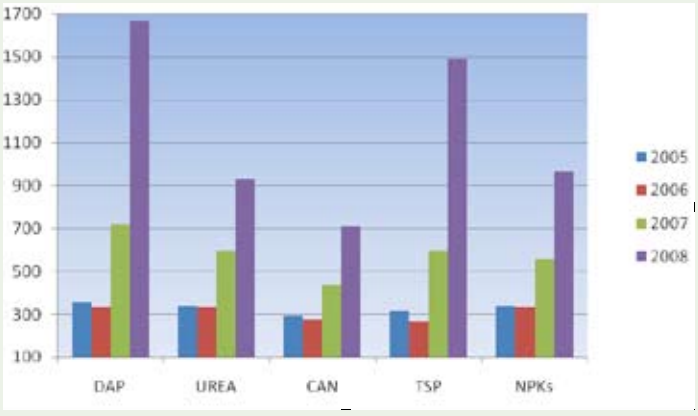
The use of fertilizer and improved seeds in Tanzania is very low compared to other countries. While Tanzanian farmers use an average of 9 kg/ha annually, of nitrogen fertilizer, Malawian farmers use 27 kg N/ha, and in Vietnam the average is 365 kg N/ha per year (MAFSC, 2007). Government efforts to overcome the declining soil fertility problem have been only partly successful.

Declining soil fertility means poor yields for many Tanzanian farmers.

Despite the government's involvement in distributing fertilizer and seed to smallholders and encouraging private traders to do the same, less than 20% of smallholder farmers use fertilizer in Tanzania. For 2008/2009 the government is issuing agricultural input vouchers (fertilizers and improved seeds) to 2,600,000 farm families out of over 4,000,000 in the country. The total cost of the programme for 2007-08 was USD 18 million (Tshs 21 billion). In 2008-09 the subsidy is set at USD 26 million (Tshs 31 billion). However, skyrocketing oil prices strained every stage of food production–from fertilizer to tractors to transport. In the past three years fertilizer prices have more than doubled (see below).

Policies to help produce food more cheaply and in environmentally sustainable ways will benefit most farmers and the country as a whole. Incorporating agroforestry systems into national agricultural development programmes offers more affordable and sustainable sources of soil nutrients through deep soil extraction and nitrogen fixation. Current policies do not take advantage of these promising technologies.

Fertilizer prices (USD per ton) in Dar es Salaam 2005 – 2008

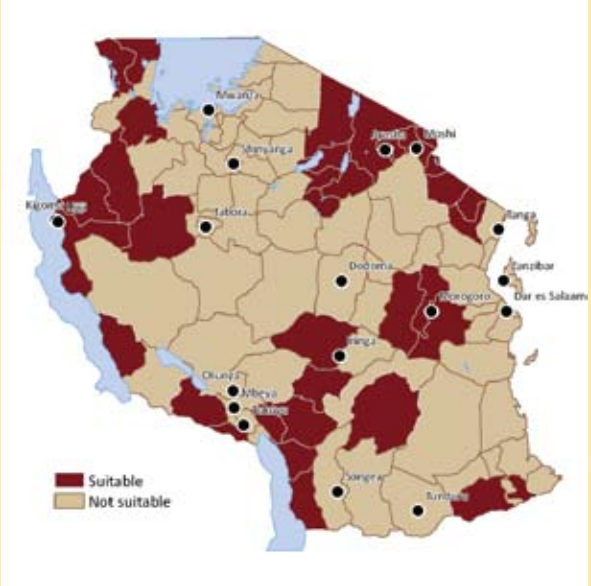


(Source: URT, 2008)

