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Exploring potentials for payments for environmental services

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Introduction

This research is about a watershed in the Uluguru Mountains, where the upstream population are small scale farmers and the downstream population are habitants of Morogoro Municipal. The objectives of this research are to examine if it would create financial benefits to pay farmers to convert to organic agriculture. This should first of all create a positive impact for the downstream population since water quality and quantity will increase. Secondly, the agricultural transition could help to increase the small scale farmers' productivity in a sustainable way which would lead to poverty reduction and strengthen the existing food security for the up-stream population.

1.1 Problem Definition

Trends have shown that the global population will reach more than 9 billion people by 2050 (FAO 2013) whereby some developed countries will almost stagnate and on the contrary, developing countries will contribute with immense growth. For instance Tanzania is expected to double its current population by 2030 (UN 2013). In this context one of the biggest challenges in the 21st century is to guarantee food security for an increasing population with changing food habits and double the food production by 2050 so as to satisfy the increasing demand (IAASTD 2008: 254). Many factors threaten this objective and their intensity increases over time. Climate change leads to increased floods and droughts which can have disastrous impact on agricultural production nationwide. The ongoing soil erosion and salinisation, caused by unsustainable agriculture practices, lead to loss of land worldwide (IAASTD 2008: 5; Pretty et al. 2010: 220).

All these problems are embedded in environmental challenges which, to an extent, are created by producing food in an unsustainable way. The IAASTD report states the necessity to increase the agricultural productivity on one hand and on the other hand to decrease the negative impact on the environment that is caused by practicing agriculture (IAASTD 2008: 5). The demand for research on innovative solutions which are capable of dealing with environment and agriculture is vast to deal these problems (Wunder 2005: 2).

The author examines a case study within the framework of Payments for Environmental Services (PES) and organic agriculture in regard to its feasibility. The goal of this research is to elaborate innovative strategies which could be 'able to hit two birds (environmental

devastation and food insecurity) with one stone' and beyond by analyzing externalities and opportunity costs of agricultural production in the Uluguru Mountains. Through giving them a monetary value, and assessing trade-off opportunities, a bargain between polluters (farmers) and the exposed party (Morogoro Municipal inhabitants) could be established. Here the author tries to elaborate new opportunities for the public sector to invest more effectively in sustainable development and to encourage the private sector to chip in as a potential buyer, willing to pay for Environmental Services (ES).

1.1.1 Agriculture

The development of agriculture was a precondition for complex societies to arise. In the last 10,000 years 600 generations of farmers produced more and more food to feed the growing population who had specialized in new fields apart from farming (Pretty 2002: VI). Agricultural productivity has doubled in several countries in the last 100 years but the food situation has not relaxed. In 2013 more than 800 Million people on our planet still experience hunger. Despite the tremendous growth of agriculture in the last decades, side effects of intensive agriculture production systems became more and more visible for the majority of human mankind (Kassie & Zikhali 2009: 1f.).

The increase in population in the last 60 years from 2.5 billion to 7 billion people (UN 2013) was exponential and the consequences on the environment were discussed in the 1970s for the first time at an international level. The Brundtland report was the output and guideline for action to rescue the situation in the coming decades. During this conference the term 'sustainability' had been used to explain that the environment cannot be simply separated from social and economic life. Furthermore the term was used to indicate that the fulfilment of the present need should not limit the resources for further generations (Kassie & Zikhali 2009: 2f.). The problems in the field of agriculture are immense; four of the main challenges are described below:

Soil erosion/fertility: Unsustainable agricultural practices have led to vast soil erosion in the last 40 years. Worldwide Erosion causes loss of more than 75 billion tons of soil every year, whereby most of it is caused by agricultural activities than compared to natural ecosystems which play a minor role. Up to 40% of the land has become unproductive, and hence is not any more in use for production (Burgess et al 2013: 78). Also loss of soil fertility has been

caused in several SSA countries (Kaplan, Ifejika-Speranza & Scholz 2013: 40) which challenges the objective to have enough food for an increasing population.

Water pollution/scarcity: Yearly, more than 7,000 km³ of water are used worldwide for irrigating crops, whereby experts foresee that this amount will be doubled by 2050 (IAASTD 2009: 184). Already by 2025 more than 60% of the world's population will face water-stress conditions, whereby 1.8 billion people will be under permanent water stress. The situation becomes worse not only because of the vast amount of water which is used for crop production but also due to the pollution by synthetic chemicals which are used in intensive agricultural systems. In almost every developed country there is a serious problem with contaminated groundwater and this environmental issue becomes nowadays also more and more of a challenge in developing countries (Burgess & Pimentel 2013: 11f.).

Climate Change: Agriculture has a big impact on climate change since up to 30% of global emissions are made from agricultural activities. It is forecasted that changing weather conditions will lead to an increase in floods and droughts which will have a negative impact on agricultural productivity (IAASTD 2009: 11).

Loss of Biodiversity: In only five years from 2000 to 2005 more than 100 million hectare forest were deforested (UNEP 2012: 134). This leads to loss of genetic information. Food security has a correlation with the availability of this information since it is needed to breed new varieties to increase productivity or to make the production more resilient (Hunter et al. 2011: 3).

In the context of these challenges, the big question is how to enhance food security in the long term view on one hand, and on the other hand how to preserve and maintain the environment alongside the need to increase agricultural productivity. More than 2 billion people on the planet are involved in agricultural activities (IAASTD 2009: 14). In Tanzania more than 70% of the population depend on this sector for their livelihood and most of them are small scale farmers with an average land size of 1.2 hectare (MoF 2010: 7f.). In the IAASTD (2009: 10), report challenges regarding effective knowledge transfer and implementation are mentioned as one of the major constraints:

Small scale farming can damage the environment, particularly when practiced under increasing population pressure and with scarce suitable land, involving shortened fallow periods and expansion of cropland areas into unsuitable environmental situations such as steep slopes. This process was particularly accelerated during the past 100 years due to the expansion of farming, despite the

emergence of agroecological practices and widespread efforts to introduce sustainable land management technologies on small farms.

Creative and innovative solutions are needed to enhance diffusion of knowledge on these issues. The fact that agricultural productivity in Tanzania is low at the moment, since still traditional methods are applied to a large extent, bears the potential that the production can be increased in a sustainable way, without extensive use of agrochemicals (Kaplan, Ifejika-Speranza & Scholz. 2013: 41). In the next 40 years the loss of water in the agricultural sector needs to be reduced by improving irrigation and watershed management (Burgess & Pimentel 2013: 11). Farmers have to change their agricultural practices in order for climate change adaptation and mitigation to be achieved (FAO/PAR 2011: 14). Local food markets have to be promoted where communities benefit from environmental, economic and nutritional benefits (Burgess & Pimentel 2013: 17).

1.1.2 Watersheds

The IAASTD (2009: 567) definition of a watershed is: "[t]he area which supplies water by surface and sub-surface flow from precipitation to a given point in the drainage system". A watershed can include a vast area or just a small one. It is determined by its slopes, soil, vegetation and annual precipitation. Hence a watershed is a hotspot for soil and water conservation (Kerr 2002: 63).

The watershed ecology has an important function since it supplies a large amount of freshwater for the world's population; hence people's capacity to manage upstream–downstream flows, carries weight (FAO 2006: 5). Especially in developing countries, where water scarcity is already stressing a big part of the society (Bossio et al. 2009: 22), degradation of watersheds significantly increase this situation. Watershed services are needed to manage the water resources in an appropriate way (Balana, Yatich, & Mäkelä 2011: 2645). Because of its importance there is a lot of funding in watershed projects nowadays (German et al. 2007: 189), for instance FAO is already active in this field since the 1980s (FAO 2006: 9).

A watershed can create conflicts if upstream and downstream population both depend on its resource (Sharma et al. 2009: 3). The former one can decrease the life quality of the latter one by decreasing water quality and quantity. If fertilizers and pesticides are not well applied, especially in the case of intensive agriculture, the possibility is high that chemicals become

washed out of the plots and enter a river or an aquifer (FAO 2006: 18). Unsustainable agricultural practices can lead to drastic consequences for the downstream population due to sedimentation, landslides and flooding (IAASTD 2009: 181). Social tension is created if the upstream population wants to maximise their benefits through intensive crop production. On one hand they enhance their food security and increase income while on the other hand it stresses the environment by polluting the water and reducing its quantity. Conflict ensues between needs for environmental protection and agricultural production (Honghai et al. 2011: 149).

A solution to mitigate these conflicts is to change the agricultural practices of the upstream farmers by implementing a watershed management. The IAASTD definition of watershed management is: "Use, regulation and treatment of water and land resources of a watershed to accomplish stated objectives." (IAASTD 2009: 567) This should lead to enough and clean water for the downstream population.

Implemented watershed management turns into an area where manifold actors have different objectives. Soil erosion control and water management is important for the agronomists. For the water sector and policy makers, rules and regulations are in the spotlight. The protection of the nature, in the sake of biodiversity conservation, is the concern of environmentalists. The social scientists or the economists have again other topics on their agenda, like for instance the collective action problem (German et al. 2007: 190).

Each watershed differs in its own way; hence in many cases a blueprint approach is not recommendable. The challenges of implementation start already during the assessment. Sedimentation and erosion have different patterns according to climate, geology and other factors (FAO 2006: 15). The use of a watershed is best, if it is structurally complex, which means to apply an integrated approach like for instance agroforestry (IAASTD 2009: 181). Such approaches are 'knowledge-intensive' and depend on experienced facilitators who apply a bottom up approach for knowledge transfer (de Schutter 2013: 35). Experiences have shown that stakeholder participation is an important key to success (German et al. 2007: 191). Monitoring of watershed services is time consuming and hence can become a very cost-intensive activity (FAO 2006: 19). If the measures are chosen carefully and the investment is targeted properly watershed management has even the potential to reduce inequalities and to create better livelihoods even for the poor (IAASTD 2009: 185).

1.1.3 Study Area

The study area is a watershed of the Uluguru Mountains, located in Morogoro, Tanzania. The upstream villages are located in the Mlimani ward which is part of Morogoro Municipal. The downstream population are the inhabitants of the urban area. The watershed has importance since it is the water source of the Morogoro River which is used by the local water authority to supply the city with water.

1.1.3.1 Ecological Sphere of the Uluguru Mountains

The Uluguru Mountains exist for more than 600 million years and cover an area of 1,800km². They are among the oldest mountains in Africa (Ulvila 1995: 34) and are part of the Eastern Arc Mountains which are well known among scientists as a biological hotspot (Kusiluka 2011: 68; Burgess et al. 2002: 140). The highest two peaks are both more than 2,600m above sea level and the plains are at 500m above sea level. The forest grows in the mountain on an altitude between 1,500 and 2,400m above sea level (Ulvila 1995: 34, 37). Steep slopes, rocky outcrops and extensive cliffs frame the landscape whereby some centuries ago most of the vegetation was moist forest. The forest reserves are centrally managed by the Tanzanian government. The land has changed due to agricultural practices which have led to deforestation. Since the Uluguru Mountains receive large amounts of rainfall, they are ranked by the central government as most important water catchment for Tanzania. The Uluguru Mountains are the source of River Ruvu and have great importance to the country since this river is the most important source of water for Dar-Es-Salaam, which is the biggest City in Tanzania (Burgess et al. 2002: 140ff.).

1.1.3.2 Socio-economical Sphere of Upstream Villages

Nine villages are located in the watershed these are: Kireka, Mbete, Mng'ongo, Visegese, Choma, Lufuza, Tulo, Ruvuma and Kisosa, which belong all to Mlimani Ward (Mlimani Ward Office 2014) which has a total population of 4,893 people (NBS 2013: 61). The watershed covers a total area of 19 km² and is on the northern side of the mountains (Rapp et al. 1972: 125). The forest is used as a common pool resource for gaining fuel wood, herbal medicine, wildlife meat and edible plants for the villagers (Kusiluka et al. 2011: 69).

Eco-Tourism has become increasingly important for the villagers, since they can create some income apart from agriculture. In Choma there is an Eco-Camp which is managed by a farmer group (Maro 2013).

The Uluguru Mountains were settled in the 17th century with various tribes. The oral history tells that indigenous people had been living in the area before, who were actually displaced by the settlers. The population increased during the 19th century because of migration caused by violent groups in the plains around the mountains (Ulvila: 38f.).

Before independence land belonged to the lineage. The warden had the highest institutional function. He allocated the land to the clan members. The right to cultivate land was the same for men and women. The person who cultivated was actually the owner of the crop and usually planted annual crops since the warden tried to avoid that people create a stronger bound with the land. The reason of his endeavours to stop people from planting perennials was that it would have created a conflict if the warden wanted them to move to another plot. Non-lineage members had to give a contribution from their yield if they cultivated in the mountains. Since the clans were maternally structured, there were only limited land rights for the male children. During the Villagization in the 1970s the local authorities lost a lot of power. All the land became state property and was from this moment on distributed to household heads from the village council (Ulvila 1995: 54f.). In 1999 the Tanzania Land Reform which consists of the Land Act and the Village Land Act was legislated by the government to relax the land issues. Both acts are based on the 'right of occupancy', which is a leasehold system with a maximum period of 99 years and the possibility to renew the certificate (Kusilika et al. 2011: 67). The owner of the land is the President of Tanzania but the citizens have the right of occupancy over land (Pedersen 2010: 6).

Burgess et al. (2002: 144) see the loss of power of the old traditional system as a reason for vast deforestation. They assume that this happened since the political functions of the Luguru were undermined from new upcoming institutions after establishing Tanzania as a state. According to them the forest from the Uluguru Mountains was under the power of the Luguru chief.

1.1.3.3. Challenges from the Upstream Population

Kusiluka et al. (2011: 69) see poverty and loss of biodiversity since they are highly interrelated as major problems of the Luguru. The more they become impoverished the more they depend on these resources, which lead to an overuse.

In several studies which were conducted in the Uluguru Mountains following agricultural problems were reported frequently: Production loss through pests and diseases, soil erosion, decreased soil fertility and droughts (Ulvila 1995: 26; Ruheza 2012: 239; Zagast 2012: 22). With the use of focus groups Kusiluka et al. (2011: 70) found out that villagers connect reduced rainfall with the ongoing deforestation.

Many young men in the age group of 15-45 years have left the village to search for work in Morogoro town or in Dar es Salaam (Ulvila 1995: 54). Ulvila states that the Luguru have changed their landholding system: "The old system of autonomous land holding lineages has disappeared. However, the matrilineal decent is still strong since in a household survey half of the plots were identified as mother's land and in more than half of the partnerships men had moved to their wives' place of residence." (Ulvila 1995: 54)

In some areas villagers experienced that people from other places received permits from the government to harvest timber in their forests. This led to deforestation and had as well negative side effects since the locals depend on forest products. In 2006 the government decided to relocate people who lived adjacent to the forest reserve. In these areas, many people don't have titles deeds for their land since they entered the forest reserve previously. Hence, in many cases, the boundaries are not clearly known. The conservation initiative was confronted with resistance from the villagers; but nevertheless some of them who lived in this area had to move. This land acquisition didn't decrease pressure on land, since the villagers refused to move to the land provided by the government, and instead moved to other places in the mountains which resulted again into environmental degradation (Kusiluka et al. 2011: 69, 71).

1.1.3.4 Conservation Experiences from the Old Days

In 1884 the period of German colonialism started. During this period, which ended after the First World War, the Germans were concerned about the environmental situation in the Uluguru Mountains and created a forest reserve (Kusiluka 2012: 68). Under British

colonialism these environmental endeavours were broadened by launching the Uluguru Land Usage Scheme (ULUS) initiative to fight soil erosion. The main focus was on the construction of bench terraces. There was Mgeta, a village in the Uluguru Mountains, which had already implemented soil erosion measures before the British Empire came over and was the only village which achieved the objectives of ULUS project. All the other villages refused the technology whereby even a revolt against the construction of terraces occurred in 1955, which marked the end of the British endeavours to construct terraces (Carswell 2006: 404ff.).

During the ULUS project, villagers were forced to construct terraces but they did not show the promised positive effect. Some of the terraces were washed away during heavy rainfall. Further critique from the villagers was that only a few efforts were put in construction of demonstration plots. The Extension officers were also described as corrupt, since they demanded bribes from the local community (Carswell 2006: 404ff.).

In recent years villagers from the Mountains were involved in environmental conservation initiatives which were implemented by the government and other agencies (Ruehza et al. 2012: 239f.). Kusilika et al. (2011: 70) interviewed farmers who assumed coercive power behind these environmental services: "They also stated that one of the reasons for environmental conservation is the fear that if they destroy the environment, they will be relocated to other places."

1.1.3.5 Downstream Population and its Use of the Watershed

Morogoro region has a total population of 2.22 million with an average household size of 4.4 members (NBS 2013: 1f.). Morogoro Municipal is the provincial capital of this region and has a total population of 315,000 inhabitants (NBS 2013: 61). It is a fast growing city which has increased its population more than tenfold since the census of 1967 (Kusiluka et al. 2011: 67).

The Morogoro Urban Water and Sewage Authority (MORUWASA) supplies Morogoro Municipal with water from 7 rivers from the Uluguru Mountains. The Morogoro River watershed provides up to 23% of the distributed water. Almost 70,000 people benefit from the watershed of the Morogoro River due to its water supply. 85% of the water which is used in Morogoro Municipal is supplied by MORUWASA, 10% is from streams, rivers and wells and 5% are connected to private systems (MORUWASA 2013).

The water provided by MORUWASA is treated but the water from private water sources, streams and locally dug wells is not treated and may be polluted. Morogoro Municipal is not free from communicable disease caused by urban water pollution (MORUWASA 2013). A further challenge is that MORUWASA does not have the capacity to provide enough water for the Municipality which has a demand of 30,000 m³/day (MORUWASA 2010: 2). Under perfect conditions the water authority can produce 26,000 m³/day but this highly depends on the season. In the dry season the water availability decreases drastically which leads to water rationing (MORUWASA 2013).

1.1.3.6 The Institutional Level of the Watershed

Among 30 roles, functions and obligations of MORUWASA three are directly related to environmental issues namely: to practice conservation, to promote conservation practices and appropriate use of water resources, and to work on policy level to advise the Ministry of Water regarding conservation issues in the context of watersheds (MORUWASA 2009).

In an environmental and social assessment of MORUWASA the importance of environmental stewardship is mentioned. This document refers to the Ministry of Water and Irrigation (MoWI) to take action in the Morogoro Municipal through providing “protection of the Uluguru Mountains Catchment” since it is the sole water source of Morogoro and hence of great importance. The National Environmental Management Council (NEMC) is also addressed to take action in the Uluguru Mountains through monitoring the catchment (MORUWASA 2010: 6). In the National Strategy for Growth and Reduction of Poverty II (NSGRP II) which is the current Poverty Reduction Strategy Paper (PRSP), access to water and conservation of catchment area are explicitly mentioned. The achievements of creating access to water have been modest. The actual goal is to increase access to water in rural areas from 59% in 2009 to 65% in 2015 and in Dar-Es-Salaam, the biggest city in Tanzania from 68% in 2010 to 75% in 2015. The NSGRP II lists as well the goal to conserve catchment areas, which are decisive in providing enough water for the citizens (MoF 2010: 55, 77).

The management of watersheds are the responsibility of the MoWI. In Tanzania each basin has a Basin Water Board (BWB) which is under the MoWI. In the case of the Morogoro River Watershed, which is a sub-catchment of the Wami River, the BWB is as well responsible for the Ruvu River basin. A BWB is, for instance, responsible for preparing water resource

management plans, collecting and analyzing data, and to issue water use and discharge permits (WRMA 2009: 372). Water resource management is a collection of different management practices which are applied by water managers who have the objective to improve water quality and quantity for the whole society. This requires that the managers understand cause and effect of environmental and social issues. Furthermore they have to be aware about the economical value of water (Hellegers 2005: 281).

The responsibility to maintain a watershed can be handed over to a Local Government Authority (LGA) or to water users (JICA 2013: I-17). Water users, who have received a permit for discharging water from a river, have to pay a water fee. This fee can be paid by a water association (user group) or by a single user. BWB charges for each intake with a maximum water capacity of 3.7 l/second. Such water associations build the nuclear of the water resource management. They are responsible for the catchment area. A user group uses water from the catchment for domestic or agricultural uses. The user fees are intended to be reinvested in ES. The Water Resources Management Act of 2009 builds the institutional frame for this, which states as well opportunities to create income for project activities. The act also empowers the BWB to announce charges in the context of PES (WRMA 2009: 406).

1.2 Objectives and Research Question

Appropriate solutions which create food security without harming our environment can be found in innovative and creative approaches. In this paper the author utilizes the concept of PES schemes, which use the market to solve the problem of the negative externalities by encouraging farmers through direct payments to change their agricultural practices. In the first step the author tries to develop and analyse different Environmental Services (ES) & payment scenarios. In the second step he analyses the preconditions and drivers to practice organic agriculture¹ by using data from farmers who have already experience in this field. The first step shows if in the case of Morogoro River watershed a PES would be a feasible approach from the economical point of view. The second step gives an idea about the sustainability of this scheme on the long run, since it shows if farmers will continue providing ES after the contract ends.

¹ The author demonstrates in the following chapters that applied organic agriculture provides ES

Hence, the two objectives with corresponding research questions to conduct this study were:

1st Objective

Investing Payments for Environmental Services (PES) and their potential to minimize the negative impacts on water quality and quantity in a watershed, caused by upstream farmers.

Research question (Objective 1)

Does PES create a win-win situation between upstream and downstream population, as the avoided externalities are priced and farmers paid?

2nd Objective

Exploring other drivers next to payment incentives which motivate upstream farmers in their willingness to provide Environmental Services (ES)

Research question (Objective 2)

Is the financial incentive the only motivation which motivates farmers to provide ES?

2. Theoretical Background

2.1 Ecosystem Services

The agricultural production of food, fibre and fuel shapes not only landscapes, but as well our culture. It creates values which are important for human well-being. Agriculture is multifunctional and leads as well to functions which protect the environment (IAASTD 2009: 146). Such functions are known as Ecosystem Services (ES) which are, according to the Millennium Ecosystem Assessment (MA 2003: 3), defined as:

[the] benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other nonmaterial benefits.

Chee (2003: 549) defines ES as “the conditions and processes through which natural ecosystems and the species that make them up, sustain and fulfil human life.” An ES is a public good hence its provision is complicated, since it has no owner and hence nobody has the right to this service or can be excluded from it. Hence from the economical point of view, the incentives for beneficiaries are basically low to sustain such systems by providing ES.

ES become interesting if their costs are smaller than the economical damage caused by externalities, which could be avoided by applying them. In several cases, the monitoring costs of turning agriculture into an environmentally friendly direction are less expensive than compared with the cost of monitoring the emissions. Hence policy makers are aware of the advantages of prevention with the aim of changing the ‘output/waste ratio’ (Branca et al. 2009: 12).

Through the creation of hypothetical markets, people’s ‘preferences for environmental goods’ can be assessed. This is the precondition to assess afterwards their willingness to pay for environmental services or to receive compensation for trade-offs (Pretty et al. 2001: 266).

Organic agriculture is described as a provider of ES. Nevertheless natural ecosystems are superior, since they have higher biodiversity and less soil erosion. By considering this fact a trade off between agricultural production and ES is almost inevitable (IAASTD 2009: 184)

2.1.1 Policy Measures to Deal with Negative Externalities

The primary function of agriculture is to produce food, fibre and energy. The production of these goods leads to soil erosion, loss of biodiversity, water pollution and climate change. These side effects are unwished for and commonly not included in the price. They are in this case negative externalities and create disadvantages for the local or even for the global community (Wunder 2005: 02). There are also positive externalities, for instance if farmers manage the landscape, it is perceived as beautiful. Hence the work of the farmers creates values which may even have deeper cultural roots. Pretty et al. (2001: 265) define an externality as “any action that affects the welfare of or opportunities available to an individual or group without direct payment or compensation, and may be positive or negative.” Since they are not included in the price of agricultural production they are market failures.

According to Hanley (1991: 5) an externality occurs “whenever any real variable in any agent’s utility or production function has its value/s chosen by another agent”. For a free market system to work efficiently, and to reach a Pareto optimum, the following conditions must hold: “(i) price taking behaviour by all agents; (ii) perfect information; and (iii) and efficient set of property rights.”

Hanley (1991:5f.) mentioned the following characteristics which are needed to have efficient property rights but are commonly violated in case of environmental issues:

1. *Universality*: rights exist for all resources and for all entitlements to these resources;
2. *Exclusivity*: the benefits of owning resources occur solely to the owner, either directly or indirectly (through rental or sale);
3. *Transferability*: rights must be transferrable between agents, or else mutually beneficial trades cannot occur;
4. *Enforceability*: property rights can be protected from usurpation [sic].

In many cases the market is not able to incorporate externalities because of not effective property rights. The effectiveness is hampered due to existing non-rivalness and non-excludability of consumption. This leads to more negative externalities than compared to positive ones (Hanley 1991: 6).

