Agro-forestry as a tool toward sustainable development in Babati district

Figure 1. Babati, Tanzania 2009, Photo by Jessica Eklund

By

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Bachelor’s Thesis 2009
Agro-forestry as a tool to sustainable development in Babati district

Abstract

“Recognizing the rights of local people to their indigenous knowledge and traditional use of native plants and to benefit from commercial development of this knowledge” (Leaky et al, 2006)

In Babati district, Tanzania, agro-forestry land use system has been traditionally used for hundreds of years. It is a multi layer system with trees and/or bushes integrated with crops. That knowledge has been extended in the district through the land management programme, LAMP. It is said to be a “win-win” system with both economic and ecologic benefits. For a land use system to be sustainable, three spheres have to incorporate to reach a balanced development; the economic sphere, the ecologic sphere and the social sphere. To achieve sustainable development, one sphere can not develop without the others. This study aims to see if agro-forestry in Babati district balances all three spheres, if it is a proper tool toward sustainable development. It is a qualitative case study with semi-structured interviews with farmers in Babati and one interview in Sweden. The fieldwork in Babati where held under two weeks, based on interviews with farmers who practice agro-forestry and farmers who do not, and their opinion about it. The result indicates that it employs a lot of people and that the economy among farmers in the district has improved. Most farmers say their economy is more secure, because it is a multipurpose system and most people can adopt the technologies because high costs or advanced technology are not required. Farmers benefit from the ecosystem services provided from agro-forestry, for example water catchment and decreased soil erosion which also improves the environment. Soils regain their fertility and the land use becomes more resilient when trees integrate with crops. Many farmers believe the equity between gender has improved and that condition for women improves when fuel wood can be gathered from trees on the farm instead of walking long distances to a forest. The conclusion is that agro-forestry in Babati district fulfill more or less all three sustainability spheres and is a useful tool towards sustainable development, but has not yet reached full potential, there are possibilities for improvements and to scale up for greater benefits for all three spheres.
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Introduction
Around the world interest in agro-forestry has increased mostly because human population is growing. Consequently natural resources are overutilised and there is a need for ecosystems and agriculture to become more productive to support the growing population with its growing consumption. In many places, depleted soils are threatening rural farmers livelihoods and a more sustainable way of managing a growing population requires innovations in land use management that increase soil fertility and productivity to sustain biodiversity, ecosystems and human lives (Stancheva, 2006). Ago-forestry is said to be a “win-win” system. It means that there are benefits for both the economy and the environment.
Definitions
To define agro-forestry can be a difficult task. There are many ways to conduct an agro-forestry system, for example by integrating trees and pasture, trees and beekeeping, trees and crop or trees and pasture and fishpond. To have trees with specific qualities such as giving shade, be deep rooted, and be multipurpose and fast growing is important. According to Mr Mshana, agro-forestry could to plant a tree on your land. You can have an agro-forestry system without knowing that you practice it, for example a live fence be can be agro-forestry. A live fence is a bush with thorns to keep livestock out of the farm or to mark a boundary (Mr Mshana, 2009), but to be a system a definition of agro-forestry is:

“complex agro-forestry systems which look like and function as natural forest ecosystems, but are integrated into agricultural management systems” (Oke, 2007).

The definition chosen for this study is from Mr Kaviche, LAMP:

“a component of trees inside agricultural systems. Trees which are left out when clear new land, or planted on the land, scattered or in rows. The trees are chosen for a purpose, trees with medical qualities, timber trees, ritual reasons like trees “catch rain”, provide shade, windbreak or fruit trees. There can be many different plots, wood plot in one area, crop plot in another area and it is still an agro-forestry system. Trees can be planted along a line, scattered among the crops, or the end of the crops as a boundary”.

The Millennium Development Goals
The United Nations Millennium Development Goals (MDG) has eight major challenges. Their aim is to eliminate hunger and poverty, decrease child mortality, improve maternal health, improve the human health trough mitigation of HIV, malaria and other diseases, raise the status of women, educate more people, create a global partnership for development and at the same time conserve the global environment (http://www.mdgmonitor.org/browse_goal.cfm). If accomplished, these goals will improve the economy, give peace and security and well-being to all. Holistic solutions are necessary to succeed with such an achievement as the current problems are complex and interact with one another. Agro-forestry may contribute to most MDGs and to other goals such as: Convention on Biological Diversity, United Nations Framework Convention on Climate Change, Clean Development Mechanism, United Nations Convention to Combat Desertification and the United Nations Forum on Forests. The world agro-forestry centre has identified seven global challenges related to the MDGs that may partly be targeted through agro-forestry:
• Hunger: Decrease the hunger through soil fertility and land regeneration with agro-forestry methods.

• Poverty: Reduce poverty through local marketing of forest products that bring income. Improvements of economic security through this multipurpose land use system meaning that if one crop fails, another income or food source may be utilized to support the household.

• Health and nutrition: Agro-forestry provides more diverse and nutrient rich food, beneficial to child growth and human health.

• Biodiversity: Agro-forestry technologies help to conserve biodiversity if properly conducted. Ecosystem services are another benefit, pollination as an example. Other ecosystems may indirectly be protected, if pressure on the natural environment declines due to agro-forestry.

• Watershed services: Water erosion decreases if trees are planted on treeless land, tree leafs fertilize the soil, roots retain soil and the soil texture improves so that water can infiltrate instead of becoming overland flow contributing to sheet erosion.

• Climate change: Agro-forestry systems are more resilient to climate change and enable the rural poor to adapt better to climate change and work as carbon sink.

• Human and institutional capacity: It is necessary to build a human and institutional capacity in research and development for agro-forestry, for example in some places in developing countries, primary and secondary school classes learn about the agro-forestry approach to become “farmers of the future” (Garrity, 2006).

Sustainable development

According to the United Nation document “Our Common Future: Report of the world commission on environment and development”, the definition to sustainable development is:

“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs”.

Development is a progressive transformation of economy and society and the way to that transformation can not be at the expense of the physical environment. Economic growth is necessary in many places and societies need to satisfy human needs by increased productivity but at equal opportunities for all. The increasing population puts pressure on resources but it is the distribution of resources that is the issue. The environment and access to natural
resources have to be considered when planning for economic and social development for equity between and within generations and the fulfillment of human needs. In developing countries these needs are not fulfilled and sustainable development is required to improve the quality of life for those people. Interventions in the environment have degraded ecosystems and their potential to provide ecosystem services diminishes. Sustainable development means that natural systems, the atmosphere, the waters, the soils and the living beings are not endangered by human intervention. Lifestyles are sustainable only if consumption and energy use are long-term sustainable, and do not consume more than the carrying capacity of ecosystems manage to support (http://www.un-documents.net/oef-02.htm#I, 090507).