Best areas for agroforestry options

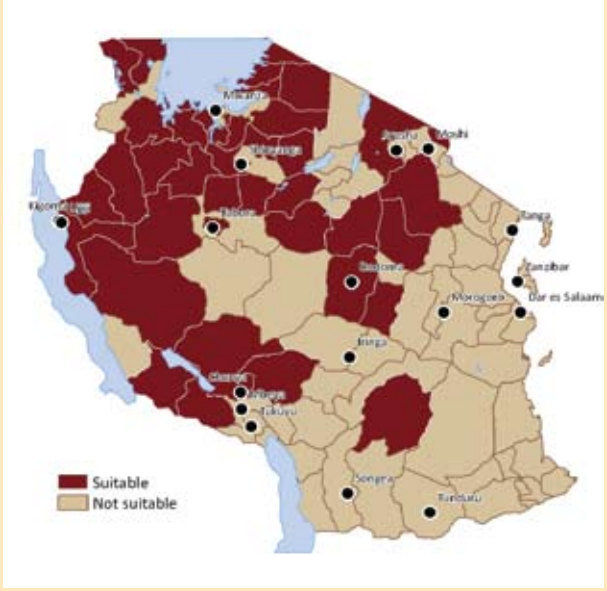
Maps prepared by Miika Mäkelä, World Agroforestry Centre GIS Unit

Multistrata home-gardens



Multistrata/home-gardens agroforestry: Trees, shrubs and herbaceous plants grown together in a dense spatial mixture.
Major function: Land use intensification and soil and water conservation strategy in high gradient landscapes.
Limitation: Increasing land pressure and low soil moisture.
Agroecological zone: High altitude, high rainfall areas of the high plains and plateaus.

Improved fallow/fertilizer trees

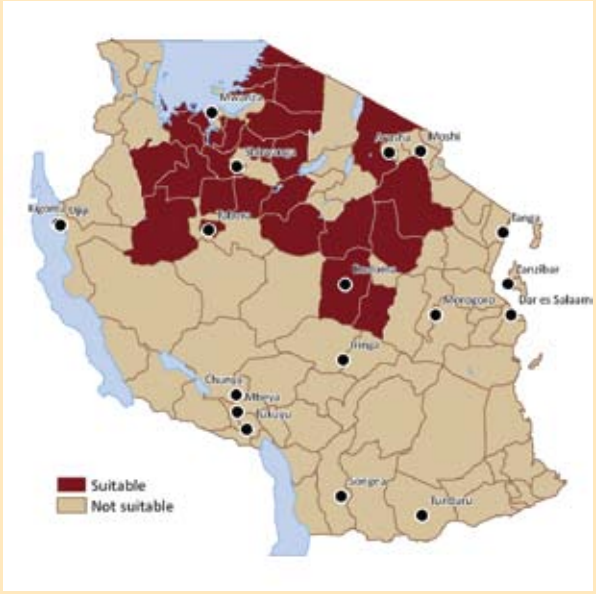


Improved fallow: Rotation of planted trees, mainly N-fixing, with crops.
Major function: Soil fertility and soil structure improvement.
Limitation: Land size; labour required to incorporate litter into the soil.
Agroecological zone: Central plateau and medium altitude plains of western Tanzania.

Biomass transfer

Biomass transfer: A tree litter mulching system, where biomass is transported from one area to another for nutrient replenishment.
Major function: Minimizing tree-crop competition, while maximizing use of organic matter to replenish soil nutrients.
Limitation: Labour, where simple tools, such as the hand-hoe, are the main farm implements.
Agroecological zones: Medium altitude plains and the eastern plateaus and mountain blocks.

Silvi-pasture systems



Silvi-pasture system: A tree/pasture/livestock production system, mainly for agro-pastoral systems linked to traditional systems such as *Ngitili* (Sukuma land) and *Olalili* (Maasai).
Major function: Rangeland management in drylands to reduce land degradation.
Limitation: Land tenure security and large livestock herds.
Agroecological zones: Medium altitude volcanic plateaus and the medium altitude plains.

Fertilizer trees

Nitrogen, the main nutrient that plants need, is in short supply in the soil. But it is abundant in the atmosphere, and "fertilizer trees" capture it from the atmosphere and make it available to crops. The World Agroforestry Centre and partners in the Southern Africa region (including Tanzania), have developed four related fertilizer tree options for soil improvement. These are:

1. Sequential fallow rotation of nitrogen fixing trees with cereal crops;
2. Fertilizer tree/cereal inter-cropping managed as coppiced fallow;
3. Annual relay fallow intercropping of shrubs with cereals;
4. Biomass transfer systems which are particularly useful for high-value vegetables.