The externalities in the field of agriculture have four main features: “(1) their costs are often neglected; (2) they often occur with a time lag; (3) they often damage groups whose interests

are not represented; and (4) the identity of the producer of the externality is not always known.” (Pretty et al. 2001: 265) This definition indicates that evaluation and valuing of externalities needs a multidisciplinary approach since this field is very complex (Tisdell 2007: 1). Because of its complexity, only few valid data has been generated on the costs of agricultural externalities (Pretty et al. 2001: 265).

Pretty et al. (2001: 270ff.) state three main fields of policies which can internalize externalities: a) Advisory and institutional measures, b) regulatory and legal measures and c) economic instruments. The advisory and institutional measures are mainly based on agricultural extension services which work directly with farmers. Regulatory and legal measures are implemented through standards whereby a fine can be used to punish farmers who are not in line with the rules. Economic instruments are used to tax the environment or for subsidization, incentive reform, grants and loans.

Advisory and institutional measures have been the integral part as policy tool to internalize costs for a long time. Since these measures build on voluntary action of farmers they are cheap and hence favoured by policy makers. Anyhow they don’t provide any tangible incentive, hence the ES outcomes are marginal and the trade-offs high (Pretty et al. 2001: 270).

Regulatory and legal measures are mainly implemented as standards. If such a standard is exceeded by a polluter he or she has to pay a fine (Pretty et al. 2001: 270) which is known as the ‘polluters pay’ principle. Here environmental services are perceived as public goods (Scherr, Milder & Inbar 2007: 378). The disadvantages of mandatory regulations are that they have high transaction costs, since it is expensive to control the compliance of the standards. Hence such measures are rarely implemented in developing countries (Branca et al. 2009: 12; Pagiola 2003: 39).

Economic instruments can be used to internalize the costs in the production, or to encourage the polluter through paying a financial incentive (e.g. subsidies) for not producing externalities (Pretty et al. 2001:272). The first one is again the ‘polluter pays’ principle. The second one is the ‘provider gets’ principle, which creates incentives to the polluter to make additional efforts to reduce the externalities (Uthes & Matzdorf 2013: 252).

An important question in the context of such approaches is if farmers should pay for pollution or if it is better to realize the manifold benefits they provide for the society. From this point of view, it would make sense if the farmer receives a payment to provide such services.

2.1.2 Payment for Environmental Service

In only three decades, a vast number of environmental measures have been developed to tackle the ongoing devastation. During this time it has become more and more popular to value ecosystems to know more about the economical efficiency of such services (Gomez-Baggethun et al. 2010: 1209). In the case of developing countries, the financial capacity of governments has been often too low to deal with environmental issues. Hence, such policy initiatives are usually complemented with Integrated Conservation and Development Projects (ICDP), which are funded by bilateral or multilateral donors. These projects are to a large extent driven by altruistic purposes. On one hand they focus on mitigation of environmental problems and on the other they aim to increase the welfare of the people who live in these ecosystems or are dependent on them. ICDP's approach is to strengthen local institutions and to influence government policies. Since its foundation is based on a holistic approach which combines conservation with social development objectives, it has as well a paternalistic character because of offering a complete solution. Financial incentives may play a role in this approach since a motivated and active community is the integral part of an ICDP (Wunder 2005: 6f.).

Nowadays on a global scale, out of the 17,000 main protected environmental areas almost 50% of them are used for agricultural production. Apart from governmental measures, further innovative approaches are needed to reduce overexploitation of natural resources and to foster environmental services since regulatory measures are commonly expensive and hence do not have the needed outreach. The idea to change the economical equation by creating financial incentives which encourage farmers to adapt environmentally friendly practices is known as PES (Scherr, Milder & Inbar 2007: 378ff). PES is able to efficiently deal with the multifunctionality of agriculture in terms of giving benefits a monetary value (IAASTD 2009: 462). PES is an approach which does not only depend on financial sources from the public. Wunder (2005: 3) describes this approach as "the most promising innovation in conservation

since Rio 1992” and mentioning the need for further research and practical implementation on a larger scale to get a clearer picture regarding its efficiency.

For PES implementation an important step is to assess the value of an ES to be able to create a market. ES can be perceived as former positive externalities. Through giving them a value they become tradable and hence lose their status as externalities. In the context of PES Kumar & Muradin (2009: 1) state that valuation is used “to estimate and compensate the costs incurred by providers and to highlight economic efficiency considerations for decision makers in the concerned location.”

In the literature the terms ‘ecosystem’ and ‘environmental’ are used interchangeably. In recent papers the term ‘environmental’ was mostly used. For Muradian et al. (2010: 1202) ecosystem services are a subcategory of environmental services. Since a service can effect different ecosystems services at the same time. For instance agroforestry, on one hand reduces soil erosion and on the other hand sequestrates carbon from the atmosphere. Since services for watershed are mostly strongly related with reforestation, the author uses the term ‘environmental’ in the context of this paper.

In 2005 for the first time PES was comprehensively defined by Wunder (2005: 4) who shaped its framework in an economical way:

1. a voluntary transaction where
2. a well-defined ES (or a land-use likely to secure that service)
3. is being 'bought' by a (minimum one) ES buyer
4. from a (minimum one) ES provider
5. if and only if the ES provider secures ES provision (conditionality).

For a clear PES definition Wunder (2005: 7) further differentiates between two major fields which are ‘area-based schemes’ and ‘product-based schemes’. The former one stays for a clear defined contract and a ‘pre-agreed number of land units’. The latter one stands for a product which is delivered with a ‘use or non-use value’. A further distinction is to differentiate between ‘public schemes’ and ‘private schemes’. The last differentiation regarding PES scheme is to differentiate between ‘use-restricting’ and ‘asset building’

activities. Hereby the difference lies between stopping an activity or shift to a new activity which is mainly related with increased work load.

A more up to date definition is for instance from FAO (2011: 03) which broadens the framework of this scheme by defining its preconditions as:

(a) the demand for at least one ecosystem service is clear and financially valuable to one or more 'buyers'; (b) the provision of ecosystem services is threatened, but the adoption of specific land-use/management practices has the potential to address the supply constraints; (c) a trusted intermediary is available to assist both parties in developing the negotiation and provide expertise in the PES design; (d) clear criteria are able to be established to ensure compliance of the contractual agreement by both parties; (e) land tenure and usage rights are clear; and (f) there is a cross-sectoral coherence between existing policies and laws and PES requirements.

According to Scherr, Milder and Inbar (2007: 379ff.) the two key factors of PES are that it has to be *voluntary* and *conditional*. The authors mention five basic types of buyers who are all driven by different incentives:

1. Public Sector agencies who seek to secure "public goods" on behalf of their constituencies
2. Private sector companies who are under regulatory obligation to offset environmental impacts and may do so by purchasing ecosystem service credits
3. Private business or organizations who seek to secure ecosystem services for their use values or for other business benefits.
4. Philanthropic buyers, such as conservation organizations and charitable individuals, who are motivated by the nonuse values of ecosystem services
5. Consumers of eco-certified products who seek to purchase goods produced in ways consistent with their environmental values.

PES revenues can be generated from user fees, private money, subsidies, taxes, and grants by International Financial Institutions (IFIs), Non-Governmental Organisations (NGOs) and foundations (IAASTD 2009: 463). In several cases the buyer of ES is the public sector. NGOs are mainly functioning as intermediaries who are in charge to coordinate the process (FAO 2007: 36). Regarding the public sector it is assumed that the government, under democratic conditions, is the representative of the society and hence it decides on their major will. In this case the state is the buyer. This can create dynamics which are not conducive if the benefits are only paying off for a small group since money which is used for PES is

commonly generated from taxes. Even so public funds are still the major funds for PES (Ottaviani 2011: 14).

The above definitions indicate that environmental issues moved in the direction of economics. This neo-liberal approach created the prospect of being in the legal position to outsource responsibility to the private sector. Hence, most literature published in the last years dealt with economical methods (Gomez-Baggethun et al. 2010: 1209). The output of this process was PES, an innovative approach which bases on the assumption that polluters have a next best alternative. Nevertheless in the last five years many practitioners and scientists had faced several challenges which were outside the realm of economical explanations. Even Wunder (2005: 04; 2012) criticises his own strict classification, since only few of the functioning PES stick to all these five points. Hence, the ideological concept of PES has changed over the last years.

Muradian et al. (2010: 1205) point out that "[t]he main goal of PES ought to be the creation of incentives for the provision of such goods, thereby changing individual or collective behaviour that otherwise would lead to excessive deterioration of ecosystems and natural resources." Hence they further define PES as "a transfer of resources between social actors, which aims to create incentives to align individual and/or collective land use decisions with the social interest in the management of natural resources."

In contrary to Wunder the PES criteria from Muradian et al. (2010: 1205f.) is broader. Next to 'economic incentive' they mention as well 'the directness of the transfer' and the 'degree of commodification', since they assume human behaviour in the context of environmental services is influenced by more drivers. The economic incentive explained above is completed with the directness of the transfer which refers to the 'ultimate beneficiaries' and how they pay the providers for their services. Here they mention the involved intermediaries and that individual service providers are not always directly paid with money, sometimes there are as well in-kind contributions. The degree of commodification shed light on how the output of the services can be assessed, since there are often only assumptions regarding environmental services and land use.

The first environmental services (ES) were introduced in the 1980s in the US and Europe and in the 1990s in Latin-America (FAO 2007: 8). Programs with long-standing lifespan are for instance established by Quito in Ecuador and New York which in both cases established a

system where consumers pay a higher price for water whereby this price premium is used to pay for ES to maintain watersheds (IAASTD 2009: 463). Nevertheless PES approaches in developed and developing countries differ in design and costs (Kawayu, Sallu, & Paavola 2013: 27). Nowadays in Europe PES are applied for almost 20% of the farmland and contracted farmers to apply environmentally friendly technologies (Scherr, Milder & Inbar 2007: 381). In 2011 already more than 300 PES projects were worldwide implemented in a timeframe of only 15 years (FAO 2011: 03). Watershed services in Latin America have proven to be a success story. For instance hydroelectric power (HEP) producers are paying for such services. In Costa Rica private and public HEP producers pay for 18,000 hectare watersheds a yearly amount of US\$ 0.5 million. In Venezuela, in the watershed of Rio Caroni, farmers receive a yearly amount of US\$ 2 million which are 0.6 % of the revenues of the power company (Whittington & Pagiola 2012: 263).

Compared to Latin American and Asian countries PES is not very common in Sub-Saharan Africa (SSA). According to Ferraro (2011: 535) the common views of PES experts are that PES schemes in SSA have obstacles like: “[l]ack of technical and market information, limited institutional experience, inadequate legal framework, limited successful business models, suspicion of markets for public goods, and equity concerns.” He sees as well other obstacles since SSA countries are more financially limited, having a three times higher poverty level than Latin America, which reduces the capability to pay for such a service. A further constraint is that transaction costs are higher in SSA since land owners are mainly small holders which increase the administrative and management costs as compared to countries where bigger landholders reduce the amount of providers drastically. Weak property rights are as well a constraint since the ES provider should be the owner of the land. A further constraint is the information on hydrological regime, since the data available in SSA is quite limited.

PES schemes are basically applied in four fields of intervention, described by Wunder (2005: 2) below:

1. Carbon Sequestration and storage
2. Biodiversity Protection
3. Watershed protection
4. Landscape beauty

PES applied to maintain watersheds makes agriculture practices and land-use decisions the integral part, since the upstream population has positive influence on water quality and quantity. The financial incentives are needed since these farmers have not really stringent reasons to change their decisions (Balana, Yatich, & Mäkelä 2011: 2634). Whittington & Pagiola (2012: 263) argue that payments for watershed services are easier to implement than for biodiversity since the additionality for the latter is not as clear as for the former one.

According to Blackman & Woodward (2010: 1626f.) the main advantage of a public PES scheme is its economical efficiency since the work load can be spread over a large number of agents who facilitate PES agreements. Hence transaction costs can be reduced from searching buyers, negotiating contracts till monitoring the compliance. A disadvantage of such an approach is the inefficiency. If PES projects are enrolled on a larger scale they may not be implemented where they could be most efficient. This is because the government is lacking local information about the environmental situation. Furthermore they might be biased due to political interest. Since a national PES project highly depends on tax revenues, or in case of developing countries, as well on bilateral or international assistance, it cannot be perceived as a sustainable income and hence it is more at risk that payments are dwindling.

Payment of results is a way to improve or to sustain the environment by providing financial incentives for adopting technologies or measurements which are needed to achieve that objective. This approach leads to several advantages since it is more flexible compared with management agreements. It allows farmers to incorporate their local knowledge which results as well to a better learning environment. For the government it is attractive since it shifts the uncertainty to achieve the ecological objectives from theirs to the farm side. This shift of responsibility is maybe less attractive for 'risk-averse' farmers. A disadvantage for the government is that the payment by results has higher transaction costs compared with the management agreements (Uthes & Matzdorf 2013: 259). According to Whittington & Pagiola (2012: 262f.) there are three striking facts which make PES attractive for policy makers: a) they generate new sources of financing which would otherwise not be available for environmental conservation; b) since PES build on mutually self-interest between seller and buyer they are assumed to be more sustainable as command and control measures from government or altruistic projects from NGOs; c) they are efficient regarding the fact that they are only implemented if the costs of implementing them are less than compared to the actual benefit out of it.

How important nowadays PES are is shown in the recently published paper The Top 100 Questions of Importance to the Future of Agriculture, where a multi-disciplinary team of 55 representatives from the world's major agricultural organizations ranked PES as no. 22 with following question: "Can payments for ecosystem services (e.g. carbon sequestration, green water credits, biodiversity enrichment) lead to adoption of recommended land-use and management practices by resource-poor farmers in developing countries?" (Pretty et al. 2010: 225)

According to Wunder (2005: 2) PES in developing countries faces two main challenges: First of all, there is limited demand, sometimes even because people don't understand the linkage between land use and benefits due to ES provision. The second challenge is that the PES dynamics are not yet well understood. There are still questions like for instance what institutional settings are needed to lower the transaction costs of ES? How are the dynamics regarding local livelihood, and what are the incentives which are lucrative for sellers?

2.1.3 The Economical Theory behind PES

Like highlighted in the definition above, the PES approach is based on economical assumptions. The theoretical framework of this scheme is based on the Coase Theorem (Baggethun-Gomez et al. 2010: 1215; Ottaviani 2011b: 75; Vatan 2009: 1246).

The Coase Theorem builds on the theory that if somebody has a disadvantage due to an environmental problem, which is caused by somebody else, the problem can be solved by the involved parties themselves. Here preconditions are that a bargain can be established between the polluter and the party who is affected by the pollution (Balana, Yatchi & Mäkelä 2011: 2634; Ottaviani 2011b: 76; Muradian et al. 2010: 1203). The Coase Theorem is based on optimistic assumptions in which the wealth effects are absent, transaction costs are low and property rights are well designed (Ottaviani 2011b: 76). The translation of non-market values into economical incentives makes ES tradable and hence creates a market in which transactions benefit from efficiency (Gomez-Baggethun et al. 2010: 1215). If it comes to a bargaining a social optimum can be achieved due to agreeing on a price. In general the assumption is that due to the creation of new markets, externalities can be affiliated by them. Hence, through the provision of ES, solutions to avoid pollution become tradable, which will lead in the best scenario to Pareto effect (Muradian et al. 2010: 1203).

The Coase Theorem is embedded in the neoclassical economical framework. This framework includes further principles to deal with PES functions which are market essentialism, utilitarian principle and consumer choice theory. From the point of market essentialism the best institution for an efficient allocation of resources is the market since its values are created by supply and demand which signals as well scarcity through price fluctuation. The utilitarian principle is that an ES has only a value if it is considered valuable by people who may benefit from it and hence are willing to pay for such service. Consumer choice theory deals with the behaviour of people who are expected to be a) self-interested individuals who aim to maximise their utility; b) able to choose rationally since they have full information on the probability of possible outcomes; c) their set of preferences is stable and d) can be measured with the willingness to accept (WTA) a compensation for something forgone or the willingness to pay (WTP) for something which creates a benefit (Ottaviani 2011b: 76).

2.1.3.1 The Valuation of PES

To create a new market, it is important, that the seller and buyer have information on costs. In the valuation of PES there are two major fields, which have to be assessed: a) the opportunity costs of the providers and b) the actual value of the ES in the context of the buyer.

According to Howlett and Nagu (2001: 165) opportunity costs are an important concept for economic analysis. They define them as: “the next best alternative forgone in undertaking a course of action. Whenever the opportunity cost of an item is not equal to its price there is an argument for using shadow prices. Opportunity costs can best be explained by reference to examples commonly used in the economic analysis of projects: land, labour and capital.” The payment for ES should cover the opportunity costs of the providers. In the case of watershed services, they are the forgone advantages of a farmer who is converting to a new agricultural practice (IAASTD 2009; FAO 2011; Wunder 2005). According to Matthews (2003: 9f.) the payments to ES providers should not be higher than the marginal benefit of the buyer: “Defining the appropriate level of ‘landscape production’ or other environmental good requires that we can measure the marginal benefit associated with that production and compare it with the opportunity cost of the resources necessary to ensure its provision.”

Since it is difficult to measure the opportunity costs of farmers who convert to a new way of production, there are techniques which can be used to ease this process. Basically there are two types of auctions which are appropriate to assess them. Important in both cases is that the farmers know that they bid among other farmers, to be aware that if their price is too high they probably don't get the contract. The classical approach which is also commonly used for non-environmental goods is the **first-price reverse auction**. Here the bidder, if she wins, gets exactly the amount she bid. This auction is also known as the discriminatory pricing where the winning units are selected. **The second-price reverse auction** is an auction where all bidders are chosen who are below the benchmark. All accepted bidders receive the same amount which is the bid from the closest rejected bidder. Since this auction selects multiple units it is also known as uniform pricing (Jack, Leimona & Ferraro 2008: 361; Jindal et al. 2012: 2). The advantage of the latter auction is that a bidder is supposed to state her true opportunity costs. The logic behind this assumption is that if she bids more than her opportunity cost she loses everything when the benchmark is not as high as her bid. If she bids below her opportunity costs she is probably supposed to sign a contract which does not pay off. Hence this auction system is a reliable tool to get a picture of the real costs. According to Jack, Leimona & Ferraro (2008: 360) such auctions: "reveal preferences by creating a temporary competitive market. An appropriately designed auction provides an incentive for all bidders to reveal private information about their true valuation of a good or service." This is an advantage if there is a predetermined budget which can be spent or an exactly quantified ES.

For measuring in economical terms the marginal benefit of ES, it is needed that the output of such a service is monetarized. The problem for measuring these environmental goods is that they have non-market values. Hence environmental goods are mainly categorized as public goods. The main characters of a public good compared with a common market good are: a) the non-excludability, which means that consumers have permanent access and cannot be excluded from consumption of this good and; b) they are undepletable which indicates that the good cannot be depleted due to consumption, like for instance beautiful landscape scenery (Hodge 1991: 180).

According to Chee (2004: 553) the classical economic concept of a value is a direct use value, which is created when a tangible benefit can be quantified and qualified. Regarding

ecosystems this concept has to be broadened since appreciation for intangible values exist as well.

Values which do not need a personal presence are for instance option value, existence value and bequest value. The **option value** is the WTP for something which, at the moment, does not create any benefit but probably becomes a direct use value in the future. The **existence value** represents a WTP to sustain something without having any direct benefit from it. The **bequest value** stands for a WTP for maintaining something which will have later on a specific value for future generations (Hodge 1991: 180).

Since PES is a market based approach, one of its integral parts is the valuation of ES. Proponents of this approach believe that due to valuation: a) the understanding of trade-offs can be improved; b) decisions can be made more easily; c) benefits become visible and hence the cost-sharing of management initiatives is facilitated; d) it lights the way to promote ES through creation of innovative instruments which deal with institutions and markets (Chee 2004: 550).

The valuation of ES can be done with different techniques like production function analysis (PF), replacement or restoration cost (RC), travel cost method (TCM), hedonic pricing and the contingent valuation (CV). They are all capable under needed preconditions to give ES a value. The common market value is established due to supply and demand; hence such a value is not able to express WTP for seeing the scenery of beautiful mountains. The valuations of ES focus on the latter one (Chee 2004: 553). According to Whittington & Pagiola (2012: 265) such techniques can be used to get ideas if there is 'room for a deal' and ease the establishment of a price which will be later charged to the ES buyer. Furthermore they provide needed information for politicians, so that they can give a green light for a feasible PES project. The most used valuation techniques in the context of PES and watersheds are the production function analysis and the contingent valuation. Both of them are further explained below:

The **production function analysis (PF)** calculates the economic value of ecosystem services or products which are used for producing commercially marketed or at least marketable goods like for instance domestic water or fish harvest. The analysis calculates how much loss is made if the quantity and quality of this good is reducing, whereby this information is subsequently used to calculate if it would pay off to invest in ES (Chee 2004: 553f.). In this

study the PF is used to get the information about the external costs of the agriculture production in the watershed of Morogoro River which is actually mostly faced by MORUWASA. The external costs are in this case the money which has to be spent for water treatment and as well the money which is lost due to reduction of water quantity.

The **contingent valuation (CV)** is used to give non-values a price. In the context of PES they are primarily used to get information about the WTP whereby the objective is to find the amount which people are willing to pay. CV can be used as well to calculate the WTA, whereby in that case, the search is for the minimum amount service providers are willing to accept. Anyhow to calculate the WTA it is more conducive to focus on the opportunity costs. With data obtained from CV, afterwards with the use of cost benefit analysis it can be calculated if the PES is contributing to welfare (Whittington & Pagiola 2012: 264f.). The disadvantage of CV is that, instead of revealing preferences, it is based on hypothetical questions which create biases. Hence the information provided through CV is rough estimation of the true values (Ura, Stringer & Bulte 2009: 261).

According to Hodge (1991: 182) by giving a non-market value a monetary value it is important to consider the cultural, social and environmental context of this situation. The value will differ from person to person because they normally do not have the same preferences. Furthermore the value of the ES depends on ecological and geographical factors.

2.1.3.2 Critique of a Pure Economical Approach

The neoclassical approach builds on the assumption, that as soon the ES has its price, a bargain can be established and the problem of the externality becomes solved by the market. Exactly this need of valuation is questioned by several authors (Branca et al. 2009; Gomez-Baggethun et al. 2004; Matulis 2012; Salles 2011; Vatan 2009;). Information is a major challenge. In many cases the calculation of WTP and user benefit are difficult (Branca et al. 2009: 20). Hence the whole context of the PES schemes are characterized by vast uncertainty since the accountability of ES provision is hampered because of biophysical complexities, which are in relation with land use and ES. Information is a precondition for a well functioning market but incomplete information is usually faced, if it comes to the relationship between ecosystems and environmental services since it is scientifically complex and costly to gain needed data. This makes an accurate evaluation difficult and hence it does not create

conducive environment for business (Muradian et al. 2010: 1203, 1205). According to Chee (2004: 561) the techniques have several limitations which are nowadays used to value ecosystems. Some of the ES are too complex to be accurately valued and if it comes to social aspects they might diverge from the environmental objective which bears as well conflict potential. Moreover there is always a challenge with uncertainty.

The concept of public good states, that such a good is not excludable from consumers. Hence, the logical conclusion is that as long as an ES stays public, it won't be effectively absorbed by the market because of the free rider problem. This problem occurs in several cases, which makes it difficult to find a buyer (Scherr, Milder & Inbar 2007: 393). In this context it has to be considered that if the scale of ES is small its valuation is likely to be more effective, since a convenient size is easier tradable. Nevertheless this is not the intention behind ES since they are commonly perceived as more feasible when they have a broad scale impact (Simpson 2010: 41f.).

Gomez-Baggethun et al. (2004:1215) for instance argue that economical concepts cannot be purely considered as ideologically neutral. The authors argue that the “[valuation processes and economic value] can act as vehicles that articulate particular notions of property and ownership, rationalities, and ways to relate with the environment that are specific to particular societies.”

Like stated above, the PES definitions have become broader in the last 5 years. They are not anymore only propelled by economical assumptions which are supposed to lead to a successful PES implementation. There are as well social and cultural factors which have to be considered. Nevertheless the economic approach gives the concept of PES the ability to create information for policymakers which can be easily digested. Hence it finds a better resonance as compared with other conservation approaches which have failed to convince policymakers at the policy level (Gomez-Baggethun et al. 2010: 1215).

The neoclassical framework of PES builds its foundation with assumption of an almost perfect market. In reality PES approaches face several challenges. In many cases farmers in developing countries do not have title deeds for their land and hence there might be the risk to exclude people by implementing a PES approach. In such a case PES benefits the local elite rather than poor farmers (Scherr, Milder & Inbar 2007: 389). In most cases PES face high

transaction costs, hence only for a small numbers the Coasen model shows relevance (Vatan 2009: 1247).