Background
Tanzania risks to not being able to support its people with food as over 70% of the population is dependent on the agriculture with rain as the only water source to survive. Agro-forestry can be a solution to this problem because it improves the environment and increases agricultural productivity. The 2004 National Agro-forestry Strategy wants to spread the benefits and achieve a better livelihood for people through adoption of this system by four million households by 2025 (ICRAF, 2009). That goal is a complement to the Tanzanian national development strategy “MKUKUTA” with its aim to increase income for people and preserve the environment (http://www.tzdpg.or.tz/uploads/media/MKUKUTA_20FINAL-June.pdf). Research and development about agro-forestry have proceeded for over 30 years in Tanzania but there are traditional agro-forestry systems that have been practiced for hundreds of years. One of them is the”Chagga home gardens”, a multi-layer system with perennial and annual plants mixed together. It almost resembles a natural forest (ICRAF, 2009).

Climate change is expected to have severe consequences, especially for rural, poor farmers. Developing countries such as Tanzania will be affected more severely from climate change than developed countries because they have difficulties to adapt. For example higher temperatures may lead to shorter growing seasons and diminishing yield for most crops. With vulnerable agricultural systems, many rural people with their livelihood dependent on agriculture are at risk if they can not adapt to climate change. When the weather is changing, the conditions for crops and plants change, making the prospect for a good yield unsecure for farmers. Agro-forestry is more resilient than other agricultural systems, therefore suitable for resource poor farmers. Another function with possibilities for improvement is the function as a carbon sink to mitigate the climate change. (Kandji, 2006)

Developing challenges in Tanzania are to provide enough food, reduce the increasing poverty, regain degraded natural resources and increase the human health. Prolonged drought periods, degradation of
natural resources, unsustainable farming systems, shortage of firewood and fodder, soil erosion and fertility decline in soil, are some obstacles for the livelihood of the farmers relying on their agriculture. The increasing population puts a pressure on the agriculture and the time of fallow is becoming shorter. To meet their needs, people have cleared indigenous forests to receive charcoal and more land for cultivation and pasture. The soil is very fertile after clearing, but as the cultivation continues the fertility decline and new areas need to be cleared for agriculture. Trees are the major energy resource in Tanzania. Previous Tsetse clearings in the early 20th century still affect people in Tanzania. The forests were cleared to mitigate the sleeping sickness transmitted to humans by the tsetse fly, resulting for example in losses of fuel wood and increased soil erosion (Allan, 2003).

Conducting Agro-forestry in Tanzania and Babati District
Tanzania agro-forestry Project started in Tabora in 1986 and Shinyanga in 1991 to improve living standard for small scale farmers with poor resources and to reduce poverty. It was a participatory project where farmers and policymakers were a part of the project and through training, support and networking with organizations, farmers adopted agro-forestry technologies. The technologies to practice agro-forestry were.

- Rotational woodlot technology with indigenous and exotic tree species
- Fodder-banks for dairy farmers to increase milk production
- Improved fallow with Nitrogen-fixing leguminous trees to improve soil fertility to increase maize yield that is intercropped with these trees.

The domestication and commercialization of indigenous fruit trees and medicinal trees is becoming an industry in Tanzania, and farmers can process products such as jam, honey, wine and juices after harvest. This processing work is suitable for women and an opportunity to develop entrepreneurship in the community (Allan, 2003).

Manyara region in Tanzania has five districts and one of them is Babati District. The population is 303 000 and growing with approximately 3% per year. Along with the growing population the pressure increases on cultivated land and the natural environment (Mr. Kavishe, 2009). Environmental degradation and poverty reduction are the main incentives to practice agro-forestry in Babati. Agro-forestry is particularly suited for poor farmers and women, because it is a low cost and low technology system and means a lot of benefits for women whose task in the household is to provide food and water. To handle that task women
often have to go long distances to collect firewood and water, which can be gathered in their farm if agro-forestry is practiced (Mr. Mshana, 2009).

LAMP was a Land Management Programme in cooperation between the Tanzanian government and Swedish SIDA (Swedish International Development Agency). LAMP acted in Babati between 1993 and 2000 and the main objective was to utilize land, increase water efficiency and agricultural productivity in a sustainable way and achieve that goal through four components; land security, community empowerment, extension services and village/district capacity building. The economic benefits from a sustainable use of natural resources, through a constituted tax base, would contribute to improved education, social services and infrastructure. Mapping of land and education about land owner rights was one method to gain more land security among the villagers (Havnevik, K, 2000). The land is own by the community so a tree was planted for the community, not for one person. Permanent crops like trees have to be compensated for by the government which have full owner right of land, if they decide to take advantage on that piece of land. New land law 2002 is important for farmers to secure their land rights with a certificate for village land to lend money (Mr. Kavishe, 2009). The community was thought to be empowered by participatory land use management, village forest management and management of common grazing. Extension officers taught farmers how to manage their land in a sustainable way, by using methods such as traditional soil conservation, communal pasture management, beekeeping and processing of it’s products, and agro-forestry (Havnevik, K, 2000). Other objectives were to reduce the poverty by increasing the productivity in agriculture and livestock keeping. Babati district council would provide extension services to educate farmers by demonstration and training. Through LAMP the community was to be better able to manage natural resources and support the commercial market at sub village and village level (LAMP Brochure). The traditional agro-forestry system with the multi layer Chagga system in Haraa is different. They are called “home-gardens” and have 3 canopy layers; trees, bananas and Coffey often in higher altitudes. Lamp just extended that traditional knowledge (Mr. Kavishe, 2009).

This is some of the project achievements:

- Most of the 82 villages have participatory land use management plans.
- On individual initiatives the tree seedling raising and planting have increased.
- Awareness of gender issues has increased in the district.
The connection between villages has been more transparent and the connection between villages and district council has been more transparent.

Awareness of environmental protection has been raised.

Higher productivity in agriculture and livestock result in higher food security and improved living standards.

Social services have improved because the cooperation between NGO´s is better (LAMP Brochure).

At LAMP’s training center in Babati the idea is to change the attitude among farmers with scientific data and argument to convince them to adopt more sustainable land use methods. Farm models are here available to show and teach farmers which trees are suitable. Many people in Babati are agro-pastoralists. There are almost as many livestock as people so there is a great need for fodder and pasture for the livestock. Agro-forestry system can be managed to be suitable for agro-pastoralists, with leguminous grasses for pasture integrated with trees. Fodder cultivation can also be incorporated with growing crops for household. Fallen leaves from the trees decompose and increase soil fertility resulting in better yields. A demonstration plot for feeding grasses and legumes which are drought resistant was shown as an alternative at LAMP’s farmers training center. Farmers learned for example how to prevent gullies by planting trees (Mr. Kavishe, 2009). A comprehensive view on the erosion and gully problem is necessary to achieve a consisting result. Most of the villagers for example around a mountain, need to defeat the problem, with contours, terraces, trees or bushes (Bjällås, 2009) and also to reduce tree clearings and prevent fires and free grazing livestock. A demonstration for tree nursery management was available at the farmers training center, to show how to nurse trees for planting and selling. The demonstration area was a good place because it was eroded and degraded and now the improvements can be seen since trees were planted and gullies were overgrown with plants and filled with organic matter. Farmers learnt about this practice through village meeting and villagers freely picked out got an opportunity for primary training at their own farm by LAMP staff, with following advanced training for 2-3 day at the training center. At the end the project has been adopted by 80% of the farmers in Babati district. The remaining 20% is thought to learn from neighbor farmers. The center has a school nearby with different projects related to agro-forestry, such as beekeeping (Mr. Kavishe, 2009) Today SIDA tries to spread and develop the agro-forestry system and is
involved in a university project that ICRAF (World Agroforestry Centre, former International Centre for Research in Agroforestry), conducted including 130 universities in 22 countries in Africa, to put agro-forestry on the school program, and that is a slow process (Bjällås, 2009).