Continuous cultivation of maize with *Gliricidia sepium* in Malawi yielded more that 5 tonnes per hectare in good years, and using *Sesbania sesban* and *Tephrosia vogelli* provided 100 – 250 kg of nitrogen per hectare (Pye-Smith, 2008). Similarly in Tanzania, high inorganic N content of soils under fallow, and increase in maize yields after fallowing, was reported by Banzi *et. al.* 2004.

Fertilizer trees have positive environmental impact

The beauty of fertilizer trees goes beyond the increase in food production. They also conserve the natural resource base and protect the environment:

- Fertilizer trees can provide up to 10 tons of wood biomass per hectare, greatly reducing women's workload searching for wood energy (Nyadzi, 2004).
- Fertilizer trees provide alternative sources of stakes for curing tobacco, and help reduce deforestation of the *miombo* woodlands, which are being deforested at the rate of 400,000 hectares annually in Tanzania (FAO, 2007).
- Fertilizer trees suppress weeds and reduce soil compaction, thus reducing the burden of weeding. This aspect provides a big incentive for women who traditionally do the weeding in the family's fields.
- Fertilizer trees contribute to mitigating the effects of climate change by sequestering up to 2.5 to 3.6 tons of carbon per hectare per year (Nyadzi, 2004).

Photo © ICRAF Tabora

Farmer with fallow of A. angustissima (front) and G. sepium (behind), Tabora.

Photo © ICRAF Tabora

Resulting yield improvement from a two-year Sesbania sesban fallow.

Biomass transfer improves nutrition and diversifies production

Farmers grow vegetables widely during the dry season in the wetlands of Tanzania, but declining soil fertility is a major challenge to many of them. Biomass transfer uses the nutrient-rich leaves of agroforestry species, usually planted in the uplands, (e.g. *Tithonia diversifolia)* as fertilizer for the production of high-value vegetable crops, either in the rainy season in the uplands or in the lowlands during the dry season. This offers farmers the opportunity to supplement their incomes by growing cash crops that command high prices in urban markets. It also integrates upland and lowland agricultural production. Biomass transfer increases food production and income for farmers by:

- Helping smallholder farmers to produce diverse and high value crops (e.g. ginger, garlic, cabbage and onions).
- Improving farm income and household nutrition.
- Allowing production during the off season when farm produce attracts higher prices.
- Increasing production to 2-3 crops per season.
- Potentially being combined with fish farming.

Agroforestry for food and income

Indigenous fruit trees provide food from the wild during periods of hunger. Their fruits often mature at the time when maize shortage is most critical. While research is under way in Tanzania on domestication of wild fruits, it is important to note that indigenous species from other regions such as kiwi fruit (*Actinidia chinensis*) and macadamia nut (*Macadamia integrifolia*) became popular in global markets through domestication efforts. Efforts by World Agroforestry Centre and partners in western Tanzania have raised the value of several species of indigenous *Miombo* fruits. Indigenous fruits that achieved commercial production during a pilot project included *Parinari curatellifolia, Strychnos cocculoides, Vitex mombassae, Flacourtia indica, Sclerocarya birrea* and *Syzygium guineense*. An end-of-project impact assessment showed that more than 2,500 women from 50 women's groups are employed in fruit processing enterprises in western Tanzania. The products, including well-packed raw fruits, juices, jams, jelly and marmalade, have been promoted in national and international trade fairs, and some local supermarkets.

Looking at the larger picture, one can see some significant milestones in the domestication initiative, for example:

- Indigenous fruits have changed from being a snack food to a main food source.
- Indigenous fruits provide income generation opportunities (in processing and enterprise development) for rural women.
- Conservation and propagation of indigenous fruit trees avoids foreclosing the opportunities of future generations in regions where such species risk being completely lost to deforestation.