A further issue is that there are several ES which have been delivered by people over generations. Such activities are culturally and socially rooted and are not based on financial incentives to sustain. On the contrary if such people get financially rewarded for activities they were used to do, their motivation to volunteer faces a high risk to diminish (Ottaviani 2011b: 78; Vatan 2010: 1250).

The Coase Theorem is still the up to date "mainstream conceptual basis" for PES (Muradian et al. 2010: 1203). Nevertheless in the last years this approach has been highly reconsidered. According to Ottaviani (2011: 27) the economical pillar of PES is not any more the only one which supports this scheme:

When PES was first conceived, it was believed that the market forces alone, applied to the simple structure of a PES mechanism would automatically deliver the desired outcomes. However, if there is one lesson to be learned that PES experience has been advocating, it is that it is crucial to design tools, including PES, that reflect the complexity of reality, that give voices to the plurality of stakeholders' perspectives and that adapt to the multi-faceted challenges of sustainability.

The agriculture's multifunctionality makes it difficult to explain or conclude from only one viewpoint. If it comes to sustainability it is needed to accommodate next to economical efficiency and environmental benefit also social justice. By implementing a PES all three parts of the triangle should be considered carefully to get the maximum benefit out of this approach (FAO 2011: 3).

The use of auction systems may be an exclusive approach since rich farmers have relative low opportunity costs compared with poor farmers. The selective approach focusing solely on efficiency has disadvantages for the poor (Jack et al. 2008; Jindal et al. 2011).

The economical approach creates as well the perception that blueprints, made from successful PES projects, can be used to scale up the innovations somewhere else. Jindal et al. (2012: 1) mention that: "it is difficult to directly transfer cost estimates from one project to another since the cost of implementing a new land use practice can be highly site- and farmer-specific, with differences that are unobservable to outsiders."

2.1.4 Institutional Perspective of PES

The economical concept of PES is based on the assumption that a perfect market pre-exists. One of the Coase Theorem preconditions is low transaction costs, which is actually supposed to make the PES economically efficient. But in reality this is only seldom the case. Transaction costs like provision of information to demonstrate buyers their benefits, identification costs, negotiation costs, monitoring costs and capacity building make PES an expensive and time consuming approach (Scherr, Milder & Inbar 2007: 392). Since PES cannot be enrolled in institutional vacuum (Vatan 2009: 1247), all these institutional aspects have to be considered, given that they are related with the feasibility of this approach (Muradian et al. 2010: 1205).

According to Vatan (2009: 1245f.) resource regimes were divided in the last centuries into *individual owned properties* and have led to vast economic growth. He further argues that this change created coordination problems like for instance the financial crises whereby he states: "Establishing distinct parts or properties *de jure* cannot avoid the *de facto* creation of interconnections." He concludes that in the modern history a two step development occurred. First there was the creation of *separated decision units* which fostered "individual access, control and remuneration", which led to the above mentioned coordination problems. Hence the second step was to develop manifold environmental policies to „reconnect these *de jure* disconnected entities". To reconnect the *de jure units* Vatan (2009: 1245f.) suggests: a) to establish common property structures, b) to empower the state for having more regulatory power and c) to create new markets which are able to include the externalities through appropriate property rights. In the case of PES the last suggestion fits best to deal with externalities since they can be integrated as good in new markets.

The institutional scales of agriculture, from individual till international level, have four different types of main intervention (See figure 1 below). The first one is the field of agronomic practices which is implemented at farm and landscape level. The second one is the regional level where changes need a consensus on community level. Arrangements which are established to coordinate environmental issues are commonly on voluntary basis. The third and forth are the national and international policy level where institutions are developed to foster and protect environmental systems (Ottaviani 2011: 14).

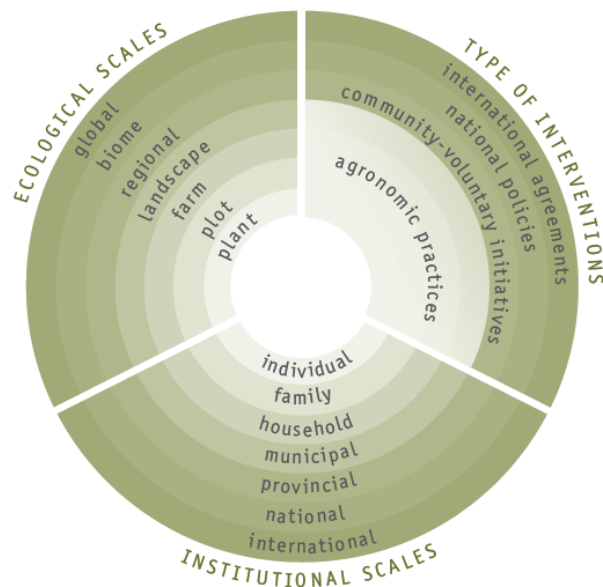


Figure 1 Correspondence between different ecological and institutional scales and possible types of interventions to strengthen ecosystem services (Source: Ottaviani 2011: 15)

The institutional scale of the farmer, family and household are complex since agriculture is multifunctional. For instance it leads into change, reduction or elimination of natural habitats. These changes in the landscape are in many cases embedded in cultural values since such practices have been present for several generations. Hence they have in several cases special meaning to people who live in these environments (Gomez-Baggethun 2010; Ottaviani 2011; Muradian 2010; Vatan 2009). Considering this issue and as well other social and cultural factors, it is important that the conceptual framework of PES is more broadened than just an

economical theory. It is needed that the outputs of ES find a positive resonance with these aspects since otherwise the implementation of PES can be hampered. In this context Muradian et al. conclude that: “[t]herefore, by definition, the lesser the importance of the monetary incentives, the larger the weight of other kind of incentives, such as intrinsic motivations and cultural practices, in explaining land use behaviour.” (Muradian et al. 2010: 1205)

Behavioural economics are a good tool to demonstrate that it is important to consider institutional aspects which may influence the WTA of farmers on village/municipal scale. Ostrom (1997: 01), for instance, has mathematically demonstrated that people can organise themselves to manage common pool resources (CPR) which she defines as:

natural or human-made resources that share two attributes: (1) substantial difficulty (but not impossibility) of devising ways to exclude individuals from benefiting from these resources and (2) the subtractability of benefits consumed by one individual from those available to others. [...] The resource units of a CPR are finite and can thus be overused leading to many externalities including congestion, higher costs of production, and a change in the attributes of the resource units themselves.

This was an important step in the end of the 20th Century to reveal that the tragedy of the commons, which is a theory developed by Garret Hardin, is not always the logical corollary of managing a CPR. According to Hardin (1968: 1244) a CPR leads to overexploitation since the utility seeking behaviour of a human being always tries to get the best choice for her and not

for the group. In several cases around the globe, it has shown evidence that the people manage a CPR even more sustainably than the government could (Dietz, Ostrom & Stern 2003: 1907).

A vibrant engagement of the state and the community build in many cases the foundation of a successful PES implementation (Muradian et al. 2010: 1203). ES markets are new and hence the guiding institutions to support these approaches are still under development. As more institutional and policy frameworks become established as more the efficiency of PES will increase since legislation and regulation are needed to get the full benefit out of it. Land rights, market rules and system of rights have to be accurately considered to operate PES successfully. Next to public agency and policymakers as well rural communities, farmers' organisations and indigenous groups have to be active participants in shaping the market place for PES (Scherr, Milder & Inbar 2007: 394f.).

For reducing the transaction costs on all institutional scales information has to be more easily accessible, since it is crucial for reducing uncertainties, which are major constraints in the process of PES. Innovative strategies are needed to reduce negotiation and monitoring costs (Scherr, Milder & Inbar 2007: 395). For instance, high transaction costs are caused since it is difficult for buyers to evaluate how much the sellers stick to their contracts. Furthermore it is difficult to predict the effect on land use practices and ES. These facts increase the uncertainty, which can be only reduced with scientific input. Hence PES, especially in developing countries, depends on intermediaries who are in charge of the assessment and mediation (Kumar & Muradian 2009: 12).

2.1.5 Further PES Aspects Regarding Equity and Efficiency

In the context of PES an important question is, if monetary incentives are less imperative as social and cultural motivations and what effect will PES have on these people? Will their altruistic behaviour be at risk? According to Gomez-Baggethun et al. (2010: 1216) market-based mechanisms can have such side effects. If the payment is pivotal the providers tend to put their opportunity costs on the first place. If they are not covered, cultural and social motivations to provide such services won't count any more. Hence such an implementation can be as well counterproductive since the provision of such services will collapse. Bekey & Cooks (2011: 145) recommend that PES should be built on existing local initiatives which are

voluntary driven. In the beginning of the 21st Century the economical paradigm of PES was unchallenged, nowadays this foundation is complemented with the old strategies of ICDP.

How integral the understanding is, that the economic incentive should not be considered as the only major part, becomes clearer by taking into account the goal of PES, which is to maintain ES on the long term, whereby the well-being of the society is always pivotal since it is a public good. In this context several dimensions have to be considered. The participation process is crucial to build on a foundation that has found the consensus of the community. This involvement is an important driver to preserve nature (Firmian et al. 2011: 42).

It is as well a risk that PES is creating outweighing incentives for people, who cause environmental degradation. On the contrary, people who are practicing ES are not perceived to be able to provide any additionality. Consequently, they are not potential service providers for a PES scheme, and hence excluded from payments which have potential to reduce poverty and to boost the local development. The conclusion is that in some cases farmers who have been providing over generations ES shift into ‘bad practices’ which cause environmental destruction or pollution to become a potential target group which can sell its services (Scherr, Milder & Inbar 2007: 395).

Gomez-Baggethun et al. (2010: 1209) argue that in the beginning of PES one of the intentions was to create awareness about environmental problems and possible solutions by applying sustainable farming practices. Financial payments for ES were used in that context much more as a pedagogical concept and were not solely based on an economic theory.

In a PES literature review Proctor, Köllner & Lukasiewicz (2009: 27) came to the following conclusions: a) equity is an important attribute of PES schemes; b) nevertheless are PES schemes basically oriented to maximise the efficiency of ES and not the equity; c) case studies have shown that in many cases PES schemes had to be adjusted to become more equitable which resulted into a loss of efficiency.

Different definitions of equity imply different questions

<i>Equality of opportunity</i>	What determines access to a PES scheme?
<i>Equality of outcome</i>	Are the poor equally likely to benefit as the rich?
<i>Positive discrimination</i>	Are schemes designed to benefit the poor rather than the rich?
<i>Process</i>	Do the poor participate in scheme design?

Table 1 Different definitions of equity imply different questions (Source: Proctor, Köllner and Lukasiewicz 2009: 17)

Proctor, Köllner & Lukasiewicz (2009: 17f.) state that different definitions of equity need different questions to become appropriately assessed (see table 1). For a PES implementer challenges regarding fairness and equity are a) to find a proper definition; b) how to measure it and; c) how to integrate the results into an economical framework.

Regarding PES access, a small scale farmer's main constraint is property rights. If they are not clear it is difficult to bargain with the owner, and hence negatively influencing the process of creating a contract between buyer and seller. A further issue hereby is that as smaller the plot, as bigger the risk aversion of the farmer to adapt new technologies. If it comes to let a plot idle or to change to agriculture practices that are accompanied with a transition period in which the soil fertility has to recover slowly, the farmer has no buffer and hence feels unsecured (Proctor, Köllner & Lukasiewicz 2009: 21f.).

The property right issue can even produce negative impact since a PES initiative can be used by LGA or private people to compel illegal land holders to resettle. The landless can be counted with the most impoverished people. In such a case PES are leading to redistribution of land to the disadvantage of the poor (Proctor, Köllner & Lukasiewicz 2009: 24). Further challenges are ES which are founded on strict conservation measures. If it comes to a stop of using forest resources, which are mostly needed by low-income households, there is a need to supplement them with other goods or the same goods, whereby the latter includes that people have to cover longer distances. Both would negatively influence the standard of living which hits poor people the most (Wunder 2005: 20).

A further issue is the distribution of ES. In general a PES buyer looks for the lowest opportunity costs to reduce her costs. The inequity starts with the differences in topography, soil fertility and rainfall pattern. In several cases fertile land belongs to wealthy people and degraded land is cultivated by the poor. Hence if it comes to an auction, people who have a

plot in a harsh environment have higher opportunity costs since cultivation is more labour and input intensive (Proctor, Köllner & Lukasiewicz 2009: 25).

Transaction costs are related to the number of sellers, the more sellers are involved, the more the costs for PES increase (Scherr, Milder & Inbar 2007: 392). This is a point where a trade-off between social inclusion and efficient environmental management occurs. Regarding the economic theory ES have to be implemented where they can be offered for the cheapest price. Hence, several farmers are excluded. In the long term perspective such dynamics can hamper the performance of PES (Muradian et al. 2010: 1204).

Because of cost efficiency many buyers preferably try to negotiate long-term contracts since this is reducing the transaction costs. Nevertheless for several farmers such contracts bear a lot of risks. This can be explained because land and agricultural markets are not constant variables and population density is creating pressure, hence farmers are reluctant to agree on long-term contracts. In this context a solution is that buyers and sellers agree on short-term contracts which can be indefinitely renewed (Scherr, Milder & Inbar 2007: 389f.).

According to Proctor, Köllner & Lukasiewicz (2009: 18) equity is not only related to people being fair with each other, which is actually an important attribute. A further character in the context of PES is the participation of stakeholders. German et al. (2007: 193) mention different understandings of participation. In several cases it is not enough to present farmers results; moreover they have to be actively involved in such a process.

Many times the PES timeframe of 3-5 years is too short. Farmers are hence not fully involved in the implementation phase. If there is no time to make a participatory diagnosis to get a clear picture about farmers' needs and strengths, the PES risk to fail and won't bring any long-term improvement for the environment. For a new generation of PES it is needed to build on a vibrant participatory approach which is the base to build a collective vision. Hence PES can be implemented at the community level where transaction costs can be reduced (Ottaviani 2011: 26).

The lack of information is mainly experienced by sellers which increase the bargaining power of the buyers. The sellers are in many cases also not sufficiently involved in the establishment of PES programmes. Hence several times PES schemes are missing to create conducive institutional environment for adaptation which in the end highly depends on local circumstances (Scherr, Milder & Inbar 2007: 392).

For German et al. (2007: 190) a participatory integrated watershed management should have two aims: First, to work out all the particular issues like activity planning whereby a precondition is that farmers know exactly what effect it will create beyond the farm. Hereby it is needed to cover the whole field which includes as well ‘non-biophysical parameters’ for instance cultural or administrative units. Second, it is crucial that the objectives and disciplines are integrated in one process whereby they highlight the importance "that any approach integrates an understanding of the principles operating natural and social systems."

There is as well an ethical issue with PES programs since they are targeting people who can provide ES for the cheapest price. This leads implementers looking for the poor because they are expected to have the lowest opportunity costs. Hence those involved are probably not in a financial situation to refuse a payment which gives the PES a character of ‘forced trade’ or ‘poor sell cheap’ and not any more the one of involved free agency (Muradin et al. 2010: 1204).

For increasing the financial sustainability of PES it is possible to ‘bundle’ different ES. In the case of a watershed, where reforestation is among the ES, the costs could be shared by selling ES at the carbon market (Ottaviani 2011: 19). Here it is necessary to balance carefully since a combination of services can lead as well to trade-offs among them. For instance a palm tree plantation leads to carbon sequestration but on the other hand it leads to loss of biodiversity (Wunder 2005: 2).

2.2 Organic Agriculture

Organic and eco-certified products build a fast expanding food market with a yearly growth rate of 30%. In 2006 its global market share was valued with US\$ 22 billion (Scherr, Milder & Inbar 2007: 384). East Africa is leading on the continent with shares in organic farming. More than a half million farmers and up to 150 companies are involved in this sector (Rundgren 2011: 28).

In this paper the term organic agriculture is used based on the definition of the International Federation of Organic Agriculture Movements (IFOAM) (IFOAM n.d.), which defines it as:

Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.

Organic agriculture (IFOAM n.d. a) has four principles, where each is expressed through a statement. The principles are composed as ethical framework of organic agriculture and supposed to inspire action:

The Principle of health

Organic Agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible.

The Principle of ecology

Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.

The Principle of fairness

Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities.

The Principle of care

Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment.

Additionally, to this already comprehensive definition, the author wants to complete with Walaga and Hauser (2005: 66) who differentiate organic agriculture from traditional agriculture since it is a complex and knowledge intensive approach. They distinguish organic agriculture as well from conventional agriculture since organic agriculture excludes genetic modified seeds and largely prohibit pesticides and fertilizers.

Organic agriculture stands for a certification scheme which guarantees customers that the producers comply with the standards. This is missing in most of the definitions, but it is decisive if a farmer can become an organic certified producer or not. The common certification schemes are expensive. For instance a producer group with a maximum of 500 farmers is supposed to pay for certification annual charges of 4,000 to 8,000 US\$, which is

exclusive allowance and travel costs for the inspector (Walaga & Hauser 2005: 66). Small scale farmers, even if they are organised in a group, cannot apply for such a certification scheme since it is only economical if farmers have a highly profitable market for their products, which is mainly abroad. Usually they have to be organised as a cooperative or are contracted farmers who operate for a company. Next to the issue of financing the certification it is as well important, since such bodies can deal with the work-intensive administration. Hence organic certification in combination with PES has received its major critique that it excludes farmers. Especially when it comes to an area where people have cultivated already a high crop diversity, conversion to organic agriculture would mean that farmers have to specialize on a single cash crop, whereby it can be assumed that this won't be accepted by all farmers. Such a scenario can result into inequality where only specific farmers have benefit and others stay excluded (Firmian et al. 2011: 40).

Organic agriculture has potential to achieve ES. According to Genmill-Herren (2011: 32) there are five major fields of agronomic practices which positively influence the environment at the farm level and in landscapes:

1. Diversification and intensification of plants
2. Applied soil and water conservation practices
3. Efficient and careful application of external inputs
4. Efficient use of local agro-biodiversity
5. Improved management for uncultivated areas

Organic agriculture covers all of these fields. Hence several environmental and social goals can be achieved together. Farm types differ and therefore it becomes difficult to measure the impact. Regarding ES organic agriculture can create impact on different objectives at the same time but since it is not focusing on these ES the impact may not be very effective (Lampkin 2011: 61).

Only a few certification schemes are solely targeting ES, which are mainly covering the field of biodiversity conservation, like for instance Bird Friendly Coffee. There are as well other certifiers like Rainforest Alliance which demands broader ES like soil and water management. The reason why certification cannot stand alone for a PES is because it is not conditional since buyers don't find any contractual agreement with the sellers (Ottaviani 2011a: 18f.).

Next to the question of certification it is important to discuss how productive an organic farm is in comparison with a conventional farm. Especially for policy makers it is required to know if organic agriculture leads to increased food security or not. The controversy debate is a hot discussion where arguments differ from both organic opponents and their proponents. According to Walaga & Hauser (2006: 66) Most of the researchers argue that under perfect conditions conventional agriculture is superior to organic. Nevertheless, as soon as it comes to droughts and floods organic production systems have several benefits which make them more productive. For Kassie & Zikhali (2009: 3) it makes a difference as well if the production is taking place in developing or developed countries. According to them organic agriculture, practiced from small scale farmers, leads to bigger yields than compared with conventional.

2.2.1 Challenges and Opportunities in Organic Agriculture

Altieri (1995: 192) describes the conversion from conventional to organic agriculture as a transitional process with four phases: The first one is the progressive reduction of chemical inputs. The second one is the intelligent rationalization by the use of integrated nutrient and pest management. In the third phase synthetic inputs are substituted by low-energy inputs like compost and manure. In the last stage a complete redesign of the farm takes place which builds on an increased biodiversity which results into an optimal crop/animal ratio which creates synergies to achieve high soil fertility and natural pest control which results into profitable crop productivity. During these four phases the following processes are enabled:

1. Increase in biodiversity both in the soil and above ground
2. Increase biomass production and soil organic matter content
3. Decreasing levels of pesticide residues and losses of nutrients and water components
4. Establishment of functional relationships between various farm components
5. Optimal planning of crop sequences and combinations and efficient use of locally available resources

According to Altieri (1995: 192) a conversion process has to be carefully considered since the extent of degradation and use of synthetic inputs have influence on the period which is used to achieve productivity that resembles the conventional production. Depending on these factors a period of 1-5 years is needed to achieve this stage.

According to Altieri (1995: 194) a major constraint to farmers to convert to organic agriculture practices is lack of information on these technologies and indicates a need for

appropriate information dissemination technologies for instance magazines. Anyhow, it is not only information the obstacles are manifold which are comprehensively listed in table 2.

-
- Limiting phosphorus and potassium
 - Organic sources of plant nutrients are limited
 - Restrictions on symbiotic N-fixation as a source of N
 - Low-solubility nutrient source
 - Limited demand for organic food
 - Lack of organized marketing
 - Increased transportation costs through geographical dispersion of producers
 - Reduced production
 - Low income crops in rotational systems
 - Economic loss during transition from conventional to organic farming
 - Greater risks from weeds and insects
 - Increased cost of labor
 - The need to maximize economic return
 - Lack of credit and financing
 - Lack of communication and understanding
 - Attitudinal barriers and inadequate knowledge about the benefits of organic farming
 - Ambiguity of organic farming concepts
 - Lack of information on organic farming
 - Lack of adaptable crop varieties
-

Table 2 Obstacles to Organic Agriculture (Source: Altieri 1995: 195)

In the context of this research it has to be as well highlighted that organic agriculture is more labour intensive compared with conventional agriculture (Altieri 1995: 194). Some needed Sustainable Land Management (SLM) practices are not only labour intensive but they can reduce as well the farm productivity over time till the new system finds again its balance. Terracing, for instance, is an intensive encroachment in the soil. Due to mixing sub soil with top soil, the soil fertility decreases and aluminium exposes (Haule 2000: 29).

Nevertheless there are as well benefits. For instance the polyculture cropping system is a common organic agriculture practice which is applied by several farmers around the world. They are cultural practices which not only shape the landscape but are also more productive. Especially for small scale farmers in Tanzania, who have an average size on 1.2 hectare land, such a system can increase productivity. The increased land use efficiency allows having higher yields and higher net economic returns per land unit. Furthermore this approach reduces the risk of total crop failure (Liebman 1995: 205ff.).

Practicing organic farming means to reduce as much as possible external inputs like fertilizer and pesticides. These inputs are supplemented with resources on farm or nearby, which are for instance nitrogen fixing plants, nutrients from biomass (e.g. crop residues and green manure), or biological pest control (Altieri 1995: 179).

Plants which are fertilized with compost and green manure are healthier than compared with plants which are fertilized with synthetic inputs. The physical condition of a plant is crucial if pest attack occurs or not, hence organically produced crops are less susceptible to pests and diseases (Altieri 1995: 186f.).

The strength of promoting organic agriculture to deliver ES is that farmers receive money for their opportunity costs in form of price premiums. The standards which farmers have to comply are supportive for verification if farmers produce ES. Therefore the monitoring costs and evaluation costs of this process are reduced since there is no need to visit farmers for auditing twice. If the price premiums are high enough to cover the opportunity costs there is as well no need for further compensation (Lampkin 2011: 66).

The price premium is a major incentive to practice organic agriculture. Like already mentioned small scale farmers in developing countries depend on a cooperative or on a company to become a certified producer. Since these bodies mainly focus on a single cash crop, the price fluctuation has direct impact on farmer's profit. In the PES watershed in Kapingazi Watershed, Kenya, the price premium of coffee is sometimes highly fluctuating. Hence, in some cases, the certification scheme even resulted into a loss when costs for the yearly auditing from the certifier had been as high as the premium (Firmian et al. 2011: 40). Hence it can be concluded that if the price premium cannot be paid, farmers may start cultivating more profitable crops apart from organic production which means that the ES is finding an end.

2.2.2 Participatory Guarantee System – Organic Products for the Local Market

According to Hochreiter (2011: 22) organic agriculture being an exclusive approach which does not fit for small scale farmers, was the reason that IFOAM developed two new approaches. One of them is the Group Certification which uses Internal Control Systems (ICS). By applying this approach farmers are certified as a group which minimizes the costs.

Nevertheless this approach can be only applied if small scale farmers have access to a company or cooperative (Herberg 2007: 11). The other approach is the Participatory Guarantee System (PGS) which is defined by IFOAM (n.d.c) as: “locally focused quality assurance systems that certify producers based on active participation of stakeholders and is built on a foundation of trust, social networks and knowledge exchange”. Herberg (2007: 11) describes the difference of PGS compared with Group Certification, that it is not centralized. The farmers can market their products individually; hence there is no need that everybody in a PGS produces the same crop. The products of a PGS are foreseen for the local market whereby the Group Certification is mainly used to produce for export.