Ayasanda is one of the first villages in LAMPs pilot study. Through LAMP the village got tap water and the forest nearby the village is now closed and dense because the villages are educated to plants trees. Before it was cleared from trees for firewood, timber and charcoal. In periods it is allowed to collect dry firewood and let livestock graze to prevent fire. In Rain season no grazing is aloud because tree seedlings grow up and risk to get eaten. (Farmer Ayasanda village, 2009). According to Mr. Mshana, the agricultural extension officer, the main purpose for a farmer to start with agro-forestry is to improve soil, fodder for livestock and timber. It is not difficult to practice and nursery for tree plants can be done without costs, seeds can be brought by council staff and terraces and contours to prevent soil erosion are not difficult to make (Mr. Mshana, 2009).

Aim
Sustainable development is described by three spheres; social, economical and ecological. A single sphere is not efficient, all three have to converge to be sustainable. The aim of this study is to see if the agroforestry system in Babati district accomplishes all the three spheres to achieve sustainable development.

Question formulation
Do all three spheres incorporate in agro-forestry system to act as a tool to carry Babati district towards sustainable development?

Methodology
This is a qualitative case study with semi-structured interviews with farmers in Babati and one interview in Sweden. The semi structured interview is an interview where the questions are prepared and the interviewer and the informant can have a conversation about them. The fieldwork in Babati was for two weeks, to have interviews with farmers who practice agro-forestry and farmers who do not, and their opinion about it. Some extension staff were interviewed as well, because they where involved in the LAMP project. Elia Mushi, the interpreter helped to decide which people to interview and with the difficulties bureaucracy can imply. The answers could later be divided, under the results in the thesis, into the three
sustainable development spheres, the social effects, economic effects and the ecological effects from agro-forestry and their relation to Babati district. The information gathered from fieldwork is complemented with literature studies. This method was chosen because it is the most proper way to understand the impact from agro-forestry in Babati and hear farmers and extension staff’s own opinions and to make field observations. It is necessary to be able to ask sub-questions because it is a complex subject and all farmers have different opinions and experiences. Obstacles can be insecurity in relevance in questions asked, translation difficulties and to understand each other and to enable enough interviews under a pressured time schedule. The thesis is written after an environmental science thesis structure because it is easy and more freely to write an understandable thesis about the chosen subject. I have strived to divide into headlines as clear and easy as possible for the reader to understand the meaning and relevance of the text.

**Delimitation**

For this case study I have chosen to delimitate to agro-forestry in Babati and to support my results with other agro-forestry research and previous experiences, mostly related to agro-forestry in the tropics to be as accurate related to Babati as possible. I have not examined possibilities for agro-forestry in Europe and temperate areas that would be my suggestion for further studies. I have not examined the chemical processes or the physical requirements for agro-forestry as an ecosystem. The focus has been to evaluate the effects of the sustainable development’s three spheres and if the agro-forestry adoption in Babati have generated in the achievements of these tree spheres. Is Babati district heading toward sustainable development with agro-forestry as a tool?

**Interviews with:**

Bjällås, Åsa from Sida, Sweden

Farmer Ayasanda village, Babati, Tanzania

Farmer 1, Bonga village, Babati, Tanzania

Farmer 2, Bonga village, Babati, Tanzania

Farmer 3, Bonga village, Babati, Tanzania
Result

Economical effects

Why can agro-forestry have economical benefits?
For Babati, agro-forestry has been economically beneficial because it is a land use system that employs a lot of people in the same area (Mr Kavishe, 2009). Many farmers practicing agro-forestry have noticed an increased and more secure income, mostly because it is a multipurpose system. Some crops might fail from drought or insect attacks, and when that happens, timber and tree seedlings for selling or other more drought resistant crops intercropped in the agro-forestry system, can bring an income. Timber used for their own house, collecting firewood in their own farm, harvesting grass to feed their livestock and crops for household purpose can also do the family self sufficient (Farmer 2, Bonga village, Mr Kavishe, Mr Mshana, 2009). One farmer in Mamire village noticed better income since he started agro-forestry because the harvest from crop and firewood has increased and as he said:

“It has been a success for me because I can sell some from my farm and use some for household purpose” (Farmer, Mamire, 2009)

Farmer X was not aware he practiced agro-forestry in a very small scale on his yard, with bananas and trees for timber. On another 12 acres plot the family cultivate crops with no trees integrated. He said he benefits from timber trees when selling them and he made his house from timber trees grown in his garden close to the house. He said the market prices matters, if there is good prices agro-forestry can be beneficial. He would like to develop agro-forestry, he supports the system, but he lacks the knowledge about it.
Obstacles for economical benefits from agro-forestry

The main purpose with agro-forestry is to improve soil fertility, prevent erosion, supply of tree products and fodder. It is a multipurpose, low technology system which is a security even if it often is not at a big scale level. Tractor is often needed for big scale farming and that is a cost (Bjällås, 2009). For a successful agro-forestry, it requires a lot of care for example to raise seedlings and have water available for them until the roots have grown to reach the groundwater. It can be hard work and intensive labor, for example is it preferable to conduct an agro-forestry system close by the house to be able to have seedlings under observation so they do not get eaten by animals. Not every farmer has access to land around the house or the time for regular check ups. Live fence are also recommended to plant around the farm to keep grazing animals away. A good planning and carefully chosen tree species are necessary so they do not compete with one another or the crops. Agro-forestry is not to recommend when to cultivate for special reason, for example if a farmer wants to cultivate hybrid maize or big scale monoculture as in Europe (Mr Kavishe, 2009).

Farmer 3 in Bonga village does not practice agro-forestry for the reason of market price. When productivity is high, the market price falls, so he tries to find a market niche to benefit. He thinks that highland cultivation is more suitable to practice agro-forestry and in low lands where his farm is situated, he can cultivate intercropped maize and peas. Another reason he does not practice agro-forestry is that he think trees can not penetrate hard pan or rocky soils. He believes it is a good land use system because it is a security when it is a multipurpose system and the family share labor and benefits. He have livestock and have to get fodder from forest and keep the animals inside during harvest and sowing time so they do not eat the seeds (Farmer 3, Bonga village, 2009). According to Bjällås, hard pan is a problem, it prevent some crop roots to grow and the water can not filtrate through and therefore cause soil erosion, but tree roots are able to penetrate hard pan, but does not give as good results as plowing through with the plow, “ripper” which is available to rent in the district for a cost.