Agroforestry for climate change adaptation

A large and growing body of scientific evidence indicates that climate change is a major threat to sustainable development and achieving the Millennium Development Goals (UK Government, 2006; IPPC, 2007). Predictions for Tanzania show average temperatures increasing from 2.1° to 4°C, with central and western parts of the country showing higher changes.[1] Areas with a bimodal rainfall pattern are anticipated to experience increased rainfall of 5% – 45% while those with unimodal rainfall patterns may experience a decrease of 5% – 15%. This shifting weather regime will have many adverse effects on agriculture, including more frequent drought, increased fungal outbreaks and insect infestations, reduction in ecosystem integrity and resilience, and decline in biodiversity. The government and development partners are challenged on how best to work with local farmers to identify innovations that increase the resilience of farming systems, and reduce farmers' vulnerability.

Both national and global assessments describe the central plateau ecological zone of Tanzania as one of the most vulnerable to climate change and variability. This vast area of dryland, covering most of Dodoma and Singida Regions as well as western regions of Tabora, Shinyanga, Kigoma and Mwanza, falls within the priority area for scaling-up agroforestry technologies.

The technologies described above have been proven to increase the resilience of farming systems by improving agricultural productivity and enhancing the productive use of rainfall in drylands. The intensification and diversification functions of agroforestry practices strengthen the socio-economic resilience of rural populations to climate change.

[1] according to the Initial National Communications to the UNFCCC and the NAPA in 2007 (URT, 2007).

Photo © ICRAF Tabora

Farmer from Magiri village, Uyui district, Tabora region: maize crop following a two-year Sesbania sesban fallow.

Constraints to agroforestry scaling up

Despite their excellent performance, the widespread adoption of agroforestry technologies by smallholder farmers is constrained by local customs, institutions and national policies. This is because technological innovation alone is not sufficient for widespread adoption. Local and national policies need to incorporate agroforestry. Soil fertility management options using fertilizer trees require new tree management skills. But the capacity for implementing agroforestry technologies also needs to be built at the national level. Farmers lack of access to quality tree seeds is one of the greatest constraints to the adoption of some agroforestry technologies.

There is little or no institutional structure to make agroforestry seeds available 'off the shelf', unlike the seeds of annual crops where established institutions exist to promote them and private sector organizations manage their multiplication and distribution. Such structures and institutions need to be developed, and this process can be kick-started through public sector investment (for a limited period) paving the way for the private sector to take up the commercial opportunity.

The human capacity, infrastructure and institutional support for agroforestry are not as well developed as for annual crop technologies. Such missing supports include well-developed input and product markets to enable smallholder farmers to get premium prices for their farm produce.

Widespread adoption of agroforestry requires appropriate policies at national and local levels. This has been hampered by a lack of local data on the impacts of climate change on agriculture and the environment.

Policy recommendations

Technical aspects

- Policies should promote fertilizer trees and other integrated soil fertility management approaches in order to make the most efficient use of expensive mineral fertilizers.
- Subsidize mineral fertilizers under the Agricultural Sector Development Program (ASDP) and District Agricultural Development Plans (DADP), and integrate fertilizer tree seeds, and improved crop varieties as an integral part of the inputs package of the Program to ensure sustainable soil fertility replenishment.
- Provide support to implement the national agroforestry strategy and target priority areas to scale up.
- Provide more agroforestry technology training opportunities to government agricultural extension staff to help them provide information, and scale up the technologies to farm communities.
- Support agroforestry products markets and marketing infrastructure.
- Do participatory assessments of vulnerability to climate change and local adaptation measures.
- Build capacity at all levels to mitigate and adapt to climate change impacts on the agriculture sector.

Institutional aspects

- Institutionalize agroforestry as part of the official programme of activities in the Ministries of Agriculture Food and Cooperatives, Livestock and Fisheries, and Natural Resources and Tourism.
- Institutionalize and support regular science-policy forums where updates on agroforestry research results and opportunities are presented to policy makers and stakeholders in Tanzania. The forum must emphasize the need to examine food security through a sustainable development lens.
- Assess how existing national policy and institutional setups facilitate or constrain the adoption of agroforestry.

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