PGS is a solution which can promote organic agriculture as well in income poor countries like Tanzania. First important step in East Africa was the development of the East Africa Organic Product Standards (EAOPS). These organic standards, which are internationally recognized, enable nowadays farmers who comply with them to use the East African Organic Mark. Precondition is that they are certified by Participatory Guarantee System (PGS) or by a third party certifier (Rundgren 2011: 28). The former one makes it very interesting for small scale farmer since they don't have to be organised through a cooperative or company, hence even a small farmer group can apply. This is possible since administration work is not so demanding (Hochreiter 2011: 22) and the costs for certification are not so high (Herberg 2007: 1).

A PGS builds on a strong involvement of all stakeholders and is designed for the local market. The responsibility and empowerment of the stakeholders are pivotal. Hence capacity building is a crucial component of this approach which is based on a foundation of trust instead of compliance to organic standards which is guaranteed through external certification systems (Hochreiter 2011: 22).

According to IFOAM (n.d.b) the key elements of PGS are

1. Shared Vision
2. Participatory
3. Transparency
4. Trust: Integrity-based approach
5. Learning Process
6. Horizontality

Furthermore the features of PGS as described by IFOAM (n.d.b) are:

1. Norms conceived by the stakeholders
2. Grassroots Organization
3. Suitable to smallholder agriculture
4. Principles and values that enhance livelihoods
5. Documented management systems and procedures
6. Mechanisms to verify farmer compliance
7. Mechanisms to support farmers
8. Farmers' pledges
9. Seals or labels as evidence of organic status
10. Clear, pre-defined consequences for non-compliance

The disadvantages of this approach are that the farmers have to spend a lot of time in group work. Furthermore it is needed that stakeholders are dedicated and willing to support the farmers. Hence it can also result into a conflict of interest since many tasks rely on voluntary work (Herberg 2007: 12f.). A further problem is that in several cases consumers, governments and certification bodies do not recognize PGS since it does not comply with ISO norms because PGS training, certification and inspection are carried out by the same party (Hochreiter 2012: 39).

2.3 MORUWASA and the Negative Externalities

MORUWASA faces costs because of a decrease in water quality and quantity. A possible reason might be the farming practices of the upstream population, since agriculture can cause soil erosion and needs water for irrigation. Fact is that the alternation of a hydrological regime directly results into a change of the water quality (Mahoo 1990: 59, 64). The quality decrease is related with the sedimentation and biological and chemical pollution. Furthermore is the use of water for irrigation is a critical aspect. In the Wami/Ruvu Basin more than 60% of the water is used for agriculture (JICA 2013: I-15).

During the rainy season the water, which is normally clear, becomes coloured due to sedimentation of runoff water. The amount of sedimentation caused by runoff has a strong relationship with practiced agricultural systems and deforestation. Forest cover has positive

impact on lower soil erosion and sedimentation. Deforestation next to riverbeds leads to an increase in the water temperature caused by solar radiation. This can lead to biological and physical changes which influence the quality of the water (Mahoo 1990: 64f.).

Useful data about the Morogoro River watershed rarely exist. Nevertheless sedimentation has been examined in other watersheds in the Uluguru Mountains. For instance the water catchment of the Ruvu River has high sedimentation which during a peak reaches up to 300 Nephelometric Turbidity Unit (NTU)². NTU of up to 5 can be considered as safe, otherwise water has to be cleaned whereby the treatment costs are next to chemical and biological pollution related with the extent of turbidity. When the water has extremely high NTU, treatment filters can be damaged. The level of NTU in the Ruvu River is yearly increasing (Branca et al. 2009: 23).

To get a clear understanding of the external costs, which are faced by MORUWASA, it is useful to treat the water as an economic good. When a river does not have enough water for its users, it is necessary to make choices regarding the allocation of this resource. The selection criteria should be to take note on how different users benefit from this good, how high are the forgone benefits from users who don't get enough to satisfy their requirements and how high the service costs for provision. Next to taking account of these economic factors, it is as well conducive to consider environmental and social aspects. It is an important step to give the benefits, which are related to water use, a value during the implementation of a PES, since it increases transparency and hence will ease its feasibility (Hellegers 2005: 279).

The valuation of water is influenced by the employed measurement techniques and how data is used later on. The value of water is also affected by temporal and spatial factors. The methods to price water regarding its social and environmental values are not yet well established like economical approaches. The water price for municipal and industrial use differs highly compared with the agricultural sector, which makes it lucrative to transfer water between user groups. Water used for irrigation has a value which depends on the value for how much the crop is afterwards sold and hence its value is related with the demand (Hellegers 2005: 280).

² The Nephelometric Turbidity Unit (NTU) gives information about the turbidity of water (Branca et al. 2009: 23)

Branca et al. (2009: 13) compare costs between ex-ante measures and ex-post water treatment. They argue that in the United States of America (USA) it has shown that it is more expensive to treat the water when it has already entered the system than to promote good agriculture practices using PES. Hence they conclude that it will be as well the case in developing countries since it is very unlikely that water treatment is cheaper than in developed countries. According to Ferraro (2011: 537) institutional, financial and management capacity of municipal water providers in Africa is an obstacle to implement PES since: a) service is not reliable and has low coverage, b) in several cases water bills are not paid since water use is unaccounted; c) weak financial management; d) the created income is too low to guarantee operations and maintenance costs; e) the management systems lack of efficiency.

Hence it makes sense to look for alternative buyers or opportunities to create incentives for ES providers. The municipality is a possible partner which could benefit from a successful PES implementation on political and financial level.

2.4 Case Studies

The author reviews the literature of two case studies. One is a PES scheme applied in Costa Rica, which is mainly supported by the government and enrolled on a national scale. The other one is a PES project in a watershed in Tanzania, which was implemented in the Uluguru Mountains and financed by Coca Cola Kwanza Ltd. in Dar es Salaam.

2.4.1 Costa Rica – How PES can Create Impact on Big Scale

In the last third of the 20th Century, Costa Rica was facing a vast deforestation process, which was mainly driven to gain more land to practice agriculture and for livestock-keeping. The government already launched in the 1980s conservation projects. Some of these included financial incentives for farmers who applied conservation practices or implemented model farms. Nevertheless, most of these approaches did not achieve their objective (Pagiola 2003: 39; Zbinden & Lee 2005: 256).

Hence, to tackle problems caused by deforestation, one of the most popular PES systems was launched by the government of Costa Rica. The public-private financed PES program “Pagos por Servicios Ambientales” (PSA) was initiated in 1997 and is still continuing. PSA primarily focuses on restoring the forest cover. PES contracts are negotiated between service providers and the National Forest Finance Fund (Fondo Nacional de Financiamiento Forestal, FONAFIFO) which administers the program as government agency. FONAFIFO belongs to the branch of the Ministry of Environment, Energy and Telecommunications and has a semiautonomous status (Blackman and Woodward 2010: 1627f.). The fund collaborates with governmental extension officers (forestry engineers) and local organisations that provide facilitation on ES or to act as intermediaries (Cole 2010: 209).

PSA makes use of the whole set of PES services which are biodiversity conservation, carbon sequestration, scenic beauty for recreation and tourism, and hydrological benefits. These services are embedded in the Forestry Law No. 7575, which was enacted in 1996 and provides the regulatory basis for contracting land holders through the government (Pagolia 2003: 40). A new approach in the law was that the ‘polluter pays’ principle was complemented with the ‘beneficiary pays’ principle (Zbinden & Lee 2005: 257). PSA is to a large extent funded by national fuel and water tax revenues and from bilateral and multilateral donors. Since 1997 the governmental funds are secured through an established law (Blackman and Woodward 2010: 1627f.). In 2006 a further law was implemented by the government, which allocates 25% of water-use tariffs to FONAFIFO, so that it can be used for PES (Blackman and Woodward 2010: 1629).

PSA is not the only functioning PES initiative in Costa Rica but by far the biggest one. By 2006 FONAFIFO had covered 430,000 ha forest due to payments for ES providers. In 2005 the main part of established PES under PSA was biodiversity issues and only 35% of the provided payments were spent for hydrological improvements. Private buyers of ES are playing a marginal role which account for only 3% of the total support. Among the private sector are mainly HEPs, irrigated farms and a brewery. More than 40 voluntary units from the private sector have supported the PSA program with approximately US\$ 8 million³ the PSA program so far (Blackman and Woodward 2010: 1627ff.). Much more money could have been raised by involving as well domestic water users. A survey has shown that the households

³ In the year 2006 the total budget for the year was US\$ 15.22 million dollar. See Wünscher, Engel & Wunder (2008)

would be willing to pay for such ES. According to Pagiola (2003: 51) the fact that PSA did not reach the domestic water users is an institutional problem which could have been solved by enhancing the communication between FONAFIFO and buyers.

The disadvantages of a public PES scheme (discussed in chapter 2.1.1) are mitigated by the PSA program since the government involves the private sector. Theoretically, this approach has the benefit that a) the identification costs of potential service providers can be reduced since a buyer has a specific area where ES are supposed to be established; b) the ES can be more easily valued since the buyer is the direct affected party and is aware about the extent of caused damage due to environmental degradation; c) a private buyer will reduce the compliance costs since she has interest in the output of the ES; and d) private initiative helps to diversify the financing of the PES scheme which makes it more sustainable. Nowadays, a public financed project which incorporates private buyers is treated with favour from international financing institutions like the World Bank which provides loans for such initiatives (Blackman and Woodward 2010: 1627).

The PSA program has three modalities which are forest protection, reforestation and forest management. The former one receives the main part of the funds with 85%. For the forest protection modality it is a requirement that service providers are land owners. The sellers sign a contract with duration of five years which can be renewed. After the partial payment, money is subsequently allocated after verification of the ES by a third party. Apart from some minor exceptions the payments have the same value around the country (Blackman & Woodward 2010: 1629). According to the Forestry Law 7575 service providers could be contracted even for a period of 20 years but this is not applied because of unsecured funding opportunities (Pagiola 2003: 51). Also the PSA program does not have enough funds to offer every potential provider a contract, in some cases it is even that out of 6 applicants only one can be selected (Blackman and Woodward 2010: 1628).

Central America was lacking available data to show the role of forest cover in the context of watersheds. Hence it was important to conduct research to get an understanding of the value of the ecosystems in the country. Nevertheless it is mentioned by several researchers that data is still lacking (Pagiola 2003; Blackman & Woodward 2010; Cole 2010). In the case of PSA, the amount of payment was aligned and justified based on results of two studies; one from the Regional Centre for Studies in Economics (CRESEE) and the other from Ecomarkets Project CT Energía. According to these studies the average benefit for HEP producers are in

average US\$ 20/ha/year and as low as US\$6/ha/year and as high as US\$50/ha/year (Pagiola 2003: 38, 46).

The payments for protecting forest started in 1997 with US\$ 40/ha/year and increased to US\$ 63/ha/year in 2006 (Blackman & Woodward 2010: 1629) whereby for reforestation an amount of US\$ 538/ha is paid over a duration of five years. For forest protection PSA provides an equal annual payment over the contract period in contrary to reforestation services, where a large instalment is made in the beginning by following further smaller instalments till the end of the contract (Pagiola 2003: 50). A further implemented PSA component was agroforestry. Here in 2007 farmers received for every planted tree US\$ 1.30, when it was intercropped in an agricultural production system (Cole 2010: 209). In several cases the buyers were not supposed to pay money for the whole ES, since, like shown above, they are in some cases higher than their benefit. Hence, donors like the Global Environment Facility (GEF), which is explicit funding biodiversity conservation, chip in and top up to have the needed amount for the service providers. Hence, bundled mechanisms of different PES schemes are a common concept of PSA, which actually increase their financial sustainability (Pagiola 2008: 715).

The more users are in a watershed, the higher the risk of free riding, which is according to Ferraro (2011: 536) a common obstacle in the process of finding potential ES buyers. Till 2003 all the HEP projects in Costa Rica were established in catchment areas where just one major beneficiary was located. Only the brewery Cervecería was willing to agree on a payment in a watershed where many users benefits from such an approach. The brewery signed the contract because of public relation issues, which indicates that there are further incentives, apart from the ES, which enhance the WTP (Pagiola 2003: 49). According to Blackman and Woodward (2010: 1628) empirical research on drivers of participation has shown that private buyers become positively influenced because of pressure created by the regulators and the community. In such cases ES buyers expect to receive preferential treatment from the government.

PSA started in 1997 with agreements which were based on the negotiation on the size of land and the amount paid per hectare. In 2003 FONAFIFO changed this approach and implemented a standard payment (Blackman and Woodward 2010: 1629) which is criticised by Wunder (2005: 11) who argues that in the case of PES an accurate evaluation of opportunity costs which takes as well notice of the topography, is more efficient compared

with a PES per-area cash model. According to Pagiola (2008: 717) the implementation of the PSA faces two main problems: On one hand it is the additionality which is in several cases not given, since the forest would have been protected anyway. On the other hand it is the supply of economically inefficient ES where the costs of financing them are higher than the gained benefit. Both of these problems are caused by the standard payment, like already mentioned in chapter 2.1.5. Wünscher, Engel and Wunder (2008: 830f.) demonstrated that flexible payment schemes are more efficient compared with standard payments but only if the opportunity costs are evaluated accurately which is as well a challenge. In the case of PSA program they suggest to use a 2nd reverse auction scheme to get more information about their opportunity costs.

So far, the impact of the PSA program has not yet reached the expectations, since deforestation could not be slowed down like expected. The program receives in this context criticism because of not properly chosen fields of service provision. It is expected that through improved targeting PSA could increase its efficiency (Blackman and Woodward 2010: 1628). Cole (2010: 208) argues that the PSA program has not yet achieved any significance in forest cover compared with areas where farmers are not contracted. This can be explained by considering former conservation projects which were probably not that unsuccessful like formerly perceived. According to Zbinden & Lee (2005: 269) participation is highly dependent on knowledge since the establishment of a contract needs administrative efforts. Hence ES were several times provided by farmers who were living close to the urban zones and did not primarily depend on farming income. Organisations who acted as intermediaries try to close this gap but were not able to succeed on a larger scale.

The findings of Cole (2010: 211ff.) who interviewed 18 PSA farmers and compared from them 10 PSA farmers with 10 not contracted farmers, indicates that the former one had a larger percentage under forest plantation (0.16-0.9ha) compared with farmers who were not participating in the program (0.02-0.17ha). Furthermore the study showed that farmers who were contracted had higher level of education compared with non-participating farmers (in average two years more). By questioning non-participating farmers regarding the benefits of planting trees they mentioned: a) timber can be later on sold; b) the value of their property will increase; and c) erosion control is provided. Contracted farmers, who were supported by a local organisation, mentioned furthermore that agroforestry increases the agricultural productivity by using biomass of fast growing leguminous trees to fertilize the soil. The

interviewed farmers who receive payment for their activities had not harvested timber for sale since the trees are still young. Nevertheless 78% of the PSA farmers reported an increase of the income level, while the remaining percentage did not experience any difference. By asking them the same question without considering the payments only 44% had experienced a slightly increased income whereas 11% reported a decrease of income because of de-intensification.

Results from Cole (2010: 214f.) have shown that many farmers cannot afford to plant trees since it needs investment and is as well perceived as a risky undertaking. Furthermore an obstacle which was reported by many farmers was the lack of knowledge. Hence capacity building of farmers is a very important precondition. Only the minority (2 farmers) mentioned expected productivity loss due to competition between planted trees and cultivated crops. Farmers who were not supported by an organization but from a government extension officer complained about the perceived knowledge and the little room for participation since almost all the trees were chosen by the extension officer (See Table 3 below).

Obstacles	Comments
Economic Constraints	Need to maintain land area for subsistence and commercial crop production Cost of materials and maintenance Short-term financing Perceived risk in long-term investment in forestry Costs associated with program enrolment
Project Management	Lack of information about program Complicated process for program enrolment Inappropriate tree species selection by forestry engineer Lack of technical assistance and training
Local-level Management	Lack of trust among local stakeholders Lack of transparent system for payments from organization to farmers Excessive percentage of payments kept by local organization managing contracts

Table 3 Obstacles to tree planting by small scale farmers in southern Costa Rica (Source: Cole 2010: 214)

Farmer confidence was disturbed through several broken appointments with extension officers and delayed payments. In general farmers who collaborated with a local organization had better perception about the PSA program (Cole 2010: 215).

The equity problem is a challenge of PES in Costa Rica. PSA programs are more attractive for farmers who have larger farms which are labour-extensively managed compared to non-participants, since they are wealthier and have money to buy inputs like fertilizer and pesticides (Zbinden & Lee 2005: 269). Because PSA was criticised for excluding poor farmers, the program was modified to ease access for poor people who are interested in providing ES. For instance the institutional hurdles were reduced. Before this change, service

providers were supposed to fulfil up to nine administrative criteria which had nothing to do with their capability to provide such services. In this context an important step was the abrogation of the need to possess a land title deed since landholders who were not legal owners of a property were not allowed to sign a contract with FONAFIFO. This actually excluded landless small scale farmers from having any benefits from this program. In the course of PSA this requirement was changed by implementing a new system which acknowledges as well locally recognized land tenure systems. This was an important modification to allow the poor to access the program (Pagiola 2008: 723).

2.4.2 Watershed Service for Coca Cola in Tanzania

A popular PES in Tanzania is the Equitable Payments for Watershed Services (EPWS) project in the Uluguru Mountains. Like mentioned above the Uluguru Mountains are an important water catchment area of Tanzania, where the Ruvu River has its source. This river provides water for Dar es Salaam, which is the biggest city in the country and where almost 80% of the national industries are located. Several surveys have shown, that increased sediment loads, which are caused by soil erosion and deforestation have resulted in reduction of water quality and quantity. In the Ruvu River there is a significant increase in water turbidity which is over the next 20 years approximated to increase annually by 1.5 – 3%. Furthermore frequencies of high turbidity will rise, which occur during the rainy season (Branca et al. 2009: 23, 24).

The soil erosion is caused by farming practices, such as slash and burn agriculture which are very common in this area. Here farmers burn down the vegetation and cultivate the plot which is fertilized by the ash. After some years the farmers shift to another plot and leave the former one fallow for some years (Branca et al. 2011: 23). For a reduction of the sedimentation SLM practices have to be applied by the upstream farmers. These practices include reforestation, soil erosion and fertility management, which do not go in line with the former practices of slash and burn (weADAPT 2012).

Implementer and intermediary of the EPWS are Care international and World Wildlife Fund (WWF) who designed as well the business scenario. For this they conducted feasibility studies, baselines and further studies on a) policy and institutional level in Tanzania for PES; b) livelihoods of the upstream communities; c) hydrological aspects of the Ruvu River

watershed; d) land use and cover of the watershed; and e) a cost-benefit analysis of EPWS. Furthermore Care-WWF provided education for the upstream population on potential benefits to their livelihoods and the environment (Kawayu, Sallu & Paavola 2013: 15).

Data from a conducted baseline survey has shown that 89% of the interviewed villagers are subsistence farmers who hold not more than 2 ha of land. The education level is low since only 70% of the villagers have primary education level. The housing is very simple; people live in mud houses which are roofed with locally available materials. Up to one third of the people live on less than US\$ 1/day (Lopa et al. 2012: 37).

After gaining the data Care/WWF developed a business concept which was introduced to potential buyers. Coca Cola Kwanza Ltd. and Dar es Salaam Water and Sewerage Corporation (DAWASCO) showed interest in such ES. The upstream sellers were chosen from 4 villages in the Kibungo Juu ward. From the 4,860 villagers 144 joined the EPWS project in July 2009 and increased to 544 service providers in May 2010 (Lopa et al. 2012: 40).

The Memorandum of Understanding (MoU) was already signed in 2008 between the service buyers DAWASCO and Coca Cola Kwanza Ltd and the service providers, who are farmers from the Kibungo Juu ward. In the MoU both parties agreed on that the upstream farmers apply SLM practices and therefore receive payments from the ES buyers over a duration of four years whereby DAWASCO agreed on to pay US\$ 100,000 and Coca Cola Kwanza Ltd US\$ 200,000 (Kawayu, Sallu & Paavola 2013: 16).

At the moment DAWASCO spends yearly almost US\$ 2 million for water treatment costs which are caused by high turbidity. Like stated above the NTU was supposed to increase in the coming years drastically which means as well that more money has to be spent for water purification. It was estimated that the application of SLM practices in the Uluguru Mountains could drastically reduce DAWASCO's expenditures which are spent for water treatment. An amount of US\$ 200,000 per year should be saved due to a 10% decrease in costs. Since the saving costs of DAWASCO are usually passed to the water consumer, Coca Cola Kwanza Ltd would have as well benefits from this service. In the case of the soft drink producer, most impact would be created with a reduction of NTU peaks during the rainy season which are caused by increased soil erosion. In some cases such high sedimentation forces Coca Cola

Kwanza Ltd to buy water from other suppliers which drastically increases the cost of production (Branca et al. 2009: 25).

For establishing the PES scheme, funding of € 1.3 million was received from the Danish and the Dutch Government. The EPWS project was rolled out in two phases: In phase one (2005-2007) the feasibility studies were conducted, a business concept was developed which finally led to an establishment of a MoU between upstream farmers and downstream ES buyers. In the second phase (2008-2012) EPWS was established as a pilot project, which rolled out the facilitation on ES and built the institutional frame for payments and monitoring. A third project phase should have been that after phasing out of the EPWS project implementers Care and WWF, responsibilities are handed over to the community. This should lead to scaling up with EPWS to reach further 50-75 communities (Lopa et al. 2012: 35).

In these processes several stakeholders were involved: a) The Wami/Ruvu Basin Water Office provided information and technical support on hydrological aspects of the watershed; b) the Uluguru Nature Reserve (UNR) office provided technical advice on tree nursery establishment, planting and establishment of agroforestry systems; C) the Uluguru Mountains Agricultural Development Project (UMADEP) from the Sokoine University of Agriculture (SUA) provided facilitation and technical advice on intensive livestock keeping and on soil erosion measures; d) Land Use Planning and Management Morogoro Office (MoAFC) provided technical support on soil erosion measures and created awareness about the project during yearly agricultural exhibitions Nane Nane; and e) Morogoro District Council and Village Councils created awareness, mobilized farmers and provided supervision during project implementation (weADAPT 2012). The local organizations and government agencies were involved on a broad level so that afterwards, after successful EPWS project phase out of Care and WWF further areas in the Uluguru Mountains can be involved in such a PES scheme (Kawayu, Sallu & Paavola 2013: 16).

An important step during the project implementation was the evaluation of the opportunity costs of land-use practices. This was done by organising village assemblies and discussion groups. Here an evaluation of the economic returns was done. It was stipulated that it relates to the area which is removed from production for applied SLM and the agricultural income for main crops which were produced on this area. Here it was agreed on US\$ 128/ha. Farmers received in average an amount of US\$ 8-48 which was depending on scale and the type of applied SLM practices. The EPWS took as well notice of the labour which was needed to

implement SLM practices. Here it was agreed on to use the market price of a local labour day which was US\$ 1.2. A field visit for verification was a precondition before money was handed over (Lopa et al. 2012: 40).

Structural and vegetative agronomic practice to control soil erosion	% of land that will not be cultivated due to the adoption of a particular agronomic practice	First year opportunity cost (Tsh./ha)	First year labour cost (Tsh./ha)	First year total cost (Tsh./ha)	First year total cost (Tsh/acre)
Bench terraces	100%	160,000	210,000	370,000	149,739
Reforestation	100%	160,000	75,000	235,000	95,105
Riparian restoration	100%	160,000	12,000	172,000	69,608
Fanya Juu	20%	32,000	155,610	187,610	75,926
Agroforestry	17%	27,200	13,500	40,700	16,471
Grass stripping	17%	27,200	13,500	40,700	16,471
Pineapple contour farming	14%	22,400	18,000	40,700	16,471

Table 4 Opportunity costs and payments received by farmers for soil erosion control practices
(Source: Lopa & Jindal 2011: 112)

The activities of EPWS project took place as well on national policy level. Success was achieved since PES was discussed and hence institutional settings were established afterwards. For instance, in the Water Resource Act of 2009 PES is stated as a measure which can be used by Water Basin Boards to announce charges for financing payments for service providers. As well the Environmental Act of 2009 acknowledges PES as a conservation tool and encourages public and private stakeholders to apply such alternatives (Lopa et al. 2012: 37).

In the case of EPWS its successful implementation depended as well on functioning institutions on a smaller scale. Group work was a very crucial component during the rolling out of the activities in the field. Terrace construction groups and tree planting groups were formed which were later on divided in sub groups for animal husbandry and cultivation of high value crops. The group leaders from the five participating villages formed a network group which was in charge of monthly monitoring of the SLM practices implementation. In this way the information flow was enabled (Kawayu, Sallu & Paavola 2013: 17).