For a good crop yield, trimming of canopies to avoid them to grow too large and shade the crops are important. That is one of the tasks LAMP have taught farmers who are interested to adopt agro-forestry (Bjällås, 2009). Another farmer that do not practice agro-forestry, thinks a starting capital can be a problem for people who wish to adopt agro-forestry, zero grazing for example be a high investment cost (Farmer 1, Bonga village, 2009). A Farmer in Mamire village has some problems with livestock eating tree seedlings and boundary trees that
sometimes can be cut down by neighbors who want their own land to be larger, except from that, he thinks it is simple system to start and practice (Farmer, Mamire, 2009). Farmer X that does not practice agro-forestry think obstacles can be insects eating seedlings and the high cost for pesticides which he can not afford (Farmer X).

Figure 2. Zero grazing with a different dairy breed than the traditional breed in Babati. Photo by Jessica Eklund, Babati, Tanzania 2009

Problems with wildlife
Habitat loss results in conflicts between farmers and wild animals in the buffer zones with game reserves. Farmers are forced to clear new land to cultivate. Piece by piece, the buffer zone, a green corridor for wild animals to enter in and out of national parks, transforms into agriculture. Farmer’s livestock and crops get eaten and property can be destroyed and no compensation to farmers for their losses is received from the government. The situation is complicated and there is a major conflict between conserving biodiversity in the parks and the protection of human lives and farmer’s livelihood. Trees planted in the agriculture as in agro-forestry attract more animals. To scare the animals away, landowners can use smoke and noise. Game officers can shoot on the intruding animals with plastic bullets to make them leave the farm. Trees can attract some snakes and birds, but birds can easily be scared away with plastic bags tied to a string around the farm (Mr. Mshana, 2009).

Family in Haraa village with traditional Chagga homegardens
Farmer 2, (Haraa village, 2009) and her family thought they could benefit from an agro-forestry system that is why they conducted it. The family planted elephant grass to provide the family’s cows with fodder and for soil erosion prevention. They started agro-forestry because the elephant grass was not enough to prevent soil erosion. The wife in the family also tried to
plant bananas to shade beans which died by the sun and noticed it was a success. The climate in Haraa is humid so water availability is not a problem. At the moment the family manages a 12 acres agro-forestry farm with different plots, some are for household and some for cash crops. The family members is helping each other a lot during harvest and sowing times. What brings the most income depends on the market, and that can be a problem, another problem is the high cost for pesticides needed for coffee (Farmer 2, Haraa village, 2009). The husband in the family has practiced agro-forestry for about 30 years and he, his family and some daylabor work at the farm. He was a pastoralist first and searched for pasture in the forest, now most of the things he need to support his family is at place, on his farm. With the cash income the agro-forestry have generated, he can afford to pay for his children’s school. He thinks some obstacles for people who want to practice agro-forestry can be land scarcity, soil fertility problems, shortage of education and the acceptance of it. Some people want benefits earlier, it can take up to 15 years for timber trees to be sellable and tree nursery can be a cost (Farmer 1, Haraa village 2009). Agricultural extension officer came to educate the family about agro-forestry but they already practiced it. Haraa village is an agro-forestry model for other countries. (Farmer 2, Haraa village, 2009)

These economic effects have been noticed

- Too few interviews have been carried through to make the conclusion that poverty in Babati been reduced, but the result indicate improved economy among farmers in the district.
- Agro-forestry employs a lot of people in the district
- Farmers income’s are more secure
- The market has an influence on agro-forestry farmer’s income
- There are some expenses with agro-forestry for pesticides and tree seedlings (losses, nurseries, buys).
- Expenses in time and effort for caring of tree seedlings, trimming, plowing and planning.
- Earnings in time and effort are less foraging of fuel wood, fodder and timber
- Most farmers are self sufficient with food, timber, fuel wood and fodder
- Increased income so the family affords school fees and school material
• Agro-forestry is suitable for a lot of people because it is a low cost and low technology system, but not suitable for big scale or mono-cropping farming.

• Agro-forestry is a long-term agricultural system, requiring a lot of knowledge and the benefits can take a long time to harvest.

Ecological effects

Why can agro-forestry have ecological benefits?
Agro-forestry systems are according to Mr. Kavishe a win-win situation because the environment has improved a lot, and so has the economy since the LAMP programme in Babati. Environmental services, such as soil improvements because of crop rotation and organic materials and leaves from trees for fertilizers are some benefits provided by the agro-forestry system. Organic farming is encouraged because less commercial fertilizer is needed and agro-forestry does not require a lot of chemicals as pesticides, because the system resembles a small, balanced ecosystem with no monocultures and insects are biologically controlled by birds. Erosion can be reduced through contours, terraces and to plant trees which bind the soil as water catchment. LAMP encouraged farmers to conduct zero grazing which also can help to improve the soil. When livestock graze freely, farmers crops and seedlings can accidently get eaten and problems with overgrazing can occur (Mr. Kavishe, 2009). With fewer plants to bind the soil, water and wind can transport soil particles more easily and create an eroded landscape with less productive soils. Zero grazing generates more milk but is an investment to build a stable and buy a special dairy breed if it is necessary to produce more milk. To keep livestock as zero grazing it helps to decrease the overgrazing around the area and if the remnants of crops return to the soil instead of let the cattle out on the farm to eat it, it would be better to use it as mulch and turn it back into the soil (Bjällås, 2009).

Farmer 2 in Bonga village owns 2 acres of land where he cultivates coffee, banana, maize, beans, avocado, mango, lemon, orange, and trees for timber. To make a good yield he use manure as fertilizer which is easier to collect from zero grazing (Farmer 2, Bonga village, 2009). As for all agricultural systems, nutriments are necessary to make a good yield. The need for commercial fertilizers decrease when trees and crops integrate, fallen leaves decompose into natural fertilizer but are often not enough so most farmers add manure. When there is balance in the environment it becomes more resilient and can manage a bit better
against insect attacks (Bjällås, 2009). A farmer in Ayasanda village thinks the LAMP project contribute to sustainable development because it educate young people so the knowledge proceeds and people are more aware of the environmental problem. It generates economical benefits, for example from sales of tree seedlings. The forests in Babati are today more conserved because people have timber trees at their own land, indigenous species are planted which increases biodiversity and releases exploitation pressure from the natural forest. The trees give shade and preserve the soil (Farmer, Ayasanda village, 2009). Farmer X has noticed decline in amount of rain in recent years (climate change). To adapt to the drier climate he intercrops different plants and plant trees because traditionally it is believed that trees make it rain more (Farmer X).