The involved farmers from the EPWS project increased 3.5 fold during the year of launching PES (Lopa 2012: 39). Results from Kwayu, Sallu & Paavola (2013: 22) indicate that farmers continued providing ES after EPWS was phased out. 37% constructed bench terraces, 34% constructed Fanya Juu terraces and 43% planted trees. According to Lopa et al. (2012: 39f.)

some of these farmers mentioned that they want to experiment but are not willing to sign a contract. Nevertheless, in 2011 the contracted farmers increased up to 650 farmers who received in this year a total payment of US\$ 11,000 and there are still further farmers who want to join the project (Lopa et al. 2012: 40). From the contracted farmers already 327 farmers (109 female/218 male) established terraces. Tests which were conducted during project monitoring showed a significant reduction of sedimentation in the river. The soil fertility and the water holding capacity could be improved on the plots and some farmers invested in commercial agriculture for producing cash crops like cabbages and onions. They used the money which had been received for ES. These led into a significant increase in productivity which tripled in some cases. Hence food security could be enhanced (weADAPT 2012) and higher incomes achieved. Most of the farmers who participated in the EPWS experienced an increase in well being (Innocensia 2012: 55). According to Lopa et al. (2012) it is difficult to assess if the WTA from the upstream farmers is attributed to payments or if there are other driving factors like facilitation on improved agricultural practices, which are promising increased yield.

Kwayu, Sallu & Paavola (2013: 23ff.) have shown that there is a significance between farm size and EPWS participation. A farmer with a larger land available for cultivation is assumed to be in a better financial position and hence able to buy needed inputs like farmyard manure or tools. Furthermore the farmer is not that much risk averse, since when it comes to an agreement, she can test SLM practices and does not need to convert the whole farm. This can be an advantage since the preparation of terraces decreases soil fertility because of mixing sub soil with top soil. In some cases up to five years are required to build up the former productivity of the soil. Hence, small scale farmers who have only small plots are less willing to construct terraces. Next to land size as well access to information, participation of farmers in project design and the required extent of change of agricultural practices.

The experiences of the CARE project in the Uluguru Mountains have shown that the participatory approaches were not sufficiently applied since farmers demanded to first have support on livestock training to get manure for use as fertilizer on the terraces, but the facilitators did not follow this advice. Because the livestock component was introduced too late, many farmers were hesitating to construct terraces in the beginning (Kawayu, Sallu, & Paavola 2013: 26).

Through the EPWS implementation, first experiences in PES were made in Tanzania. The costs for this intervention do not stay in any profitable relation with gained benefits. Hence, from the economical point of view there is not a major difference compared with common ILDP initiatives, which have always been expensive (Lopa et al. 2012: 42).

2.5 Conceptual Framework

The framework of this paper builds on the PES approach which is bundled with an alternative certification system. Ottaviani (2011a: 15) names three main interventions to support the delivery of ES which are agri-environmental policies, certification, and PES schemes. The ES are watershed services, which are provided by farmers who practice organic agriculture under PGS as a mean of certification.

In this paper the author analyses the economical feasibility if a PES would pay off for downstream water users from the Morogoro River watershed. Therefore he uses suggested steps from Pagiola (2003: 45) to design an environmental watershed service, which are:

1. Identifying and quantifying water services.
2. Identifying key beneficiaries and charging them for water services.
3. Developing payment systems that work.
4. Addressing institutional and political economy issues.

Regarding existing literature (Kongola 2000; Mahoo 1995), local observations and information gained at the MORUWASA head quarter, the water quality of Morogoro watershed is highly influenced by agricultural practices by the upstream population. Furthermore it is assumed, that deforestation causes a reduction of the water flow, although convenient scientific data is not available for drawing clear evidence. IAASTD (2009: 567) defines watershed management as: "Use, regulation and treatment of water and land resources of a watershed to accomplish stated objectives." In a similar environment which is as well located in the Uluguru Mountains experts concluded that reforestation and soil conservation measures are appropriate services to reduce the negative impact of agriculture (Lopa et al. 2012: 39).

The upstream population in the Morogoro River watershed uses most of the water for irrigation. On the contrary, the downstream population uses mainly water for domestic use. Hence the author selects in his PES scenarios the local water authority MORUWASA and the Morogoro Municipal as buyers. In the first scenario PES are solely financed by the local water authority MORUWASA, whereas in the second scenario MORUWASA teams up with the municipal, which gives an in-kind contribution through offering space in town, where farmers are able to market their products directly to consumers.

Hence the PES is not solely understood as the classical economical definition from Wunder (2005) although this part remains pivotal. Since the author uses an interdisciplinary approach he complements with social and institutional aspects to get clearer and more holistic data about the feasibility of a PES project in the Morogoro river watershed.

By incorporating social aspects as well in the process of valuation the author uses Hellegers (2005: 280) definition of social values which “involve issues such as social equity, livelihoods, food security, affordable consumer prices, poverty alleviation, rural development, and counter-urbanization, as well as the closely related concept of cultural values.”

For developing a payment scheme the author evaluates the opportunity costs faced by farmers during conversion to organic agriculture by using a 2nd reverse auction. Furthermore he uses a production function analysis to assess if PES could be a feasible solution for MORUWASA and the Morogoro Municipal.

In the paper SLM is mentioned in several PES examples as an appropriate measure to provide ES in watersheds. SLM is defined by UNCED as: “the use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions.” (UNCED 1992 cited in Branca et al. 2009: 9) SLM cannot be equated with organic agriculture, since it is rather a part of it.

The author uses the term agriculture in the same way as the IAASTD (2009: 2) which defines it as multifunctional as quoted below:

It provides food, feed, fibre, fuel and other goods. It also has a major influence on other essential ecosystem services such as water supply and carbon sequestration or release. Agriculture plays an important social role, providing employment and a way of life. Both agriculture and its products are a medium of cultural transmission and cultural practices worldwide. *Multifunctionality of agriculture*. As an activity, agriculture has multiple outputs and contributes to several ends at the same time. Agricultural resource management thus involves more than maintaining production systems. Services such as mitigating climate change, regulating water, controlling erosion and support services such as soil formation, providing habitats for wildlife, as well as contributions to cultural activities such as use and preservation of landscapes and spiritual sites are some of the positive functions.

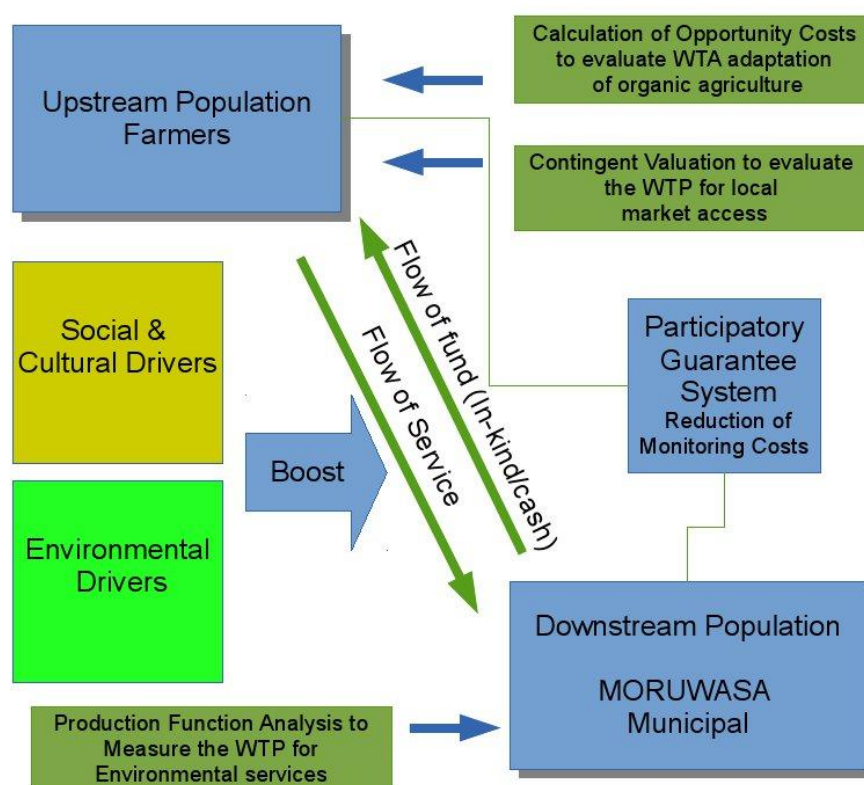


Figure 2 Conceptual Framework

Figure 2 above shows the conceptual framework. Here the bargain between upstream farmers and MORUWASA (in the 2nd scenario together with Morogoro Municipal) is pivotal. For getting the right price the opportunity costs of the farmers together with costs faced by MORUWASA due to externalities. Furthermore the framework includes environmental and social factors which have influence on the farmers' WTA.

According to Simpson (2010: 57) ICDPs are proven to be not as promising in terms of economical and ecological efficiency as formerly expected. PES projects have a different approach through creation of a market and provision of payments. Hence, nowadays, they hold the spotlight, and new attention is given to conservation efforts. Nevertheless, they still have a similarity which has to be considered critically: the assumption that local people do not have the awareness and hence are not capable of managing such services on their own.

Hence the author wants to examine if there are, next to economical incentives, other drivers which might motivate farmers to adapt environmentally friendly practices. He examines why farmers have interest in taking measures to conserve the watershed by converting to more sustainable practices.

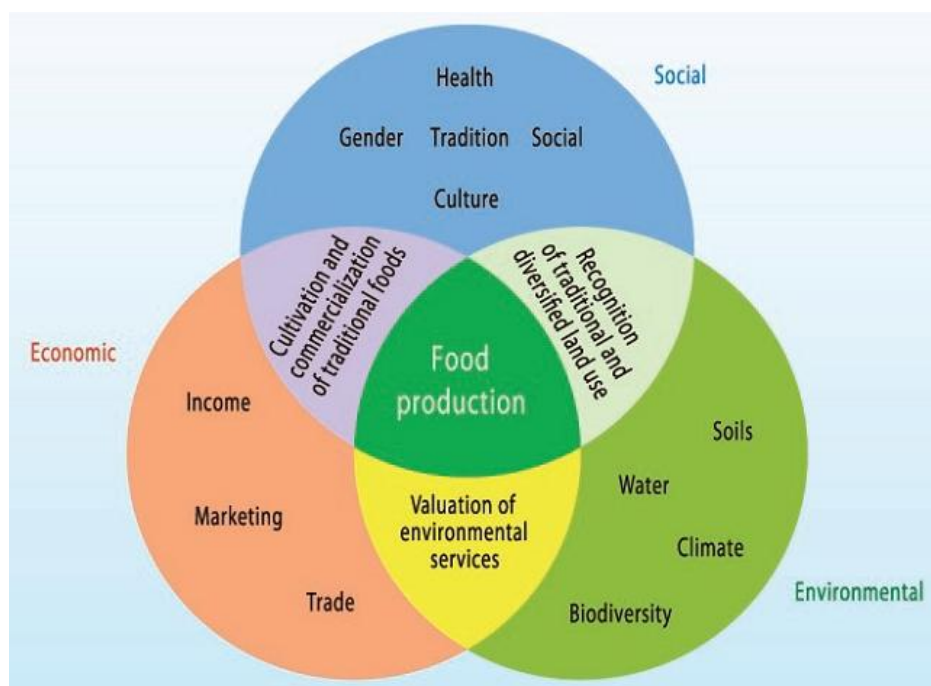


Figure 3 The inescapable interconnectedness of agriculture's different roles and functions (IAASTD 2009)

Hence the methodological framework covers all the pillars of sustainability which are the economical, the social and the environmental sphere (Figure 3 above). Next to these spheres the author uses the framework from Jones (2002: 1608f) to analyze if farmers have the needed preconditions to adopt new farming techniques. These are perception, knowledge, incentive

and capability. Perception means that farmers are aware about a problem which they are facing. Knowledge stays for having the needed skills to remedy the problem with other practices. The incentives to apply SLM practices are not only financial; they are moreover embedded in social and cultural context. Capability in this framework means that everything which is needed for conversion, like land, capital and labour, is in place.

The author discusses PES in the context of poverty and equity. From his point of view, in the context of developing countries, these terms should form the categorical imperative of this approach. In the PES literature the term 'well-being' is one of the pivotal incentives to establish such services. In the Millennium Ecosystem Assessment (MA 2003: 3) report this term is defined as:

Human well-being has multiple constituents, including basic material for a good life, freedom and choice, health, good social relations, and security. Wellbeing is at the opposite end of a continuum from poverty, which has been defined as a 'pronounced deprivation in well-being.' The constituents of well-being, as experienced and perceived by people, are situation-dependent, reflecting local geography, culture, and ecological circumstances.

Jones (1996: 191f.) challenges the scientific authenticity with four critical points: First of all, interpretation of results can be forged by political and economical interest. Secondly, it is difficult to ask the right questions since it is decided by the scientific community what is important. Thirdly, a single measureable reality may lead to a "pluralist assertions of multiple realities." Finally, ecological systems are difficult to measure since they are very complex and have immeasurable variables.

3. Methodology

3.1 Methodological Frame Work

The complexity of PES becomes visible by pinpointing economical, social and environmental dimensions. To understand these dimensions scientific input is needed. The economical one can be assessed easily since it is based on the individual preferences and reflects the perceived opportunity costs. The scientific input for social dimension can be ranked as medium level which is mainly based on background information and due to a vivid participatory dialog among the stakeholders. The environmental dimension on the contrary needs more scientific input since modelling and creating scenarios requires a broad set of data. The understanding of the environmental dimension is the starting point for opening a discussion between stakeholders (Ottaviani 2011b: 75).

The methodological frame work which is used for this paper deals with the economical, environmental and social sphere.

3.2 Opportunity Costs Analysis

Organic agriculture is known as being more labour intensive than compared with conventional agriculture. Hence the author assesses opportunity costs in the context of extra work which had to be invested to produce ES. By calculating the opportunity costs the author differentiates between two kinds of extra work. On one hand extra work is used to apply technologies that are mostly used for conservation measures (building terraces and reforestation) which are not directly in relation with farm productivity. These costs are evaluated by using 2nd reverse auctions.

The opportunity costs of preparing on one acre terraces (O_1)

O_1 calculated through 2nd reverse auction

The opportunity costs of planting 150 trees on one acre plot (O_2)

O_2 calculated through 2nd reverse auction

On the other hand the author segregates extra work which is used to substitute the previously bought input materials synthetic fertilizer and pesticide by making compost, liquid organic fertilizer and organic pesticides. The production of these farming inputs does not contain a content which has to be bought, since everything needed grows in the farm or in its surrounding. The only economical value of these products, which has significance, is labour time, which has to be spent to produce them. For proving if the farmer faces opportunity costs, or on the contrary has savings because of less costs, the labour costs for the production of the internal inputs have to be deducted from the price a farmer paid previously in the shop for external inputs. Hence the author uses a cost-benefit analysis.

This combination of methods to assess the 'real opportunity costs' is not a standard PES approach to calculate a forgone profit. The author believes that conversion to organic agriculture cannot be perceived as an alternative⁴ to conventional agriculture; since the collected data shows evidence that many farmers who converted to organic agriculture were able to increase their income.

This presumably indicates that the neoclassical assumption of farmers having full information regarding their choice has to be considered critically. In developing countries, according to Jones (2002: 1608), one of the major constraints to apply appropriate farming technologies is lack of information.

The total time for production is multiplied with the average amount of a working hour⁵. Further the costs for buying chemical inputs are deducted from this amount. A positive amount shows that the farmer has a benefit since she was saving money. A negative result indicates that the farmer is facing (opportunity) costs since the organic is the next best alternative next to conventional agriculture.

⁴ Alternative means in the context of opportunity costs the second best approach to utilize a benefit

⁵ The amount of wage per hour was in the beginning used from Lopa et al. (2012: 41) who counted for a PES project in the Uluguru Mountains a whole labour day with US\$ 1.2 which are equal to TZS 1850. The author had introduced this amount to the farmers who did not agree. Hereby it can be assumed that the farmers from the Morogoro watershed have greater income since they can bring their products to the city even by feet compared to the farmers from the other PES project. In the end they agreed TZS 625 per hour. This amount is equal to a payment for a whole labour day which is paid in the Morogoro River watershed for casual labourer.

$$CB = L_1 \times PL + L_2 \times PL + L_3 \times PL - (P + F)$$

L_1 = Labour hours used for producing compost for one acre/one crop cycle

L_2 = Labour hours used for producing liquid fertilizer for one acre/one crop cycle

L_3 = Labour hours used for producing biological pesticide for one acre/crop

PL = mean price of labour/hour

P = Price of pesticide applied per acre

F = Price of fertilizer applied per acre

For getting a clearer idea about the real opportunity costs (ROC) the gained benefit is deducted from the costs of making terraces and planting trees.

$$ROC = O_1 + O_2 - CB$$

3.3 External Costs Caused by Agriculture

MORUWASA the municipal water provider for Morogoro City has increased costs because of a reduction in water quality and quantity. For analysing these external costs which are caused by inappropriate agricultural activities from the upstream farmers the author uses a production function analysis:

- a) First of all the production function of the purification plant is specified according to its inputs, which are water from the watershed with a particular quality, filtration and chemicals, and the final output, the drinking water. Input and output have a functional relationship.
- b) Secondly, the costs of purification are estimated when water quality and quantity changes by using the production function from step (a). Quantities of water, filters and chemicals are multiplied by their cost.
- c) The last step is the estimation of the economic benefits of applied ES which has impact on water quality and quantity. Since the runoff is biggest in the rainy season the purification costs between this and the dry season is made to get an approximation to what extent can costs become reduced.

$$CB = RE - PES$$

CB= Cost/Benefit

RE= Reduced externalities

PES= Payments for environmental services

3.4. Value of Market Access

For calculating the value of having access to an organic market in town farmers were asked how much they would be willing to pay for it. The author used the mean which was later introduced to the farmers during the 2nd reverse auction.

$$\bar{M} = \frac{M1 + M2 + \dots + Mn}{n}$$

M= Value of having access to organic market in town (the farmer's WTP to have access to market products directly to customers in Morogoro town)

3.4. Drivers for Organic Agriculture

The complexity of the multifunctionality of agriculture needs an interdisciplinary approach to comprehensively understand the social behaviour in its context. Hence the author uses mixed methods to analyse the drivers for practicing organic agriculture. The validation was made through triangulation which is according to Blaikie (1991: 115f.) suitable to increase the validation and to minimize the bias. This method, like the name already indicates, can be used to analyse a specific problem or opportunity from different angles which are in the case of this research qualitative and quantitative data from economical, environmental and social viewpoints. Farmers were asked quantitative and qualitative questions to evaluate their challenges and opportunities. Furthermore the author was using ranking which is a Participatory Rural Assessment (PRA) method (Chambers 1994), to assess the drivers that motivate farmers to adapt SLM practices.

3.5 Data Collection

Three semi structured questionnaires were prepared to interview in total 30 farmers. A purposive sampling was used. From the total population 10 farmers practiced organic agriculture for three years, 10 farmers practiced organic agriculture for at least one year and 10 conventional/traditional farmers received recently training on organic agriculture and have hence an idea about terracing. The questionnaires were pre-tested with one farmer.

The first one was used to get basic information about challenges and opportunities. Furthermore it contained questions about opportunity costs.

During stakeholder interviews with key informants like MORUWASA and Wami/Ruvu Basin Office the author found out that the water amount which is used for irrigation is a crucial issue. If too much water is used for irrigation, the chance is high that too little is available for the downstream population who need it for domestic use.

Hence in the second round of interviewing farmers the author asked mainly questions about irrigation. The questionnaire was as well displayed to complement data for the opportunity costs.

The next step was to conduct two 2nd reverse auctions, where 27 farmers out of the 30 former interviewed participated. One auction was about tree planting and the other one about terracing.

Next to the auctions time was used on this day to present and discuss the first results from the research, like reduction in irrigation, productivity of terraces and the average amount farmers would be willing to pay for having market access. Here the author encouraged farmers to participate and further share their ideas or criticize the gained results. After reflection a PRA ranking system was used to evaluate their drivers.

The auction day was closed by interviewing farmers (third questionnaire). The only three questions were about present market situations, preferences and if they would accept an in-kind contribution, in form of access to a farmers' market instead of a cash payment.

The data for assessing the negative externalities were collected from MORUWASA. The author received support from the staff at Mafinga water treatment plant who had experiences with treatment costs.

4. Results

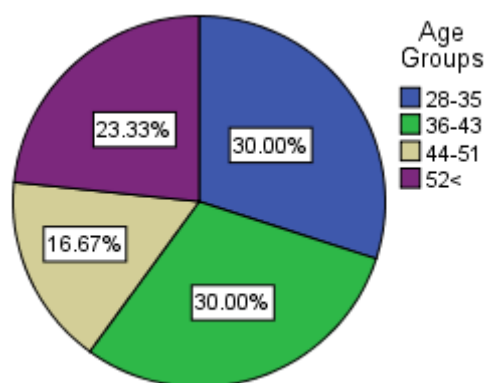


Figure 4 Age Groups

The interviewed farmers live in three villages Ruvuma, Choma and Tulo in the Morogoro River watershed. All of them have received technical support from the organisation Sustainable Agriculture Tanzania (SAT), which is a local organisation focusing on sustainable solutions for small scale farmers. Hence all have practical experience with terracing, making compost and producing liquid fertilizer and botanical pesticides.

The extent of experiences differs from village to village. The Ruvuma farmers practice organic agriculture already for 3 years, furthermore they are the members of a PGS and hence certified producers. The Choma farmers have received trainings for almost 1.5 years; they are aiming to become certified producers by the use of PGS in 2014. The Tulo farmers are trained by Ruvuma farmers through a farmer to farmer project none of them has experiences in organic agriculture for more than 4 months. Hence the Tulo farmers are aware about the needed time to produce terraces and inputs but do not have any broader experience about organic agriculture.

Out of the 30 respondents 19 are female and 11 male. They are all small scale farmers who produce for subsistence and sell the surplus at the local market. The youngest farmer is 28 and the oldest farmer 60 years old. Figure 4 shows that with 60% the younger half (29-43years) is bigger as compared with the older age group (44-60). The farmers have on average 4.7 children.

Regarding the topography of the land, 28 out of 29 respondents (97%) said that the average farm land is steeper than 30%. This fact indicates that terraces are the ideal measure to controll soil erosion when practicing agriculture. The average total farm land has 3.4 acres whereby this land is distributed to several plots which are scattered in the watershed (mean 3.66 plots/farmer). The years before receiving training in organic agriculture every farmer was using industrial fertilizers and pesticides. Synthetic fertilizers are subsidized by the government. The watershed is located in Mlimani Ward, Morogoro Urban District which has a total of 8 villages. Out of these 8 villages 4 of them have people who depend on farming for their livelihoods. These are Tulo, Ruvuma, Choma and Kisosa which have a total population

of 1,227 inhabitants. Not all of these villagers farm in the watershed. Some of them farm behind the ridge. The author uses the total amount since data about the population who farms directly in the watershed does not exist.

4.1 Economical Dimension of Morogoro River Watershed

4.1.1 Opportunity Costs

Two 2nd reverse auctions were conducted to get information about the opportunity costs of farmers. In total 27 people out of 30 interviewed farmers participated. The participants could bid on one hand for constructing one acre terraces and on the other to plant 150 trees on one acre. The precondition regarding the latter was the care keeping for a period of 3 years. There was no obligation which trees have to be planted.

In total 23 people participated with a valid bid (four bids did show an amount of less than 5,000) in the auction for terraces. The mean of bids was TZS 157,273.

During the auction for planting 150 trees in total 18 farmers gave a valid bit (four bids were not valid and four further were not bidding). The mean of bids was TZS 123,611.

In table 5 below, the different bid scenarios are listed. Most attractive bids are the uniform payment of TZS 200,000 which would cover 74% of the bidders for terraces and TZS 150,000 for tree planting which would cover 61% of the bidders.

	Bidding Price Terraces	Bidders	Percentage
Terraces	TZS 150,000	4/23	22%
	TZS 200,000	17/23	74%
	TZS 300,000	20/23	87%
	Bidding Price Trees		
Trees	TZS 100,000	3/17	17%
	TZS 150,000	11/17	61%
	TZS 300,000	16/17	89%

Table 5 Two 2nd Reverse Auctions

By using the 2nd reverse auction the amount which is paid to the sellers is a uniform payment. It is equal with the bid from the closest rejected bidder. A problem in this context was that in

the case of tree auction the difference between paying 56% of the farmers or 89% of the farmers was a single step from one bidding level to another which was in that case from TZS 150,000 to 300,000. Anyhow, if this tool is applied in a real auction for PES, more farmers will participate, and hence it will decrease the likelihood that there is a big gap between the amounts bidden..

An objective of organic agriculture is to use as much as possible internal inputs for supplementing the former use of external ones like chemical pesticides and industrial fertilizers. The input materials which are utilized for increasing soil fertility and for plant protection are shrubs and trees for instance *Tephrosia Vogellii*, *Veronia Amygdalina*, *Tithonia Diversifolia*, *Glyricidia Sepium*, *Lantana Camara* and *Azadirachta Indica*. These plants and trees usually grow in the buffer zones and do not compete with the agricultural production. Furthermore some of them are supportive plants which enrich the soil through Biological Nitrogen Fixation (BNF) from the atmosphere, and they protect the farm from erosion, wind and direct sunlight. Since they don't need care like crops or vegetables the author uses only the labour time a farmer needs to process the products to assess the value of the internal inputs. The time which was used for calculation is the average wage of a casual worker who is employed by the farmers during the rainy season. The daily rate was TZS 5,000 which is equal to an hourly rate of TZS 625. The wage was discussed and agreed with 27 farmers during the 2nd reverse auction. In table 6 below, the mean of the production time is multiplied with the hourly rate of a casual labourer. All the inputs are used over one crop cycle which lasts approximately four months. By asking farmers about their former use of external inputs the price was inquired for these inputs exclusive the subsidy which they received by using a voucher⁶.