By planting trees, the water from the mountain slows down and retains in the soil and vegetation and prevents soil erosion. The land was eroded before agro-forestry was practiced and the soil fertility has improved since then (Farmer, Mamire village, 2009). Mt Kwaraa is a water source and important for Babati. Water from the mountain drains out into lake Babati. Lake Babati and the near by lake Manyara become shallower because so much material drains into the lakes (Bjällås, 2009).

Obstacles for agro-forestry benefits
Agro-forestry is not necessary for big scale farming, if the soil is fertile or if there are no requirements for tree products. Farmer 2 in Bonga village owns 12 low land acres where he does not practice agro-forestry for cash crop cultivation like maize intercropped with pigeon-peas and sunflowers. The soils in lower parts of Babati are according to farmer 2 not favorable for trees and the maize is not favorable in the shades from trees. Rain is a problem and due to season and drought, the environmental condition varies. He has no problem with soil erosion, but with insects which eat the coffee plants. To handle that problem he uses insecticide that is poison to animals. If the animals eat grass with the insecticide on it, they can die. Fruits from the farm need to be washed before eating to reduce the risk of intake of chemicals (farmer 2, Bonga village, 2009). Soil fertility is a problem for farmer 1 in Bonga village to start, that is one of the reasons, he has not adopted agro-forestry technologies. He uses manure for increased soil fertility and mentions he has some problems with insect attacks and uses insecticides when an attack occurs (Farmer 1, Bonga village, 2009). A farmer in Mamire village use ash as a pesticide in storage and on some of his plants in agro-forestry. Insecticides are used when ash has failed or for locust, grasshopper or cricket attack, because they survive
the ash (Farmer, Mamire village, 2009). Farmer 3 in Bonga village does not practice agro-
forestry because trees and shrubs reduce soilfertility and decrease crop growth and pesticides
needed for coffee is poison to other crops. During harvest of timber it destroys other crops
when it falls on them and that is too risky for him. Soil erosion is not a big problem, it is
reduced through contours near the mountain and by boundary trees, teached by LAMP, but
they did not teach him the agro-forestry system. What he knows about agro-forestry, he has
taught from Chagga people, but he thinks his land is not suitable for it (Farmer 3, Bonga
village, 2009).

**These ecological effects have been noticed**

- Reduces soil erosion through tree planting and contours.
- Water catchment, effective water use.
- Increased fertility in soils
- Less overgrazing since zero grazing
- A more resilient land use
- Commercial fertilizer is not extensively used, many farmers use manure
- Industrial chemicals such as pesticides is extensively used
- The natural forest is conserved
- Wild animals are not a big problem except for farms nearby national parks
- Trees give shade that favor other crops
- Conservation of biodiversity and indigenous tree species
- Lakes and inland waters can benefit from soil conservation measures
- Different opinions if agro-forestry is suitable for only highlands or both high and low
  lands
Social effects

Why can agro-forestry have social benefits?
According to a farmer in Ayasanda village, the gender issue has been raised since LAMP project so the equality has improved, for example, LAMP has conducted the forest committee with 6 men and 6 women. Men and women often share work duties on the farm but to provide the family with food is a women problem and with an agro-forestry system they do not have to walk long distances to collect firewood and water. Benefits from timber sales are shared equal at 75% of times. For the remaining percentage the men collect the benefits (Farmer Ayasanda, 2009). Since starting practice agro-forestry, Farmer 1 in Bonga village thinks it is more equal now between men and women because they share income and make decisions together. Farmer 1 in Bonga village who does not practice agro-forestry also decides what to cultivate together with his wife (Farmer 1, Bonga village, 2009). To start an agro-forestry system was difficult for Farmer 2 in Bonga village and his family before they had any education about it but they managed with the little knowledge they learnt from his grandfather. The tree nursery is a woman project and the seedlings are sellable after about a year (Farmer 2, Bonga village, 2009). It is not expensive to start an agro-forestry system and does not require more labor. Income from agro-forestry is often spent on expanding it.

Obstacles agro-forestry benefits
According to Mr. Mshana, the situation in Babati is not totally equal between men and women. Men get money from nursery sales and timber, they also decide most times where the income is spent. Conflicts can arise between farmers when boundary trees get stolen by their neighbor who wants bigger land (Mr. Mshana, 2009). Another problem is the fear of thieves. Farmer 1 in Bonga village does not practice agro-forestry because he has no available land close to his house to cultivate, therefore he can not control an agro-forestry system and is afraid of thieves. He has not got any education about agro-forestry but he does not want trees on his farm anyway because it reduces crop growth and shades too much (Farmer 1, Bonga village, 2009). Farmer X has not got any education either. He thinks that there is not enough education about it around the district, that is why not everybody practices it (Farmer X, 2009). According to Mr. Kavishe, not everybody in Babati practices agro-forestry because of tradition, like some people are agro-pastoral. The size of farm land matters if you want to decide to adopt agro-forestry, planted trees can take place from food crops (two ha is most
common farm area) and the cultivation technique matters if an ox plow or tractor is available to use. If the land area is too large, a tractor is more effective, but is also more expensive.

Åsa Bjällås, SIDA does not think agro-forestry as a land use system makes the community more equal, more likely a micro finance project that is a part of LAMP and involves gender issues. To practice agro-forestry you need access to land and be aware about utilizing rights, otherwise the wish to invest in your land because it is unsecure. Valuable land can be a conflict risk, not just for agro-forestry utilizing (papers and contract is important), but for different interests in general. Pastoralists, farmers and wildlife corridors, irrigation of water are often interests in conflict. Land use management plans for the district are a solution to this problem and have been successful in Babati. The understanding of the changing society and partly adapt to it is important for people. Bjällås thinks there is a great wish of modernization, but perhaps it is not always the best to follow the western world’s solutions? Instead of totally new methods and ideas it can sometimes be better to develop the traditional knowledge, which can favor the landscape and be affordable. Like maize for ugale is not drought resistant, a more native plant perhaps yields less but is more persistent (Bjällås, 2009).

“The direction of technological developments may solve some immediate problems but lead to even greater ones. Large sections of the population may be marginalized by ill considered development” (http://www.un-documents.net/ocf-02.htm#I).

A new idea in the agro-forestry research has arisen, if there is a risk of an increase of mosquitoes when they lay their eggs in water pools (in banana leaves for example) and if there could be a small risk that malaria disease increase when a lot of people have these small water pools (Bjällås, 2009).

**These social effects have been noticed**

- Many farmers believe the gender issue has improved but is difficult to make any conclusion since there are too few women interviewed and no comparison has been conducted with other land use systems.

- Situation for women has improved, when the labor at farms get easier and less time consuming when for example search for fuel wood is not necessary because it can be collected at the farm.

- Education and the acceptance of it have had a major impact for agro-forestry and those farmers that do not practice agro-forestry have not got any education.
• Conflicts between neighbors can arise when there are vague boundary lines and seedlings or other property can be stolen.

• Tradition can be an obstacle for the adoption of agro-forestry. Agro-pastoralist may think agro-forestry is not suitable for their lifestyle.

• Farmers utilizing rights of land have to be clear to dare to invest in a long term project as agro-forestry. Land use management plans in the district are a solution to minimize risk of conflicts between different land use interests.

Discussion
A winning concept for a successful transmission of the agro-forestry practice is to respect the rights of traditional knowledge and adapt the market to the indigenous plants and make a benefit from it. Minimal skills and capital are required when the market is based on traditional knowledge and technologies, it becomes easily adopted by poor people (Leaky, 2006). As mentioned by Åsa Bjällás, instead of new advanced technologies, traditional methods and knowledge should be developed and ideas could also be more legitimated to implement if the people in the community participate.

Economical effects
To change the way people have been utilized their land for generations requires good incentives to pursue people to make that change. Agro-forestry is a low cost/technology/risk and resource efficient land use system that makes it easier for farmers to adopt and benefit from it. It is also easier for farmer to take part of the market and to intensify the productivity instead of clearing new land (Aune, 2008).

Why can agro-forestry have economical benefits?
This land use system would not be a success if the inhabitants in Babati could not make a living from it. People in Babati need nutritious food, fodder for their livestock and timber for their houses. If agro-forestry is going to be meaningful economically, socially and ecologically, there must be a market for agro-forestry tree products. To fulfill what the market requests, domestication of trees could be beneficial to decide what quality is best for the market, for example larger fruits. Trees can be selected for their high yield, seasonality, regularity of production, reproductive biology, reduction of susceptibility to pests and
diseases, length of fruit season and ripening period (Leaky, 2006). If fruit tree species are
domesticated, wild fruit trees can be spared in their natural environment.

**Time and care**

One obstacle with agro-forestry system is the requirement of care and labor. It is positive in a
way as Mr. Kavishe said, it employs a lot of people which minimizes unemployment. Most
farmers think it is not more work with agro-forestry and it is an easy system with no large
capital to start, but most of them have low land farming and not the Chagga garden system,
perhaps there is a difference in work load. From my own observation the Chagga home
gardens in Haraa seemed to be more large big scale farming than the other farms in low lands.
Size is of course important for time and effort spent on labor. Farmer in Haraa is the only one
mentioned some day workers, but for most times the family is enough if they help each other
with work duties in the farm, mostly in harvest and sowing time.

According to Mr Mshana it is possible to have tree nurseries without cost. But it takes a year
of care before it generates some income from selling. Nursery problems can be fungal diseases,
lack of water, availability of polythene tubes for seedlings to grow in, insect attacks and lack of
market. Agro-forestry is a long investment and it takes years before trees can be sold as
timber. In the mean time it can increase productivity of crops. Some people want cash income
right away and do not have the courage to take that risk to invest money and time then waiting
for the results. As Mr. Mshana mentioned, suitable trees for agro-forestry have certain
qualities. There can be negative effects on crops if there is not enough knowledge about what
trees are suitable for high productivity of crops, if that is wished for, and which trees are fast
growing and good for timber trees. There can be a great benefit if the knowledge is provided
and if right, non competitive tree species are chosen.
Pesticides
Many farmers say that pesticides are a high cost, and it seems that the use of organic pesticides is not widespread. One farmer used ash sometimes, but not under cricket attack because it was not effective then. If a natural pesticide is cheaper to cultivate at your own land, it would be better for the environment and decrease the health risks to make it yourself and do not need to buy expensive industrial chemicals as pesticides. It might be too rare with pests to be worth the space on land to cultivate for organic pesticides, most farmers did not experience a big problem with pests. Organic pesticides could not be as effective, and perhaps there is a wish to be modern and abandon old traditions or it may never have been tradition so there is no knowledge about it.

The market
The market is a big issue for most farmers. It decides what to be cultivated and how much money the crops generate. That was the major problem for farmers and a cause of anxiousness. To make the economic effect in Babati expand, processing (extraction, storage), marketing and work closely with companies could be alternatives, but not to the extent of small scale farmers getting outcompeted by large companies or result in negative impact on environment or degradation of natural resources. Scaling up with new technologies can shift benefit from women and marginalized producers. For a long-term income to a district, an idea can be to cooperate with big companies who buy in commercial crops, for example cacao, rubber, coffee, sugarcane (also for fuel) and cosmetic and medicinal plants (Leaky, 2006). Agro-forestry can surf at the climate change mitigation wave with bio fuels and carbon...
market to make an extra income. A problem could be if cash crops occupy area for food production for the household.

**Ecological effects**

**Land recovery and biodiversity**

Agro-forestry is a land management system to regain biodiversity, deforestation and land degradation in the tropics. It is environmentally a better system than other farming systems. There are possibilities to protect indigenous fruit trees, be a refuge for animals, and dispersal path for plants (Oke, 2007). LAMP demonstrated, by choosing a degraded area for farmers training center as a demonstration place, that agro-forestry technologies are very suitable for degraded and low productive land. If those lands are left unmanaged, it will continue to be degraded and be useless (Stancheva, 2006). As a system gaining biodiversity, can by observation be mentioned, is not a statement to cover all agro-forestry farms in Babati. The definition of agro-forestry is not very clear among farmers and extension staff, consequently gives different results. Some have adopted contours and planted a few trees lly scattered in their farm which is another type of agro-forestry than the Chagga multistrata home gardens and can not be compared in diversity. Little is known in what extent agro-forestry can link together fragmented forest patches, but probably an agro-forestry system such as the Chagga homegardens which resembles a forest with multi levels and both annual and perennial plants is more suitable for a fragmentation mitigation management than if the agro-forestry system is managed with contours and a few scattered trees or with boundary trees.
Figure 4. A Chagga homegarden agroforestry system in Haraa village. Photo by Jessica Eklund. Babati, Tanzania 2009.
Agro-forestry provides some environmental services. LAMP has succeeded to improve the water erosion and gully problem through contours, terraces and agro-forestry. Now the forests are protected, slash and burn method to clear new land is prevented and trees are planted around the area. This has led to the recovery of the forests, gullies and erosion is not a major problem for farmers any longer, degraded lands are recovering. Of all farmers that been asked if the environment have improved, all have said they believe it is better than before agro-forestry was adopted.
Water use
Deforestation, road building and conversion of forests to agriculture can reduce the soil’s ability to infiltrate water which can cause water erosion or mudstream flows, which can be a devastating problem to farmers. Where the soil surface is crusted the recovery can be faster than if the soil is compacted. Mulch or manure on the crust protects it from direct impact from rain, wind and sun. It also stimulates biological activity in the soil and improvements can be noticed after a few months. It is very important that watershed services are managed in a holistic point of view otherwise downstream farmers who have taken action against water erosion will be affected from upstream farmers if they haven not manage the watershed (Noordwijk, 2006). Trees can make preferable microclimate for other crops and reduce evapotranspiration which is a more effective water use (Kandji, 2006). When water stays in the soil, less particles drains into Babati lake. The flood risk could be reduced and the water quality in the lake could be better when it is not turbid which also could be beneficial for fishing. Trees break the wind which otherwise can dry out the soil and reduce the need for irrigation of water (Stancheva, 2006), air cleaning and pollination are other environmental services provided from agro-forestry.