The farmers plant at least two times a year vegetables and once a year they additionally plant during the rainy season maize as staple food. The subsidy program⁷ is a fertilizer package for growing maize on one acre which includes two types of fertilizers and maize seeds. In calculating the cost-benefit of producing compost, liquid fertilizer (manure/plant tea

⁶ The voucher system is enrolled through the Agriculture Sector Development Program (ASDP) and includes a discount of almost 50%. The voucher is normally foreseen for farmers who have farmland less than 2.27 acres (Malhotra 2013).

⁷ Shops in Morogoro town sold 2013 50kg UREA for TZS 60,000, 50kg DAP for TZS 75,000 and the 10kg hybrid maize seeds for TZS 42,000. In combination with a subsidy voucher the farmers have to pay TZS 100,000 to receive this package (Maro 2013).

production) and botanical pesticides the opportunity costs are not taken into account since farmers grow as well vegetables which are not a subsidised production.

No.	Description	N	hours (mean)	TZS (mean)
A1	Botanical pesticide production	17	37	TZS 23,029
A2	Compost production	16	41	TZS 25,919
A3	Manure/Plant tea production	13	37	TZS 23,029
A4	Sub Total (A)			TZS 71,977
B1	Costs for chemical pesticides	25		TZS 39,432
B2	Costs for industrial fertilizers	22		TZS 103,300
B3	Sub Total (B)			TZS 142,732
C1	Cost/Benefit of OA (B minus A)			TZS 70,755

Table 6 Organic internal inputs compared with external conventional inputs

The results in table 6 above, show that an organic farmer needs 115 hours during a crop cycle to produce compost, manure or plant tea and botanical pesticides. By calculating this time with the hourly rate of TZS 625 the total cost for labour is TZS 71,977. The total savings are the sum of the used external input materials minus the costs for producing its supplements for organic agriculture which are in this case TZS 70,755.

The calculation does not include the time which is used to buy, transport and apply external inputs. If these factors would have been considered the saving of the farmers would have further increased. Furthermore the time to plant shrubs and trees which are used for the production of the internal inputs was not calculated.

To get the approximate data about the pesticide and fertilizer use was difficult, since its use depends on pests and crop variety. Furthermore farmers did not know exactly since they bought pesticides piece wise. Also the approximation of applied fertilizers was difficult since farmers were not completely aware how much fertilizer was used for an acre. Since the author is aware that most of the farmers do not keep record of their expenditures and incomes he further decided to ask farmers how they perceive themselves (rich/poor) in the village instead of their yearly income.

The labour intensive transition period can be perceived in this context as the forgone benefits. Nevertheless organic agriculture has as well benefits to small scale farmers. Like demonstrated in table 6 above, small scale farmers can reduce their expenditures by supplementing external inputs with internal inputs. If these facts are considered together it

makes sense by showing ‘real opportunity costs’ which include the money which can be saved. Referring to the scenario of opportunity costs which are faced by making terraces in table 7 below, it makes sense to deduct the savings from this amount. For instance, if from opportunity costs of TZS 200,000 (table 5) for making terraces the amount of TZS 70,755 (table 6 – the amount saved due to applying organic agriculture C1) is deducted the ‘real opportunity costs’ would be equal to TZS 129,245. Important to consider in this regard is that the opportunity costs of constructing terraces are only faced once. The profitable use of internally produced inputs however, will be continuous. In the context of the farmers in the watershed of Morogoro River, who have water throughout the year, the savings could triple since vegetable production can be practiced the whole year.

4.1.2 Costs for MORUWASA caused by upstream farmers

For accurate valuation it is needed to confront the total available water quantity with the flood peaks. The water does not always have the same value. The purification during flood peaks is more expensive since it results into an increase in sedimentation and chemical/biological pollution (Mahoo 1990: 3). For calculating the costs incurred by MORUWASA due to agricultural practices by the upstream farmers, data is used from the Mafinga water treatment plant. Its water laboratory provided data on approximate costs for high and low peak treatment costs which seasonally occur. Mafinga treatment plant does not treat the water from Morogoro River; it uses water from Mindu dam which is the biggest water source of Morogoro Municipal. The Mindu Dam receives its water from 6 rivers which all have their source in the Uluguru Mountains. The water has similarities with water from the Morogoro River, since agriculture is practiced by small scale farmers in the Mindu dam catchment area as well. Data on sedimentation of the Morogoro River is not available. While conducting the research a tank inclusive treatment plant was under construction which is supposed to start production in the end of 2014 and uses water solely from the Morogoro River. It is laid out to provide Morogoro City daily with 6,000 m³/day of water compared with Mafinga which is supposed to provide 24,000m³/day. Already for several years Mafinga treats less water because of some defects. In average it delivers 21,000m³/day (MORUWASA).

In general there are three different anthropogenic problems that have to be treated which are a) pollution through application of manure and industrial fertilizers, b) soil erosion and c)

bacterial pollution. The last one is not caused by agricultural practices. It is a sanitary problem which results into a high population of E.coli bacteria. According to laboratory technicians at Mafinga treatment plant the first two problems can be minimized by (a) appropriate application of manure and use of compost and (b) through soil conservation measures like terracing. According to Mafinga treatment plant staff the pollution peak occurs yearly between one up to two months during heavy rainfall MORUWASA assumes that a reduction of 50% could be achieved if all farmers apply SLM practices to avoid soil erosion and pollution (Mwakalukwa 2013).

For the calculation (see Table 5 above) a period of 45 days was used to calculate the flood peak. In the last row 34%⁸ is deducted from the (a&b) treatment costs for the flood peak and further used to calculate the assumed savings if SLM is applied. The savings (3.2) are TZS 56,571,750 which is equal to the produced 21,000m³/day in this period. Moreover this amount was converted to an amount of 6,000m³/day which matches with the amount that is supposed to be daily treated by Morogoro River plant by the end of this year.

No.	Fertilizer pollution	Platinum-Cobalt Scale	Treatment Costs daily	%	Days a year	Treatment costs yearly	-34% of high peak
1.1	Dirty	628	TZS 1,822,500	450%	45	TZS 82,012,500	TZS 54,128,250
1.2	Normal	50	TZS 405,000	100%	319	TZS 129,195,000	TZS 129,195,000
1.3	Sub total					TZS 211,207,500	TZS 183,323,250

No.	Soil sediments	NTU	Treatment Costs	%	Days a year	Treatment costs yearly	-34% of high peak
2.1	Dirty	1015	TZS 1,875,000	1667%	45	TZS 84,375,000	TZS 55,687,500
2.2	Normal	13	TZS 112,500	100%	319	TZS 35,887,500	TZS 35,887,500
2.3	Sub total					TZS 120,262,500	TZS 91,575,000

3.1	TOTAL Costs					TZS 331,470,000	TZS 274,898,250
3.2	Savings 21.000 m ³ /day						TZS 56,571,750
3.3	Savings 6.000 m ³ /day						TZS 16,163,357

Table 7 Yearly treatment costs with - 34% reduction due to SLM (adapted from Mwakalukwa 2013)

⁸ The 34% were calculated by taking from table 5 the mean of the two percentages of bidding price terraces (TZS 200,000) and bidding price planting trees (TZS 150,000). This mean was in the next step proportionally deducted from the forecasted 50% sedimentation peak reduction by MORUWASA which would take place if all farmers adapt ES in the watershed.

The actual savings which can be achieved through a reduction of chemical treatments are TZS 16,163,357 (table 7). This amount cannot be perceived as having very significant economical importance. In the context of its calculation it has to be mentioned that it is the lowest assumption that can be made. This is because of some missing data. The calculation of the high peak is convincing but the normal use of the water does not include casual rainfalls which cause as well higher treatment costs. Furthermore the filter costs are not included. According to (Lopa et al. 2013), for instance, the highest costs faced by DAWASCO were the filters of its treatment system.

Treatments	Treatment Costs	
	250m ³ /daily	90 days
1.1 Dry season according to PI/Co pollution	TZS 4,821	TZS 433,929
1.2 Dry Season according to NTU sedimentation	TZS 1,339	TZS 120,536
1.3 TOTAL (A)		TZS 554,464
Sale	Price	
	250m ³ /water	90 days
2.1 Water sale	TZS 185,000	TZS 16,650,000
2.2 TOTAL (B)		TZS 16,650,000
3.0 Total profit (A-B)		TZS 16,095,536
4.0 Savings 6000m ³ /day		TZS 16,163,357
5.0 TOTAL COST SCENARIO 2		TZS 32,258,893

Table 8 Income for MORUWASA (adapted from Mwakalukwa 2013)

A higher amount could be achieved if ES would not only increase the quality but as well the quantity of water. The river is known to have a strongly reduced water flow during the dry season. It is assumed that due to this reduction the treatment plant can provide instead of 6,000m³/day only 4,000m³/day for at least 90 days (Mwakalukwa 2013). In table 8 above, by assuming that reforestation increases the rainfall and the application of organic agriculture reduces the need for water from the river, a hypothetical increase of water with 250m³/day⁹ would enhance the income of MORUWASA during the 90 days for TZS 16,095,536. By using this scenario the income increase through more water quantity inclusive the expenditures water treatment costs (1.3) would be TZS 32,258,893 which could be saved by MORUWASA in the end of each year.

⁹ The 6.5% increase of 250m³/day is an assumption from the author. Data was not available. Results from this research have shown that organic farmers reduced water consumption for irrigation of 41%. The water price for one m³ was calculated with the actual MORUWASA price of TZS 740 (domestic use).

4.1.3 Value of Local Organic Market Access

The farmers from the Morogoro River watershed mostly sell their products at the local market in Morogoro town. Some of them have as well access to markets in Dar es Salaam with products like carrots and leeks. Among them is the PGS group from Ruvuma. Nevertheless the majority is dependent on demand from Morogoro. In the biggest market in town the stall fee is TZS 50,000 a month. For a small scale farmer this is too expensive and as well it is difficult to get a license since they are held by the seller throughout the year. Nevertheless all of them are aware that their products are sold for much higher prices at the market compared with the money they get from selling their products to the middlemen in the market. Since Morogoro Municipality does not have funds to financially support a PES, hence an in-kind contribution could be an appropriate solution. The value of this contribution is equal to the farmers' WTP for such a good or service. It could be for instance to offer space in town where organic farmers are able to directly sell their products to consumers. This scenario was discussed with the respondents whereby they were afterwards asked if a) they have interest in such an offer; which they could answer with yes or no, and b) how much it would be worth for them to have permanent access in town to legally sell their organic products. Table 9 shows that the farmers showed interest in such an opportunity and 27 out of 27 farmers stated a yearly amount with a mean of TZS 40,222 willingness to pay. The highest amount was two times TZS 100,000 and the lowest TZS 5,000. Results in table 8 below, show that as more experience farmers have as higher their WTP for having access to an organic market.

Village	Experience	Mean	N	Std. Deviation
Ruvuma	3 years	TZS 48,500.00	10	TZS 36,670.454
Choma	1.5 years	TZS 36,400.00	10	TZS 21,925.125
Tulo	0.4 years	TZS 33,857.14	7	TZS 19,768.903
Total		TZS 40,222.22	27	TZS 27,657.706

Table 9 Value of one year access to organic market in Morogoro Town

During the 2nd reverse auction the author took as well the time to discuss with the farmers this specific result. Through the use of the 3rd questionnaire results indicated that all of the present 27 farmers agreed to use the mean of TZS 40,000 as valid value for a yearly in-kind

contribution. 25 out of 27 farmers sell their products at the local market to middlemen. All of the 9 present farmers from Ruvuma sell their products as well to the SAT organic shop¹⁰.

4.1.4 Cost Benefit Analysis for MORUWASA

By assuming that MORUWASA will benefit from these ES through a reduction of treatment costs by 34%, which would be TZS 16,163,357 savings every year (Table 7 – column 3.7), it can be concluded that, without considering the transition period, as soon as the additionality of the ES is achieved the PES would pay off already after in the beginning of the 5th year. In table 10 the total amount of payments is calculated by using the results from the 2nd reverse auction (table 5) which is multiplied with the households¹¹. It is only a theoretical assumption since the calculation is without considering the transition period. The full effect of reforestation cannot be expected to occur in the first year.

Use	Total Households	Coverage in %	Coverage households	Single Payment	Total Payment
Terraces	279	74%	206	TZS 200,000	TZS 41,292,000
Tree planting	279	61%	170	TZS 150,000	TZS 25,528,500
Total Payment					TZS 66,820,500

Table 10 Payment scenario for PES

By using a scenario where MORUWASA is not only benefiting from an increase in quality but as well in quantity of water the investment in PES would be highly profitable. The assumption is that the water quantity increases for 250m³/day during the dry season. Next to the yearly savings of TZS 16,163,357 MORUWASA could create more income through selling more water. Hence the profit/loss account would have TZS 32,258,893¹² more due to provided ES at the end of the year than previously (see chapter 4.1.2). Again by assuming that the ES have achieved additionality like agreed the investment would pay back already after the second year.

¹⁰ SAT organic shop is a model shop which collaborates with PGS farmer groups and promotes organic agriculture (Maro 2013)

¹¹ The author had only information about the population size in the four villages. The households were calculated with the average household size (4.4) of Morogoro from the population census 2012 (NBS 2013: 2)

¹² after one year (accounting period) having settled the bill for the ES providers, by assuming that the additionality is achieved

This payment scenario is not calculated with the ‘real opportunity costs’. It uses exclusively the opportunity costs which were evaluated through the 2nd reverse auction. Nevertheless it has to be as well kept in mind that the farmers actually have immediately a benefit, when they use organic agriculture methods. This could be considered during the negotiation between buyer and service providers and probably would lead to a reduction in the price.

4.1.5 Cost Benefit Analysis for MORUWASA with Municipal Support

MORUWASA is an institution which depends on donor money to provide water for Morogoro Municipal (MORUWASA 2013). Hence the possibility is high that MORUWASA has no money to invest in PES, even if it would pay off. Hence, the author developed a further scenario where MORUWASA gets support from the Municipality of Morogoro. As well this institution is assumed to have little money. Consequently the author chose a strategy where the municipality can offer an in-kind contribution which would be a farmers’ market for the ES providers from the Morogoro River watershed. Results in chapter 4.1.3 have shown that farmers would accept to value a farmers’ market access with TZS 40,000 every year. Over a period of 5 years, this in-kind contribution would be already equal to TZS 200,000. Such an in-kind contribution could reduce the amount for 57% which MORUWASA is supposed to pay in the scenario of table 9.

4.1.6 Payment Scenarios

The payment scenarios for the farmers might differ. Regarding the farmers who provide ES by constructing terraces it would be best to pay them off immediately after completing their task. Sometimes farmers are facing a reduction of soil fertility in the first two years (in detail explained in chapter 4.1.9) hence a rapid payment would be favourable. A different situation is ES which is provided through reforestation. The buyer would be probably better off if farmers receive an instalment in the beginning to cover some costs for forgone labour time, trees and tools and final instalment after 5 years, to be sure that farmers take care of the trees and do not use the plot for other activities that will destroy the trees.

4.1.7 Land Tenure

The farmers are all traditional landholders who don't possess any land title deed which is issued under the Tanzanian land laws. Nevertheless their plots are recognized by the LGA and have hence a legal status.

Age Groups		Totally available land (acre)	Land herited (acre)	Purchased land (acre)	Land rented (acre)
28-35	Mean	3.306	1.561	1.389	0.111
36-43	Mean	3.250	1.464	.679	0.000
44-51	Mean	2.950	1.125	1.000	0.200
52-60	Mean	3.857	2.929	.143	0.000
Total	Mean	3.362	1.826	.824	0.071

Table 11 Cross table of age groups and different forms of ownership

Results from the questionnaire have shown that only 9 out of 29 farmers bought a plot and further two out of them rent a plot. By drawing the means of land inherited, purchased or rented, the data shows that pressure on land increases. Table 11 above indicates that more land was inherited from the oldest age group. Hence they also purchased fewer land compared with the younger groups. The youngest group leads with the biggest size of land which was purchased. Furthermore they are the only group which rents plots for cultivation. These facts indicate that land is becoming scarcer. Anyhow, for expressive statistical tests the population size was too small, nevertheless according to the fact that the villagers cannot further expand their agriculture activities this data is meaning full. A further finding is that farmers have several plots. The mean is hereby 3.66 plots/farmer. These plots are scattered in the watershed and between them are sometimes distances of 2-3km.

The literature review has shown that farmers from the Uluguru Mountains were hampered to cultivate trees because of cultural and institutional reasons (Ruheza 2012: 237, 241). Hence, the author was asking farmers if they are allowed to plant trees on their plots. The response was 100% positive. Hence reforestation is potential to Luguru farmers in the Morogoro River watershed.

4.1.8 Economical Impact of Organic Farming

The design and evaluation of appropriate payment scenarios for an ES scheme needs information about the opportunity costs of service providers. According to the majority of reviewed literature it is assumed that ES for watersheds create tradeoffs through forgone benefits. The data from the interview has shown that farmers have social, economical and environmental benefits, instead of expected loss. Since PGS is a new concept in Tanzania, many people are still not aware about organic agriculture. Hence the farmers receive rarely price premiums in the local markets.

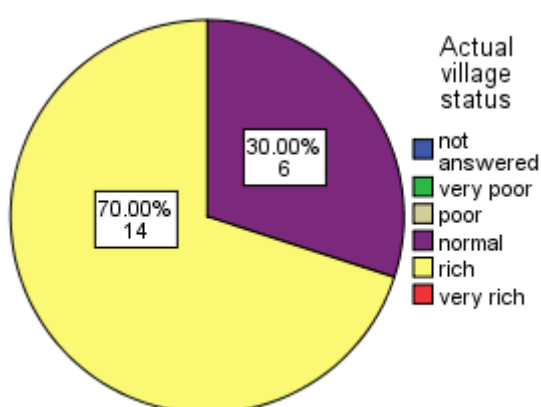


Figure 6 Actual village status

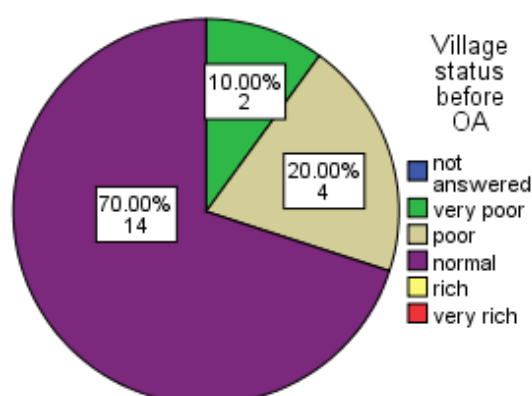


Figure 5 Village status before practicing organic agriculture

The farmers from Ruvuma (3 years experience) and farmers in Choma (1 ½ years experience) were asked how they perceive their economic status in their villages, here they could choose between very poor, poor, normal, rich and very rich. In figure 5 above it is demonstrated that out of the 20 interviewees, 14 perceived themselves as having a normal economical status before converting to organic agriculture. 4 further farmers perceived themselves as poor and 2 as very poor. None of the farmers was before organic agriculture conversion rich or very rich. The status significantly changed after conversion. In figure 6 above, 70% of the farmers perceive themselves as rich and 30% as normal. These results indicate that even the very poor farmers (both from Ruvuma) could manage it in three years to get out of poverty. One of those two former very poor farmers perceives herself as rich nowadays.

Soil fertility is important for farmers since the degree of fertility indicates to what extent yield can be increased or decreased. The construction of terraces usually reduces the soil fertility because of mixing top soil with sub soil. 8 out of 20 farmers from Ruvuma and Choma responded that they experienced a reduction of soil fertility in the first year. The results are

interesting since data from figures 5 and 6 has shown that farmers perceive themselves wealthier than before converting to organic agriculture. Even after short organic production for duration of only 1 ½ years in the case of the Choma farmers. This indicates that soil fertility is not the only factor to increase the household incomes of small scale farmers.

Hence following assumptions have to be considered for farmers who reported on one hand increased income and on the other experienced a decrease in soil fertility: a) farmers saved money, since industrial fertilizer and chemical pesticides were not needed, b) other contents of the training from SAT could improve their livelihoods like post harvest management c) farmers could complement the loss by cultivating on other plots which were not yet terraced. Reasons as to why some farmers have immediately increased production and others do not could be that farmers who had already depleted soil fertility were not so much negatively influenced by constructing terraces.

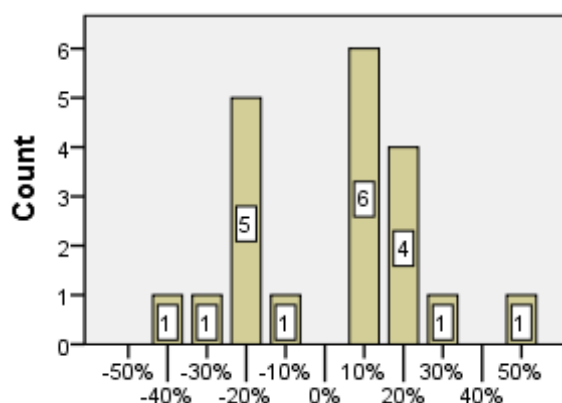


Figure 8 Productivity after 1 year

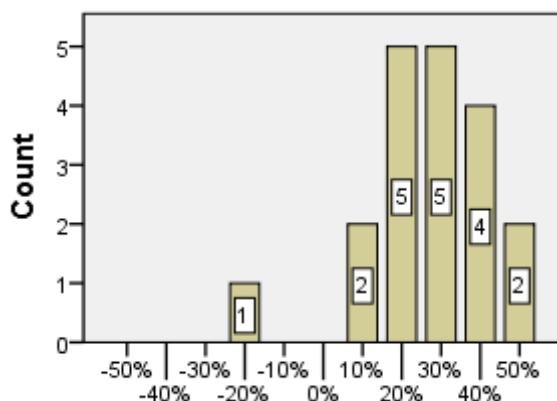


Figure 7 Productivity after 2 years

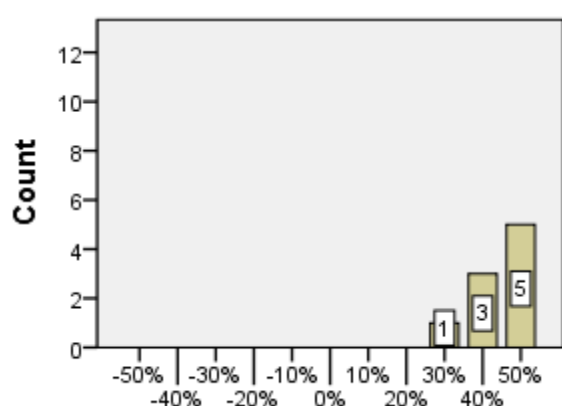


Figure 9 Productivity after 3 years

Figure 8 demonstrates that the farm productivity was reduced for 8 out of 20 farmers in the first year of conversion. Figure 7 below shows that out of the 20 farmers only one farmer still experienced a reduction. All the others have reached a productivity increase of 10% or above. The mean of the 2nd year is a 28% increase. The data in figure 9 above shows that after three years practicing organic

agriculture 9 farmers from Ruvuma reported an average increase of productivity of 43%. This Finding demonstrates that organic farming can increase income even without price premiums.

A further important issue to consider is the time which has to be invested in conversion. All the farmers experienced increased labour requirements during conversion. The author asked the respondents as well how long they assume that the soil fertility needs to be a) on a standard level to produce without loss and b) how long it needs till soil has gained in a higher fertility than experienced before conversion. The answers show that there is relation with the general question regarding farm productivity and underpins the thesis that soil fertility is an important indicator in this context. The 20 farmers from Ruvuma and Choma responded with a mean of 1.03 year for achieving standard soil fertility and 2.08 years to achieve a higher level than before conversion.