Protection of the natural environment
When people in Babati have timber, fodder and firewood at their own land and when there are forest reserves combined, as in Babati, there is successful protection of natural habitat and animals living there. Indigenous tree species are preferable in agroforestry because they are adapted to the climate and wild specimens can be left, saved in the forests. The need for tree products is often satisfied and farmers are self-sufficient from their farm. People and animals may not encounter each other as much and the most farmers do not have a problem with wild animals in their land, except for the border between a village and the national park Tarangire. Migrating animals have to cross somewhere and the buffer zone decreases so a conflict between farmers and animals is a complicated problem to solve. When agro-forestry is widespread, the land utilization intensifies and the need for new land decreases as a benefit for wildlife. For many agro-forestry farmers, a common problem with animals is those livestock that walk about and eat tree seedlings. A solution to that and also to over grazing is zero grazing and to plant live fence. With zero grazing livestock are more secure against predators and can be under observation.
Fertilizers and pesticides

Many of the farmers in Babati mention they use natural fertilizer to improve the fertility. That is positive to both the environment and the income of the farmers. According to ICRAF (Leaky, 2006) it is important to focus on a diversified agro-forestry system that integrates pest management. Industrial chemicals are used when the crops are attacked by insects. The use of natural pesticides is not wide spread. Some of the farmers have noticed problems with industrial pesticides such as livestock can get ill, other crops can fail and it is expensive. Very few mentioned the health risks for themselves, some thought the chemicals on the crops disappeared when it is let to dry in the sun. The agricultural extension officer mentioned the health risk for the farmers and believed agro-forestry was better for them because of less use of pesticides. From my observation, agro-forestry in Babati is not organic farming, because most farmers used chemical in some situations more or less frequently. Agro-forestry practice has not been compared with other land use systems in this thesis so a conclusion if agro-forestry practice in Babati is more organic than others is difficult to make.

A local, organic market

A local market for agro-forestry product is the most suitable in an environmental point of view. It is easier and more secure for farmers to support a local (perhaps regional) market and transport, infrastructure and storage become more efficient. The transports shorten and it can be easier and less expensive to maintain the quality of infrastructure. To shorten the travel distances reduces the fuel cost and supports a transport pool driven with bio fuel produced for a local market. That could be a way to combat the climate change and support the local market and also to keep a good quality on the agro-forestry products, and stay fresh (shelf-life can be short when no chemicals are used) if there are short distance and the transport can arrive in a short time. When cultivateing for bio fuel there are risks for big scale monoculture farms with a loss of natural habitat and biodiversity as a negative impact, but if most farmers could cultivate for bio fuel in their agro-forestry system and make a benefit from that sale, the benefit could be shared among more people and the environment.

A local organic agriculture brand on the products could make a niche on the market and be an incentive for farmers to converge into organic farming with fair working conditions for farmers health and a equal status for women. One example of this is from Centro Ecológico in Brazil that shows it is possible to increase food production and secure income with small scale trade and organic farming. The centre has a course farm with demonstration plots like farmer
training centre in Babati, and they provide consultation about organic farming, refinement and trade. The aim for the business is to converge into organic farming, agro-forestry to sustain the rainforest, self sufficiency, refinement, intensify local markets, PGS “Participatory Guarantee System” a low cost certificate, and network connections. The certificate is based on participatory, local trust, not international expensive extern check ups. Centro Ecológico wants to establish local markets where producers and consumers can meet and support a long term sustainable production and maintenance. Another positive effect is that healthy non-chemical food can be sold at a low price and does not become a class issue and no external money losses occur when farmers sell their crops directly on the market themselves. Agro-forestry’s provision of water efficiency and resilience is very important for the socio-economic issue as well as for the environment. Organic farming increases productivity and a resilient, diverse farming system increases food security. In the end, agriculture is the source human life depends on (Lundberg, 2008).

Other aspects
Except for the environmental benefits mentioned in the results, for example shade from threes makes a more comfortable environment for humans and livestock to escape from the heat of the sun. Another aspect is the esthetical purpose of a tree, to have a beautiful garden. The quality and even quantity of water improvements for drinking and for watering is very important as well for the human health and the environment (Stancheva, 2006). For example if the water contain a lot of pollutions and reach the lake it can make an impact on fishes and higher up in the food chain and if the water contain high levels of nitrogen from commercial fertilizer the lake can be eutrophicated.

Social effects

Equality between men and women
Many of the farmers believed that the gender issue has been raised through LAMP and improved the equality. But there has only been one woman interviewed in this study so there can be no definite result from a woman’s part of view, but according to the men, the women status in the household has improved. Women benefit from trees with fruit that ripe in school periods to earn money to school uniforms and school fees (Leaky, 2006) and if there can be a lot of time, energy and money saved to have the firewood at their own farm instead of collecting it in the forest, that could be an improvement. If men and women can decide together how to manage their land and where the benefit should be spent that is also an improvement, if
that never were a question before LAMP. Many farmers in Babati, said cooking and have food for the family was a task for women and it seemed that the role for men and women was very clear. 60-80% of the farmers are women and the food security depends on them (Garrity, 2006). Bjällås doesn’t think the status of women improved through agro-forestry as a system. That could be true, perhaps only the conditions for women have improved. Lamp has raised the gender issue and it could result in different view of women. As Bjällås said, programs for different women cooperations like the micro finance programme where women can be in charge of income and decide for their own can empower women and increase their confidence. Agro-forestry empowers women because they make an earning from example processing of fruit and feel independent and can decide where to spend the money. Nutrition and health have positive impact from fruit in their diet (Allan, 2006). Trees that suppress weed reduce the burden of weeding (often a women task) and loose up the soil and make it easier to work with and can improve work conditions for farmers (ICRAF, 2009). If women have a higher status in the society, and if they can have a career, the family planning and the first birth can be at higher age. Many farmers have said that one benefit with agro-forestry is that everything is at one place. If that results in less working hours, more time can be spent on leisure and quality time with family and friends, the social life can benefit as well as income. It is difficult to make a conclusion about time, effort and equality of work duties compared to other systems, because such comparison haven’t been conducted.