4.2 Environmental Dimension of Morogoro River Watershed

4.2.1 Water and Farming

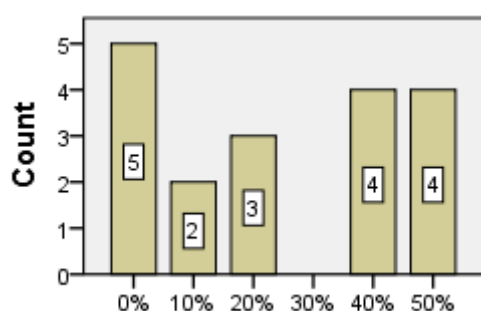


Figure 10 Water for irrigation reduced due to practicing organic agriculture

Since water quantity is next to quality an important factor for MORUWASA, the farmers were also interviewed on their water consumption. Here the author discovered that organic farmers experienced that they need less water for irrigation than compared to conventional farmers. This can be explained by the fact that terracing slows down the speed of water which results into a higher infiltration. Furthermore, the use of compost and

mulch technologies increases on one hand the water holding capacity and the other decreases evaporation. Out of 18 farmers 8 experienced a reduction in water requirement of up to 40% and more which is illustrated in figure 10. Only 5 farmers from Choma don't experience any difference regarding the amount which is needed for irrigation. The reduction of water can be explained with the reduction of days which are needed to irrigate per week. In conventional agriculture the mean of days, which are needed for irrigation, are 5.13 compared with 3.05 days/week for organic agriculture. This result demonstrates a reduction of 41%. By using only data from Ruvuma farmers an average weekly reduction of 59% was reported. These results show that a transition from conventional to organic production needs time till productivity and efficiency is maximised.

4.2.2 Impact of Farmers

Farmers have negative impact on water quality because of using fertilizers and pesticides. In this regard the author asked farmers about the use of the subsidy program from the government where farmers receive a voucher which can be used to get discount by buying chemical inputs for one acre. Before conversion to organic agriculture 20 out of 30 farmers (67%) received a voucher and 95% of them were using it finally to buy chemical fertilizers and pesticides. During the group discussion the farmers explained that only a few vouchers were allocated to the villagers. Hence most of the farmers didn't receive them every year. By asking the farmers from Ruvuma and Choma how much they use these inputs nowadays, all of them answered that they stopped completely. In this context it is needed that the author elaborates the freedom of a PGS system. A farmer is allowed to have next to his organic plot as well a conventional one. What is important is that they are both clearly separated with a buffer zone and that measures are taken to avoid chance of contamination. Hence data can be assumed not to be biased, what would be a different situation by interviewing a farmer who is certified through common third party certifier, since they are restricted to the use of manure, green manure and compost. Important to mention is that if manure is not properly applied, it can lead to nitrification of water, like industrial fertilizers. Nevertheless, because of the use of terraces and as well due to the received training it is assumed that these negative side effects are marginal.

4.2.3 Intensification of Agricultural Practices

Organic farming is known as a system which intensifies the production in a sustainable way. Farmers can for instance use an agroforestry approach like how it is practiced by the PGS group in Ruvuma. On one hand they cultivate crops for consumption or the market and on the other they have fuel wood or timber from the trees. Moreover they have fodder for their livestock and if they plant legumes, the trees also fertilize the soil which influences the crop yield in a positive way. Moreover soil erosion is reduced. Furthermore farmers cultivate shrubs for compost or bio-pesticide production. Animals are not only kept for having further products for home consumption or the market but as well for having manure to fertilize the soil. Such a circular economy reduces the dependency on external farm inputs. The Luguru have been using the forest resources over generations. Nevertheless the author was interested

in how much such a dependency can be reduced when almost everything is available on farm. Hence one question was if an organic farmer is in the same way dependent on forest resources like a conventional one. The results have shown that the majority (95%) of Ruvuma and Choma farmers believe that the dependency is smaller. A further question in this context was if farmers can permanently cultivate a plot without leaving it fallow for some years. Here 18 out of 20 farmers reported that they assume that it is possible if manure and compost is added.

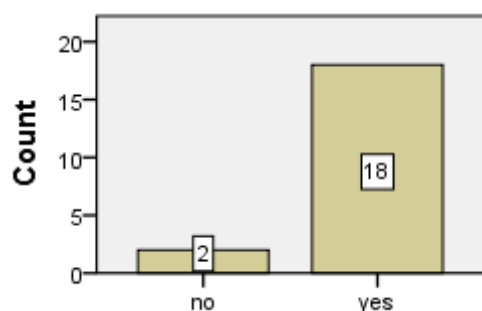


Figure 12 Slash and burn practices in the past

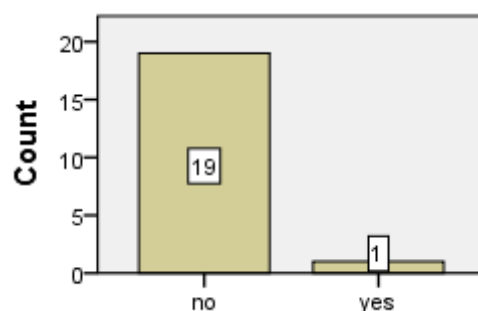


Figure 11 Slash and burn practices at present

A further question regarding intensification was how this new system has changed the old one. Formerly, most of the farmers were practicing slash and burn agriculture, which is a very common practice in the tropics. 95% of the farmers reported that they do not practice any more this technique (See figures 11 and 12 above). Slash and burn practices do not only increase soil erosion since they leave the soil completely unprotected. Furthermore they release carbon dioxide into the atmosphere and reduce the biodiversity. Hence it can be concluded that organic agriculture has a positive impact on all these aspects. A further expressive result was gained from the question if organic agriculture reduces the pressure on land. For 80% of the farmers it does. Hence it can be concluded that organic agriculture has a

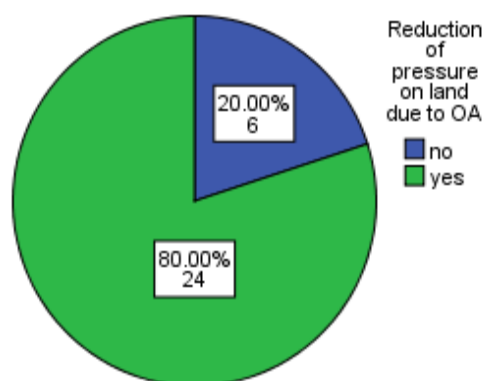


Figure 13 Reduction of pressure on land due to organic agriculture

high potential in the watershed. This is on account of an expected increase in population density. The farmland cannot anymore be further expanded since it shares its border with the forest reserve.

Figure 13 on the left side, shows that organic agriculture relaxes the pressure on land since slash and burn is not anymore necessary. Hence it creates as well new opportunities like to plant trees on plots in the higher altitudes. This was also a question, if farmers would be willing to plant trees, which was

positively answered by 100% of the respondents. Nevertheless, several of them told the author that they want first training on proper forestry management.

4.3 Social Dimension of Morogoro River Watershed

4.3.1 Awareness about Environmental Issues

The interviewed farmers were all aware about environmental issues in their watershed. The awareness about deforestation can be considered as very high with 93% of the population. On the other hand for the majority of them deforestation is not yet creating significant problems. This was found out since the author developed an open question what environmental issues, caused by human beings, have negatively influenced farmers' livelihoods. In total 27% of the farmers responded in the context of deforestation. The problems mentioned were climate change (2 farmers) and a faced reduction of water flow (8 farmers; one mentioned as well the former problem).

The use of terraces was perceived as an appropriate measure against soil erosion by all the farmers. Interesting was that none of the farmers mentioned soil erosion as an anthropogenic environmental issue which has negative influence on their livelihood. Questions regarding the benefits of terraces were also responded with conserving moisture in the soil (30% of the farmers), and that work becomes easier (30% of the farmers). By asking them if terracing has more advantages, is the same or has more disadvantages compared with common practices all of them responded that it has more advantages.

4.3.2 The Consumer's Perception; a Driver for Organic Producers?

Organic agriculture is new to many Tanzanians, since most of the organic products go for export. The farmers from the Uluguru Mountains have made already some experiences by promoting their vegetables as being organically produced and sold locally. Experiences show that almost every fourth farmer believes that many customers are aware about organic agriculture. Nevertheless, still more than the half is convinced, that consumers are not well

informed about it. The data in figures 14 and 15 below shows that the customers are more aware about health benefits compared to nature benefits.

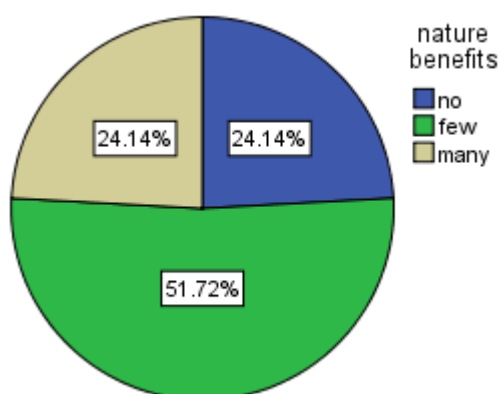


Figure 14 Consumers perception regarding benefits for the nature

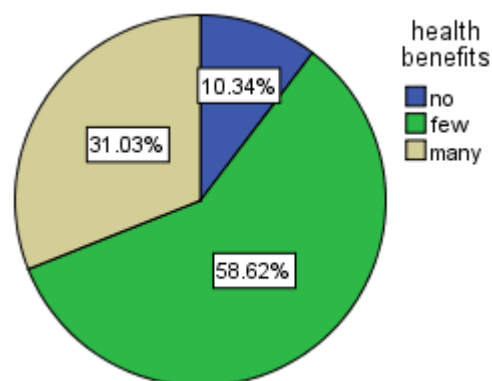


Figure 15 Consumers perception regarding health benefits

8 farmers out of 30 could not say if the consumers' awareness motivates them to produce organic agriculture. The remaining 22 respondents perceive it as a motivation. The consumer's perception of health benefits due to consumption of organic products could be answered by 26 farmers out of 30 who all saw it as a positive attribute towards their motivation to cultivate organically. The farmers from Ruvuma and Choma were also asked if they have market opportunities for their organic products. 14 answered this question with no and the remaining 6 with yes. This finding indicates that organic farming is not yet well known in Morogoro. Anyhow, to an extent the awareness by customers is already there. Nevertheless if PGS farmers become acknowledged as ES providers it would make sense that the government starts promoting organic farming among customers.

4.3.3 Is the Governmental Perception of Organic Agriculture a Driver?

The water scarcity in Morogoro Municipal is a problem which is well addressed by the government. The need of conserving the mountains is a precondition to guarantee water also for the next generations. Farmers are in this regard perceived as a problem since they cause soil erosion, chemical pollution, bacterial pollution and use water for irrigation which could be used by the downstream population for domestic use.

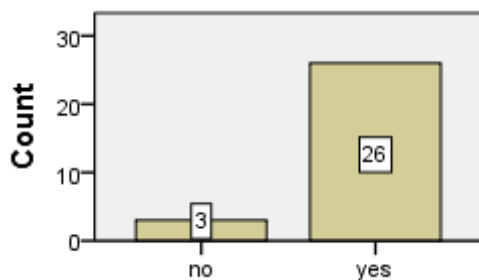


Figure 17 Pressure perceived from the Government

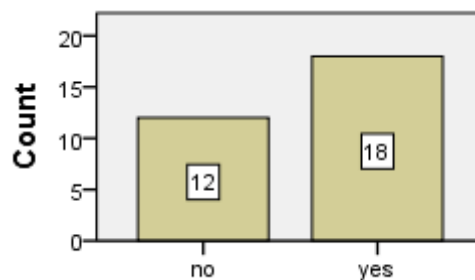


Figure 16 Pressure perceived from MORUWASA

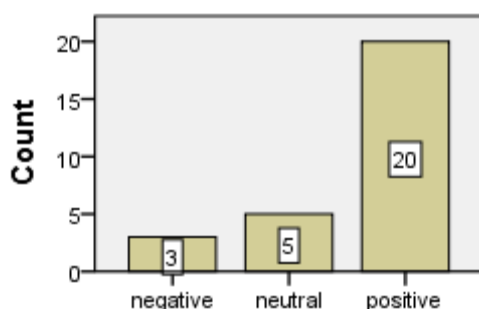


Figure 18 How farmers assume the Governments perception regarding organic agriculture

The author asked farmers if they perceive pressure on different institutional scales. On one hand 18 out of 30 farmers reported that MORUWASA is creating pressure, whereas 26 out of 29, which are 90% of the research population, said that they feel the pressure from the government. This demonstrates that almost all farmers are aware that their farming activities are a concern to the government. The government had already tried to resettle the farmers in 2006. Next to this radical

approach there were as well other approaches like teaming up with organisations and creating awareness about environmental issues. 19 out of 30 farmers reported that they have seen or were involved in governmental projects in the last 5 years. The tension is still very high. During the interview, by asking respondents about the need of environmental protection, 5 farmers mentioned a recently occurred incidence, which was an attack from a village leader in the watershed against illegal loggers in the forest zone. One of those was hit with a bush knife and was seriously injured on the neck. The author experienced that farmers suffer from the negative perception and are willing to take all the needed measures to legitimize their status as villagers who don't cause any harm to the downstream population. 20 out of 28 farmers believe that the government perceives organic agriculture as an appropriate measure to reduce the negative impact.

4.3.5 Does the History Influence the WTA?

In some papers soil conservation measures in the Uluguru Mountains were described as failed because of cultural and historical reasons. Hence the author asked farmers if they are aware that terracing was in the old days forced by the British. 19 of 30 farmers were aware about it. Nevertheless all of them are interested in constructing terraces. Since the Luguru are in the literature (Ruheza 2012: 237, 241) described as being culturally hampered to plant trees, a further question was if they are free to plant trees on their plots. All of them answered with yes. Hence, in the study area both of the assumptions terracing could be hampered due to culturally and historical reasons could be falsified by analyzing the data. Two farmers even mentioned that it was easier with the colonialist since they separated the forest and the land for agricultural use with a fence, which clearly indicated where cutting trees is allowed and where not.

4.3.6 Food Security

The results have shown that the population of this research cannot be considered as food insecure. The mean of weekly vegetables consumed by the farmers is 4.9 days. Only two farmers eat vegetables twice a week, all the others consume more. Furthermore the author asked the farmers if they were facing any hunger in the last 10 years. None of them was starving. Since 2 farmers described themselves as very poor and 4 as poor before they started with organic agriculture it can be concluded that none of the social strata in the village was facing serious problems with food and hence can be considered as food secured. This may be due to high rainfall and the Morogoro River and some other streams which can be used for irrigation.

4.3.7 Community Work

Kerr (2002: 71f.), who analysed the successful watershed management in Sukhomajri, India concludes that the reason for success could be that this village had only a small homogenous population. Hence the costs of collective action were low. If the costs are higher than the

benefits, villagers may tend to refuse the provision of PES whereby the author pinpoints the relation between social capital and coordination costs.

The results have shown that all the interviewed farmers inherited land. Hence it can be concluded that social cohesion is vibrant because of existing institutions which are based on culture.

Social cohesion is important for farmer groups since a lot of time has to be invested in group work. According to Maro (2013) a farmer group which is facilitated by SAT, needs next to the 3 up to 4 hours training a week, also voluntary labour to run the demonstration garden. Therefore further 2 up to 3 hours have to be invested weekly. Anyhow such tasks are not allocated to the whole group but rather to individuals. For a PGS group it is more demanding since they have to monitor and document the group activities from each member.

All the respondents from Ruvuma and Choma (Farmers from Tulo were not asked) reported an increase in group work. Figure 19 below shows the former involvement in community activities, which can be interpreted as being for the majority not an activity where a lot of time was invested. This changed through becoming members of farmer groups. Figure 20 shows that the involvement in group work has increased tremendously.

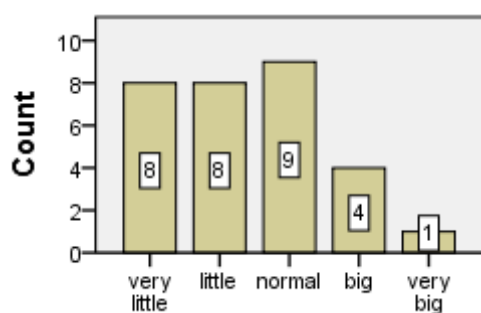


Figure 20 Involvement in community work before joining the group

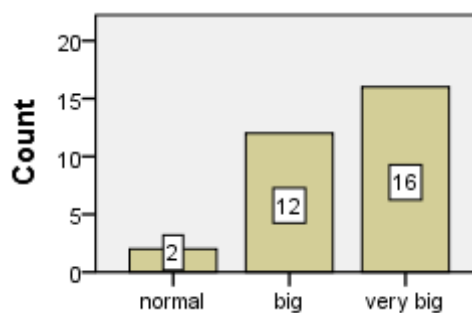


Figure 19 Time involved in group work at present

The author interviewed the farmers as well if they see this involvement in group work more positive or negative. All of them perceived it as more positive.

4.4 Interdisciplinary Dimension of Morogoro River Watershed

4.4.1 Perception of PES and Other Drivers

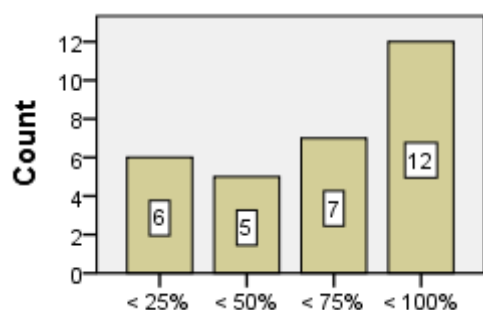


Figure 21 Percentage of farmers who are assumed to provide ES

The analyzed data has shown that the farmers in the Morogoro River watershed cannot be classified as food insecure. For drawing a general conclusion probably the population size is too small but that all of the interviewed farmers didn't face any hunger in the last 10 years can be perceived as significant. Furthermore the data has shown that there is no cultural restriction, which hampers them to adapt SLM measures. Farmers

from Ruvuma and Choma have already established terraces and as well some farmers from Tulo. The results have even shown that applying organic agriculture has high potential to increase the household income. Furthermore there is also no significance between land size and willingness to adapt SLM practices.

Figure 21 above demonstrates the perceived attractiveness of PES in the watershed. 12 respondents believe that all other farmers will be attracted. Anyhow, other farmers are not fully convinced about the attractiveness of PES for other farmers. 6 farmers assume that less than 25% of the villagers would go for such an approach. A further question was regarding payments. 21% of the interviewees don't perceive it as an appropriate measure to convince farmers in the neighbourhood to practice organic agriculture. In this context farmers were also asked if they would prefer an in-kind contribution or a direct payment. The latter was explained as training on agriculture related topics. All of the responses were the wish to have in-kind contributions.

For making the farmers' perceptions observable the author conducted in collaboration with SAT rankings to make those drivers visible which motivate them to construct terraces or to plant trees. For each of these ES a ranking was made. Therefore the farmers received for each ranking three different sized coupons which demonstrated the strength of the incentive. For the analysis the biggest had a value of 3 the medium for 2 and the smallest for 1.

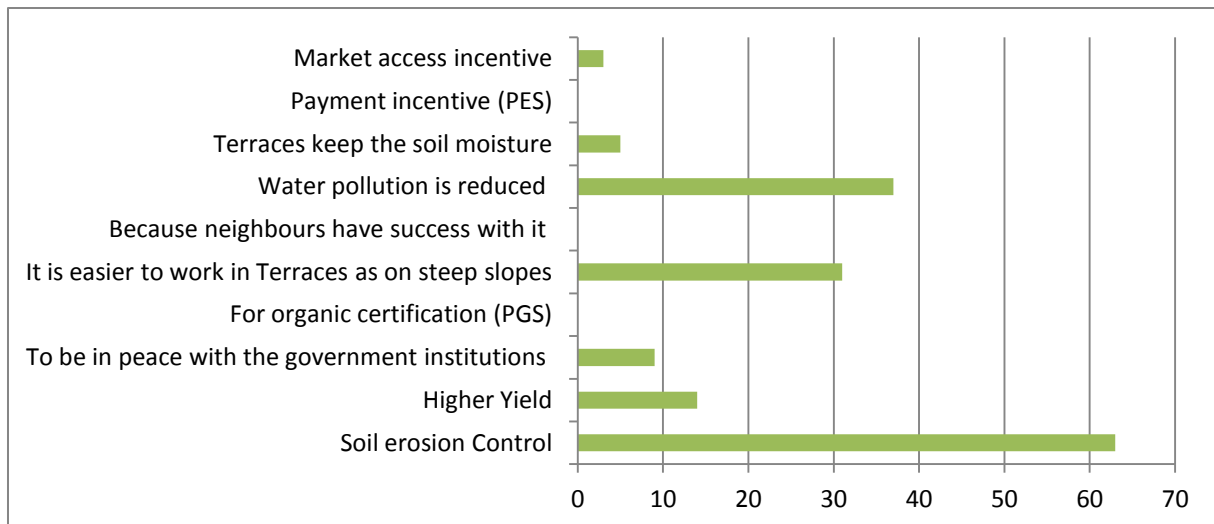


Figure 22 Farmers' incentives to build terraces

In figure 22 above the results are shown of the farmers' incentives to construct terraces. Here the greatest incentive was to use terracing as an appropriate measure against soil erosion. It received 63 points and was chosen by 26 farmers out of 27. The second one, with a ranking scale of 37 points and chosen by 23 farmers, is the benefit to reduce the sedimentation of water through terracing. Constructing terraces to make work in the slopes easier was chosen by 15 farmers and achieved 31 points. 8 farmers chose the expectation of having higher yields which became the fourth driver and was ranked with 14 points. Positioned on number five with 9 points was the wish to ease the situation with the government and MORUWASA which was important to 6 farmers. As sixth driver 2 farmers ranked with total 5 points the water efficiency of terraces. The theoretical opportunity to gain access to a farmers' market as kind of an in-kind payment was the lowest ranked driver which received in total 3 points from three farmers' coupons. None of the farmers saw important incentives in a) receiving a payment for providing ES; b) neighbours who had success with it; and c) complying to organic standards and hence to qualify for a PGS.

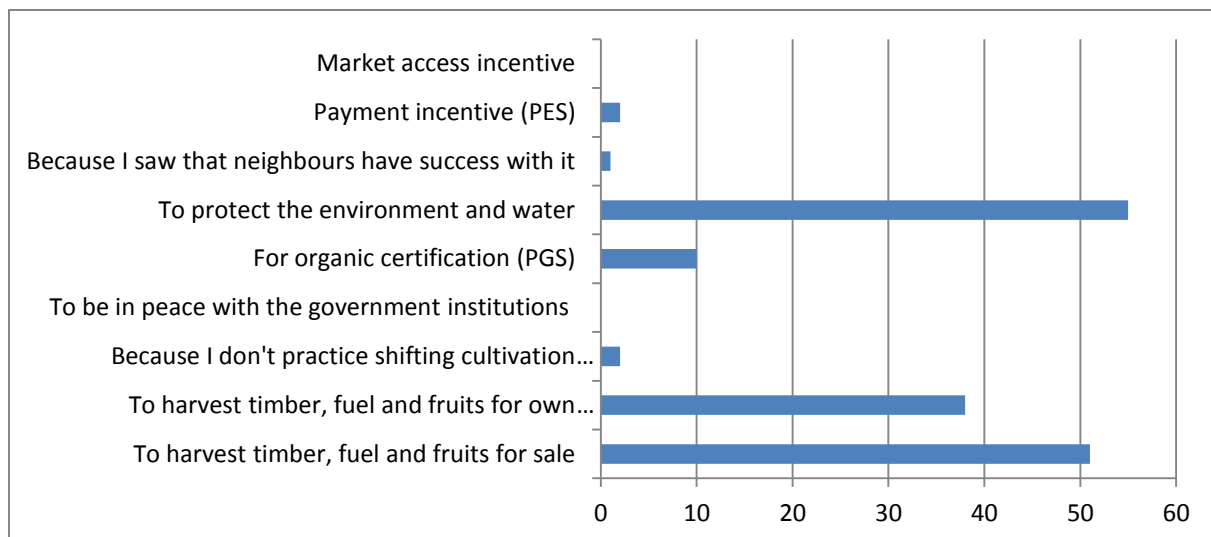


Figure 23 Farmers' incentives to plant trees

With slightly different questions the same ranking was conducted for planting on one acre 150 trees. In figure 23 above, 24 farmers chose the incentive to contribute with tree planting for environmental protection. This received in the ranking scale 55 points. More farmers (26) were driven by the motivation to sell fruits, timber and fuel wood. Anyhow, the preference strength was not as high as the former one and hence it was ranked with 51 points as number two. It was followed by having these goods as well available for self consumption, which was chosen by 21 farmers and received in total 38 points. The compliance with organic standards was important for 5 farmers and was ranked with 10 points as number four. The drivers PES and more available agricultural land for other activities through sustainable intensification were both ranked with two points each. The former received a coupon from two farmers and the latter one from one. Only one farmer indicated to be motivated by a neighbour who successfully planted trees with giving it 1 point. The incentives to have market access and to be in ease with governmental institutions were for none of the farmers of crucial importance.

5. Discussion

5.1 Opportunities for PES (First Objective)

The **first objective** was to explore opportunities of PES to minimize the negative impacts on water quality and quantity in a watershed, caused by upstream farmers.