Scaling up

Some of the farmers say that they benefit from agro-forestry and now can afford to pay school fees for their children. If agro-forestry scales up, more families in Babati can afford school fees, teacher’s salaries, materials and school lunches then the education quality can improve and more children would be able to go in primary school, secondary school and university. If families afford to have day workers on the farm, they are not dependent on the children to work there to bring an income which can prevent child labor. Children are important, they are the future. To teach about agro-forestry system and environmental problems in school, children can have a holistic view and an understanding for the interaction of humans and the ecosystems for a sustainable society.

There is a need for understanding among people and policy makers of the biophysical, economical, social and cultural factors running the society to reach a long term result of the land use measures. Agro-forestry needs to be scaled up by many farmers to have an impact on a national level. Collaborating advantages is fundamental to succeed with the scaling up process and create awareness among farmers and policy makers, and extension staff must
have the adequate skills, and be updated with new innovations to teach. Communication between scientists and farmers/extension staff is of major importance to provide adequate information. A transparent policy with meetings with answering questions provide new information and solutions (perhaps for only women to empower them in the community) is a way to make farmers participate in a project. For example new introduced species can be taught about and regarding to literacy, personal meetings and demonstration plots with seed orchard at farms and schools is necessary and do not rely on papers and books to teach the agro-forestry technologies. Money for scaling up projects or such project as LAMP can of course have an impact on the result and adoption of the project (Allan, 2003).

To bring more benefits to more people in a larger area, more quickly, more equal and more lastingly is one definition of scaling up. There are 8 essential steps in the scaling up process:

1. Farmer –centered research and extension – For best results, farmers should participate in the design, implementation and evaluation of research.
2. Technical options – Farmers should be able to choose from several options to meet the special preference, farmers have different resources and requirements.
3. Local institutional capacity – A successful strategy is to allow the local community to plan their own development.
4. A seed available – A precondition to scale up is to have seeds for trees and crops available to plant. That has been shown to be a problem for wider adoption of agro-forestry.
5. Marketing – raw product with high value on the market, and help farmers to reach the market can increase income for small scale farmers.
6. Policy options – Policy affects the scaling up process, it can limit the adoption of new practices, policy incentives can help promote adoption of agro-forestry and policy makers can themselves promote or finance scaling up activities.
7. Learning from success and failures – Learn from previous experiences and shared knowledge can help others in the scaling up process to make effective decisions. It is a knowledge intensive system and it is important to teach its technologies because it is not easy spread on its own.
8. Partnership and facilitation – Partnerships for example between organizations can offer good solutions in the scaling up process and can complement different skills, but
some risk can be time and resource demanding, blurred identity for the organizations and compromised impacts.

(Franzel, 2006)

By observation, there was not a big market for processed food, except for sunflower oil, so there are possibilities for Babati to extend the local market for processed food, if there is an interest in those products. Even fishponds and bee keeping can develop. Except for a big scale farmer and the farmers training center’s school, no one of the informants said they had those in their farm. There could be a problem with water availability or investment, but there could be benefit for the families which practice it. Fish can be an income from selling, cheap and easy too keep and a good source of protein.

Policy intervention to scale up may be:

“Develop and implement systems to protect community-based cultivars as part of legislative reforms for biodiversity management, indigenous knowledge protection and plant genetic resource conservation and use. Ensure the continued use non timber products to support rural livelihoods. Establish basic management, financial and institutional capacities to ensure that local people capture a greater share of benefits from commercialization” (Leaky, 2006).

Great results can be achieved, if there are external companies, which should involve the local community, and the local communities should cooperate and use their own strengths to manage recourses in an appropriate way (Leaky, 2006).

**Policies**

Policies which encourage cheaply produced food in environment-friendly manners would benefit farmers and Tanzania as a country. To incorporate agro-forestry systems into national agricultural development programs would for example offer a sustainable and less expensive way to fertilize soil. Such policies don’t exist, current policies don’t take advantage of agro-forestry technologies (ICRAF, 2009). The climate change is also something for policy makers to take seriously. Trees have mitigation properties for the climate change by sequencing up to 2.5 to 3.6 tons of carbon per hectare per year. The climate change is a threat to sustainable development, and from achieving the Millennium Development Goals. Parts in the world will experience increased or decreased rain fall, fungal outbreaks can be more common, more insects (pests), ecosystem resilience reduction and decline in biodiversity.

**Policy recommendations**
• Promote fertilizer trees or soil fertility management to reduce expensive and not so eco-friendly commercial fertilizers.

• Provide support to implement the national agro-forestry to scale up

• Provide training to government agricultural extension staff and provide information and news.

• Agro-forestry products need market and marketing infrastructure support

• Participatory assessment on environmental problems and climate change and how to adapt and confront it

• Institutionalize science-policy forums with agro-forestry updates to policy makers and stakeholders.

(ICRAF, 2009)

Agro-forestry’s possibilities for HIV/AIDS mitigation

HIV/AIDS is a threat to a long term project such as agro-forestry. Investment in training trainers, farmers and education can become financial losses and malfunctions in social structures due to deaths or illnesses related to HIV/AIDS. Research on the medicinal and nutrient potential for HIV mitigation from agro-forestry products is currently ongoing. Tanzania is one of the countries with highest rates of HIV in the world. Trees can be an income when crop yield fails due to climatic stress or bad market prices. HIV infection can cause the same stresses for a long time and therefore be a threat to the long term potential for agro-forestry. Tree resource can be exploited faster when there’s no wish to start a long term project. 80% of the population in Sub Saharan Africa relies on remedies based on herbs gathered from the wild so a lot of those plants are overexploited in their natural environment. 65 % of medicinal plants are trees and can be identified and cultivated in the agro-forestry system. The diverse and nutritious food, vegetables and fruits etc from agro-forestry can boost the immune system and keep infected people healthier for a longer time. When training the agro-forestry technologies, the extension staff can also teach how agro-forestry can reduce vulnerability to HIV/AIDS and to choose the more labor saving technology options like woodlots for timber and charcoal. Timber can also be an income security for ill farmers (Swallow, 2003).
Conclusion
The conclusion from this thesis is that agro-forestry in Babati district, more or less fulfill the three spheres of sustainable development, the ecological, economical and social sphere. Agro-forestry is a useful tool towards sustainable development, but it has not yet reached its full potential, there are possibilities for improvements and to scale up for greater benefits for all three spheres. There are some recommendations for improvements in the text. Participation from people and grass-root movements are, together with a transparent, awareness increasing policy, important for long term, sustainable results.

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Appendix
Interview question for Åsa Bjällås:

1. What environmental, social and economical effects do agroforestry have?
2. What future do agro-forestry have globally?
3. Can everybody practice agro-forestry (Start kapital, owners rights, climate)? Why do not everybody practice it?
4. What obstacles can face agro-forestry practice?
5. What is the definition?
6. Is it sometimes better to have seperate agriculture and forestry?
7. What pros and cons are there?
8. What is required for a development of agro-forestry (democracy, markets, laws etc)?
9. Why is agro-forestry not widespread in Europe?
10. What is the main purpose with agro-forestry?
11. What meaning does agro-forestry have for the environment?