A good opening point for discussion is to start with the difficulties which are faced by assessing the feasibility of a PES approach. According to Pretty et al. (2001: 266) the challenge starts already with the comparison of data from PES because different frameworks and methods were used to analyse them and moreover all implemented schemes have different economical, social and environmental backgrounds. Hence, it is important to deal carefully with data gained from other projects.

5.1.1 Opportunity Costs of Farmers

The challenges of assessing the feasibility were faced by the author as well. The first calculations regarding opportunity costs were made by using reference from Lopa et al. (2012) who calculated with US\$ 1.2 the labour costs of farmers in the Uluguru Mountains. By using the average exchange rate 2013 with US\$:TZS 1,551 (Oanda 2014) this amount is equal to TZS 1,903. During the presentation of the research results which had been so far analyzed from Questionnaires I & II the author introduced these labour costs to the farmers. All of them rejected this amount, and mentioned a standard daily wage of TZS 5,000 for a casual labourer who helps in the farm. This increase of 263% can significantly change the whole scenario since the opportunity costs of small scale farmers are mainly based on labour costs which have to be invested to apply ES. The vast difference in labour wage can be explained since the villages of the case study from Lopa et al. are located approximately 100 Km from Morogoro Municipal which is the closest city. Hence labour costs are assumed to be lower in the rural area compared to the Morogoro River watershed, which is actually a part of Morogoro Urban District. These findings are also helpful to understand how economical development can influence PES.

According to Ottaviani (2011: 10), by using the PES framework, the payments have to cover the whole forgone opportunities. For this paper the author used a two step approach to

calculate the opportunity costs of a farmer to adapt ES. The first one was to use 2nd reverse auctions to evaluate the opportunity costs of constructing terraces and planting trees. The second one was to find out how much time farmers invest to supplement the external inputs with internal self-made inputs, like compost, liquid fertilizers and botanical pesticides to use this information to calculate the cost-benefits. The finding, that organic agriculture creates financial benefits due to a reduction of expenditures, depends on the average loan, which is used to calculate the extra work. If this loan increases the benefits become reduced. By using the data from this research in a case of an increase of 100% (daily wage of TZS 10,000) the benefits are gone and the production of organic inputs can be handled as a classical forgone benefit which has to be added to the opportunity costs for making terraces and planting trees that, of course, also would have increased. What these facts are demonstrating is that the costs for PES, in areas where rapid development is expected, are foreseen to increase with time. Hence, in the case of Morogoro Municipal, which is expected to have one million inhabitants by 2040, as soon as the PES is implemented as cheaper it will be. This fact can be further supported with findings from a literature review made by Uthes & Matzdorf (2013: 259) which show that PES is more attractive to maintain valuable habitats instead of developing them. If it is assumed that environmental degradation increases with time if not proper measures are applied it probably comes the point where it has afterwards completely redeveloped, what would as well increase the price of these ES. According to Chee (2004: 558) it is needed to carefully consider the forgone benefits which are caused by environmental degradation. First of all they have to be treated as costs and secondly they are supposed to increase over time since it is expected that the demand for ES will increase. In Morogoro Municipal water from MORUWASA is already rationed during the dry season.

Auctions are not the only way to find a contractual agreement. There are other opportunities to create incentives for farmers to apply ES. According to Uthes and Matzdorf (2013: 259ff.) next to auctions as well payment of results, spatial targeting, combined approaches and collaborative agri-environmental measures are used by several EU members to increase the adaptation of SLM measures. In this paper the author chose the auction system to have a tool to evaluate the opportunity costs. It is probably a very cost efficient way but otherwise it is very difficult to assess them since they vary according to topography, soil fertility and other factors. Hence in such a case, it is helpful to simply assess the opportunity costs by focusing on a competitive approach for getting the best price by assuming that the farmers state their real opportunity costs (Wunder 2005: 11).

According to Haule (2000: 96) the impact of terraces to reduce soil erosion has been proven by many researchers. The effectiveness is obvious but its degree still depends on factors like topography and soil type. Tenge, De graaff & Hella (2005) state that these factors have as well impact on the productivity of the terraces.

The different opportunity costs of farmers underpin these factors. The lowest bid was TZS 70,000 and the highest bid TZS 1,000,000. The opportunity costs may also relate to the physical condition of the farmer and the plot size. Regarding the latter in this research no significance could be observed.

5.1.2 Getting the Right Price for ES

In the context of getting the right values, Wunder (2005: 11) argues that it is not necessary to make a) an accurate and expensive valuation of ES for the buyer and b) to conduct a comprehensive and time consuming economic study about the upstream population. He believes that any price which is developed through negotiation between the buyers and the sellers will be ‘the right price’.

Nevertheless to some degree information is needed that both parties are aware about what they are negotiating. Uncertainty about the effects of ES (additionality) may counterproductive in the process of agreeing on a price. For instance, if it comes to a reforestation project it is not always the case that planting more trees in a catchment is resulting into an increase of water. In some cases it has even shown that planting trees has led to a decrease of water flow. Hence it is very important to have here a clear clarification regarding environmental services and tree planting in watersheds (FAO 2006: 15). The vegetation in the summit of the Uluguru Mountains is tropical cloud forest (Lopa et al. 2012: 35), which on the contrary to other forest systems has positive influence on increased water flow of rivers in a catchment during the dry season (FAO 2006: 15). Furthermore every change in a catchment area leads to a different hydrological equilibrium, for instance when deep rooting forest vegetation is replaced for cultivating shallow rooting crops. The change of the hydrological regime is highly related to the evapotranspiration in watersheds with forest cover (Mahoo 1990: 5f.).

The data from MORUWASA Mafinga Treatment Plant was used to calculate the value of ES in the Morogoro River watershed which treats water from other catchment areas. These water sources have to a large extent similarities with the study area. The major difference which has to be considered is that Mindu dam collects the water from six rivers before it is pumped to the treatment plant. Hence two factors have to be considered: 1.) If water enters Mindu dam it has time to let the sediments sink, compared with the Morogoro River watershed where the water directly goes to the treatment plant. 2.) If the algae population is too large, the water from Mindu dam needs as well from time to time a special treatment. These costs are not assumed to occur by pumping water straight from the river. Hence these factors have to be considered carefully if this data is used as final baseline.

5.1.3 Other Findings in the Context of PES

The theoretical background of PES is provided by the Coase Theorem, which states that it is needed to have well defined property rights to have a legal starting point for negotiation (Baggethun et al. 2010: 1215). In the case of this study the property rights are acknowledged by the local government. Most of the farmers have their own land which is inherited or purchased. Only to a very small extent land is rented.

A further PES criterion is to achieve additionality. If the externality cannot be reduced the buyer is supposed to have the chance to withdraw a contract, which is for Wunder (2005: 4) a precondition of a classical PES. Since in developing countries data about the impact of ES is only to a marginal extent available and as well the intermediary (presumably a NGO) won't be interested that its target group becomes minimized, this is a crucial point which may hamper the implementation of a PES scheme from the beginning. To ease this situation the PGS system could be the solution. PGS could be, for instance, designed that the ES are in the contractual agreement of the standards. They could be developed in collaboration with the buyer. Afterwards the monitoring of the project progress would be done by the group itself which could probably reduce the costs and the stickiness to the agreement. Furthermore the PGS group could inflict soft punishments if some members don't apply the SLM measures in the stipulated way.

This is as well an important fact for a good functioning CPR management which is an example of demonstrating how potential groups can manage resources and their allocation. According to Ostrom (1997: 5), next to seven other important pillars, a CPR management becomes efficient if graduated sanctions, with the final option of exclusion, are applied. This would be in the case of the service providers an end of the contract. Results from this research indicate the cultural unity of the farmers in the Morogoro River watershed. It is an advantage to have already existing institutions which make it easier to organise the responsibilities in the group. From this point of view the 2nd reverse auction has to be questioned critically. With this approach the first preference is to contract farmers with the lowest opportunity costs, to make ES as much as possible attractive for the buyer. If this would be applied in this area existing groups would probably fall to pieces. The value of such an existing and functioning institution has to be in such a case confronted with amount of money that could be saved by choosing only the farmers with the lowest opportunity costs, an act that would actually burst the old structure.

Kusiluka et al. (2011) conclude after their conducted study about land issues in Morogoro Municipal: "that where basic traditional structures are maintained, communities have their own sophisticated ways of dealing with disputes without external interference." Working with farmer groups may be great chance since it can reduce the transaction costs for monitoring if farmers are using PGS. But on the other hand it increases the costs for information flow since Vatan (2009:1249) states: "Working through collectives reduces transaction costs, but at the potential expenses of lower overall knowledge dispersal."

Two important conditions to make hydrological services attractive to buyers are a) an institutional capability to avoid the free-rider problem; and b) the financial situation of the water consumer who should be in the position to pay (Ferraro 2011: 536). MORUWASA would be the only buyer in the Morogoro River watershed; hence free riding is not a problem that has to be considered. A challenge in the PES scenario is that MORUWASA does not have a financially strong position. Hence the author added the second scenario where the municipality joins and offers the service providers an in-kind contribution in form of access to a farmers market.

This research has so far shown that farmers were interested in having such an access. All of the interviewed farmers would agree to value such an in-kind contribution with TZS 40,000 every year. For sure such an approach would increase the knowledge about organic farming

and ES of the consumers. A similar initiative is in East Africa not existing. Nevertheless it has to be as well scrutinized carefully. According to Lampkin (2011: 46, 53) agri-environmental incentives are in the European Union (EU) already a scheme which is applied from its beginning. Among different initiatives farmers were motivated through financial incentives to convert to organic agriculture. Here it came in some cases to an overproduction what resulted in falling prices. All the organic farmers had a disadvantage even those who would have converted without receiving any payment.

What did not find space in this research was to increase the financial efficiency of PES. Here attractive measures would be to bundle the services (Ottaviani 2011: 18). Hence, in the case of the reforestation program, it would make as well sense to join the carbon market. In the UN Climate Change Conference (COP 19) in Warsaw it was announced that much more money will be invested in such projects than before. Here the objective is to mobilize US\$ 100 billion annually for developing countries by 2020 (UNFCCC 2014).

5.2 The Drivers of ES (Second Objective)

The 2nd **Objective** was to explore other drivers next to payment incentives which motivate upstream farmers in their willingness to provide Environmental Services (ES)

Agriculture is multifunctional and hence it cannot be sufficiently explained from one side. Its diverse and dynamic production systems are next to economical and environmental factors embedded in political, social and cultural environment, hence the complexity of this system is vast (IAASTD 2009:12). A successful approach is to implement PES with support from the community, hence motivational aspects are important and the people have to be in line with the planned activities. In a recent FAO (2011: 5) publication it is mentioned that in the new generation of PES empowered community and certification schemes have to be pivotal to assure success.

The author uses a triangulation method to combine qualitative and quantitative data for analysing the results. By being aware about the interconnectedness of different factors the author decided to analyze the data within the framework of Jones (2002: 1608) which explains not only the drivers but as well the needed preconditions of small scale farmers to

adapt new technologies. Jones separates them in four fields which are perception, knowledge, incentive and capability.

5.2.1 Perception

Findings of this research have shown that farmers are aware about environmental problems. They perceive a reduction in water flow and bring it in relation with deforestation. Furthermore they perceive change in their environment. For instance they experience water pollution and reduction of water flow which they bring in relation with traditional and conventional agricultural practices. The assessment of the drivers which motivate the farmers to adapt SLM practices has shown that soil conservation measures and a reduction of water pollution are very important to farmers. According to the ranking scale they are the farmers' major drivers to construct terraces. Jones (1996: 195) assessed the impact and understanding of soil erosion in the Uluguru Mountains in Mgeta and found out that soil erosion shows highest significance when it comes to decreased yield. Since climate and topography are similar between Mgeta and the Morogoro River watershed it can be assumed that these problems are the same. This would explain why this environmental issue has such a big importance to them. Interesting is that the water quality is also for many upstream farmers perceived as a problem. Here it would be interesting to know if the upstream farmers should again be separated into up and downstream population or if the water pollution is for all the altitudes the same problem. A conclusion is that farmers who are facing the same problems like the downstream population are probably more willing to accept.

The relation between poverty and environmental degradation can turn into a 'negative reinforcing feedback-loop' where people become poor due to environmental degradation. Because the farmers don't have money to buy needed external inputs to overcome this situation they become even more dependent on the scarce natural resources which leads to further degradation (FAO 2011: 2). The results of the research have shown that the farmers cannot be perceived as food insecure since over a period of 10 years none of them was facing food shortage. Moreover they consume in average almost 5 days a week vegetables. They hold in average 3.5 acres land and most of them have access to water. Nevertheless the pressure on land exists since the population of the Luguru is growing and agricultural land cannot be further expanded. Hence, according to Mahoo (1990: 1) former agricultural

practices, like slash and burn, are not anymore conducive since farmers are no longer able to leave their plots for a long time fallow because of increased population density. Hence alternatives like terracing and soil fertility management are appreciated. All of the interviewed farmers see more benefits in these technologies than disadvantages. The farmers are aware that organic agriculture reduces the pressure on land, since the long fallow periods practiced in slash and burn agriculture are not anymore needed.

5.2.2 Knowledge

According to Lampkin (2011: 62) education, facilitation, participatory research and other extension methods are an essential part of enabling farmers to adapt SLM practices. It is a classical regulatory tool if applied by the governmental extension service. In developing countries knowledge about SLM is also disseminated through NGOs who are working in the field of agriculture. According to Pretty, Toulmin & William (2011: 8) sustainable intensification in agriculture are complex measures which are knowledge and skills demanding. If applied the objective is that the application of these technologies, which depend in the beginning on increased efforts, lead to net benefits when it comes to productivity. Here it is as well important to assure farmers that they will find markets for their production increase.

During the literature review the author has realized that the efforts in appropriate trainings are not well documented in several PES projects. The case study Costa Rica in chapter 2.4.1, nevertheless, gives some insights in this regard. Cole (2010: 15) has shown that the governmental extension officers were not in the situation to give the wished advice regarding forestry improvements. The application rate of farmers, which were trained by a local NGO, was higher. Such organisations have also the potential to go beyond the production and assist farmers as well in market development.

The best scenario in such a case would be that NGOs are not only focusing on capacity building of farmers but as well to introduce extension officers to organic agriculture methods. In Tanzania, according to Maro (2013), only a few have knowledge about such technologies since the syllabuses of agricultural training colleges mostly contain only conventional measures.

Like discussed in the next chapter, social capital is a very important criteria to have the security in a group which will later give people the confidence to participate in collective activities. According to Pretty, Toulmin & William (2011: 16f.) social capital is strengthened through participatory extension methods like the Farmer Field School (FFS) approach where farmers are organized in groups. The authors mention as well that: “direct farm level links between researchers, extensionists and farmers are a prerequisite for technology innovation and adaptation.”

SAT's approach is based on demonstration plots which are cultivated by farmer groups. Here farmers are visited over a period of 1 up to 2 years every week by SAT facilitators to train them in different organic agriculture methods. The organisation was launched in 2011 and in the beginning it was only specialized in vegetable and crop production. Nowadays, through getting more experience in this field SAT has broadened its focus on agroforestry and livestock keeping which are further crucial elements to intensify the production in a sustainable way. Farmers are motivated to try their knowledge first in their kitchen gardens¹³ before they convert their whole production. Choma and Ruvuma are both trained by using this approach. On the contrary, farmers from Tulo were trained from Ruvuma farmers in the course of a farmer to farmer training which was organised and supervised by SAT. The adaptation rate of constructing terraces is almost 100% (Maro 2013).

Not all activities to encourage farmers to adapt SLM in the Uluguru Mountains were successful. Ruheza et al. (2012: 241) report broad efforts which were accomplished to introduce agroforestry methods to small scale farmers in the Uluguru Mountains. Aim was to help them to deal with land degradation. The authors conclude that “its rate of adoption has been disappointing regardless of farmers being aware of the significances of the methods and practices addressing the problem of land degradation.” This indicates that knowledge alone is not enough that SLM measures are adapted by farmers.

Nevertheless it is very important. Results of the research have shown that all the 30 farmers were interested in receiving further trainings instead of payment for constructing terraces and planting trees. This demonstrates the awareness of farmers about the need to increase their knowledge, which is a precondition to change their farming situation. Interesting for further discussion is how knowledge diffusion takes place in a village where some farmers already

¹³ Smaller plots which are not used for commercial production of vegetables, which are normally close to their houses (Maro 2013)

successfully apply organic agriculture. Like further explained in the next chapter, the effect of being motivated to apply organic agriculture by seeing the success of neighbours was not a significant driver.

5.2.3 Incentive

For evaluating the incentives of the farmers, participatory rankings were applied. They showed that environmental concerns are the most driving incentives to practice technologies which create ES. It can be assumed that an intact nature is also strongly related with a functioning agricultural system. Coming from this point to productivity the environmental incentives may bear as well economical security. Economical incentives are driving factors which show a high significance in ranking the motivations to plant trees. On the contrary the highest incentive to create terraces was to avoid soil erosion. Probably this is because profitable forest and orchard systems are not yet introduced and hence planting trees seems to be promising to complement the agriculture activities. Moreover environmental protection is also a precondition to calm down the conflict with the Government.

Furthermore it has to be scrutinized if the questions were chosen in a way that one is not excluding the other. For instance the expectation of having higher yield on one side and the successful neighbour on the other side; both are definitely drivers but the higher yield does not depend on a neighbour which actually has this dependency in the other direction to appear attractive as possible income generation. Nevertheless it can be stated that the payment and the in-kind contribution for ES do not have such a counterpart. Both of them do not show any significance. Hence it can be concluded that in the case of the farmers in the Morogoro River watershed, who are already in touch with SLM measures payments are not a major driver for providing ES.

The use of the participatory ranking further draws up a list of questions. How do farmers present themselves as a group? Are farmers using participatory methods more biased to show interest in something which is good for the community? And how is the interrelation between the different incentives?

If there is no incentive to handle a scarce resource efficiently the farmers may tend to overuse, or to use it in a way that somebody else is affected through caused externalities (Hanley

1991:5). For Jones (2002: 1609) an incentive is created if SLM fosters the social networks. Also Firmian et al. (2011: 42) agree in this context and mention that community cohesion is very important to achieve sustainability in terms of long term application. Results of this research have shown a tremendous increase in social activities since the farmers joined the groups. All of the questioned farmers experience the group work predominantly positive.

The majority of the upstream population perceives pressure from the government. All were aware that the government had already resettled people from the Uluguru Mountains and they knew its concerns regarding deforestation and soil erosion. In the ranking lists of the farmers' drivers to use terraces, the incentive to calm down the situation with the government was only selected by 6 out of 27 farmers and is the fifth significant driver out of seven. According to Kusiluka et al. (2011: 71) the government was involved in environmental projects in the Uluguru Mountains. By conducting interviews villagers in Mgambazi sub-ward reported about the pressure they receive from the government and that this is a reason why it is important to adapt SLM. Nevertheless, the adoption rate in this area was low; this indicates that the pressure is not the significant driver.

According to Proctor, Köllner & Lukasiewicz (2009: 27) it is not always the case that PES results into limited resource use. On the contrary, if the farmers shift to integrated agriculture approaches it can be as well asset-building since for instance trees are planted which can be used later on. In the case of the farmers in the Morogoro River watershed the author concludes that farmers gain benefits by applying organic agriculture measures. For instance, by using soil improving measures, there is no need to move every 3-4 years to another plot. Such a sustainable intensification of production would create the benefit that farmers can cultivate vegetables on one plot and the other one could be used for reforestation. This is theoretically possible since the farmers have in average 3.4 acres of land for cultivation. Farmers also positively responded when asked if they would be interested to use at least one acre of their land for planting trees. Here it can be concluded that a successful intensification lowers the risk aversion of farmers since they depend on less land to produce vegetables for their livelihoods. Hence they have land to experiment new technologies. Many of the farmers added that first training on tree management should be conducted which further highlights the need of knowledge to successfully apply SLM (see chapter 5.2.2).

According to Pretty et al. (2008: 178) many farmers in Europe converted to organic production because of expecting higher prices. Hence their motivation cannot be defined as an

ideological one. Nevertheless after conversion some of them start internalizing environmental values because of sharing ideas and experiences with other farmers and through contact with customers. Hence organic certification can be described as an institution that can create impact on farmers' values. For the farmers in the Morogoro River watershed consumer perception about organic agriculture has importance and motivates them to practice.

The price premiums are motivating farmers to adapt environmentally friendly practices. Nevertheless, commonly they are only a small part of the income and hence they can be perceived as unspecific (Scherr, Milder & Inbar 2007: 380). The results in the research underpin this statement, since most of the farmers don't see a big motivation in adapting SLM practices to become certified. None of the farmers gave their coupons for organic certification during the terrace ranking. On the contrary the ranking of the drivers to plant trees showed significance; here 5 farmers gave in total 10 points. Three of them were from Ruvuma and 2 farmers from Tulo.

Referring to the above discussed results the objective to become a PGS farmer goes anyhow hand in hand with adapting SLM practices since they are preconditions to become certified. Hence, if someone does not have any special benefit from planting trees at least she can apply for such a certification scheme. Hence a PGS has an advantage since it leads to compliance next to the PES agreement to provide the services like stipulated. It can be expected that it reduces the monitoring costs of PES. Since a PGS is developed by the community it is established by considering social and cultural perceptions and norms of the ES providers which according to Boettke, Coyne and Leeson (2008) could be key to create an institutional stickiness¹⁴. Hence the PES scheme could be built on a solid foundation. The PGS could be also established in collaboration with other stakeholders like MORUWASA for instance (Maro 2013).

5.2.4 Capability

The famers as landowners are acknowledged by the local authorities which is furthermore acknowledged by the government. Hence a PES can be applied. Nevertheless it has to be

¹⁴ Institutional Stickiness is a term used by Boettke, Coyne and Leeson (2008) who showed evidence that a new introduced institution which contain to extent cultural and social values/norms is more accepted/effective compared to others.

mentioned that a plot with a title deed under the Tanzania Land Act would allow the owner to use her land as collateral for a loan from the bank. In the context of organic production this may not be a reason which is hampering its application since it mainly depends on internal inputs. These plenty available shrubs, leaves and grasses are from the farmers processed to compost or botanical pesticides and supplement for bought input materials. Caution is needed if it comes to a conversion of many farmers at the same time. According to the group discussion with the farmers, many of them still collect their input materials as well outside their farm on the wayside to the village. A possible scenario in this regard could be an overuse of these materials. Hence livestock keeping has to be an important component of facilitation how it is as well described in the Uluguru case study from Kawayu, Sallu, & Paavola (2013: 26).

The farmers have the right to plant trees and hence the expectation from Ulvila (1995: 46) that farmers are not willing to plant trees due to the cultural institutions of ownership of land can be falsified in the Morogoro River watershed. All the farmers are interested in tree planting and many of them have planted already several trees in their farms. Furthermore the assumption of Kongola (2000: 73), that farmers are not concerned in terracing because of the old experiences of the ULUS project during the colonial time, could not show any significance by the interviewed farmers. Beside the farmers from Tulo, who just received recently their first trainings, all of them constructed already terraces and the whole research population was interested in constructing terraces in the future.

5.3 Answers to the Research Questions

The first research question

Does PES create a win-win situation between upstream and downstream population, as the avoided externalities are priced and farmers paid?

The scenarios show that the economical significance to have a win-win situation between farmers and the downstream buyer MORUWASA is very high.

The externalities which are caused by the upstream population are calculated in two scenarios. In the first scenario externalities are calculated which are caused by water pollution and sedimentation. Here the assumption was that erosion can be minimized by the use of terraces

and chemical pollution is reduced through supplementing industrial fertilizers and pesticides. In the second scenario the water quality is complemented with water quantity, by the assumption that organic agriculture needs less water for irrigation and that reforestation increases water flow of the Morogoro River. In the first scenario an amount of TZS 16,163,357 could be saved by a 34% reduction of treatment costs during the yearly 45 days high peak pollution in the rainy season. In the second scenario the amount from the first scenario is added up with TZS 16,095,536 which is revenue for MORUWASA through the sale of an additional amount of water of 250m³/day for 90 days during the dry season.

According to the results of the 2nd reverse auction, by contracting farmers with opportunity costs below TZS 200,000 for constructing 1 acre terraces, a one-off payment of TZS 200,000 could cover 74% of the total households in the four villages Ruvuma, Tulo, Choma and Kisosa. In the case of contracting farmers with opportunity costs below TZS 150,000 for planting 150 trees on one acre, a total payment of TZS 150,000 would cover an area of 61% of the total households in the four villages. The total amount of payments for terraces and planting trees is equal to TZS 66,820,500.

By using the first scenario without considering a possible increase in water quantity the investment in PES would pay off in the fifth year by assuming that the additionality has been achieved from the first day of this calculation. In the case of the second scenario the ES would pay off under the same conditions already at the end of the second year.

The payments for these services are not foreseen to be renewed after ending the contract. This is because organic agriculture increases the household income level through supplementing former bought agricultural inputs with internal inputs like compost and botanical pesticides and due to increased productivity.

By assuming that MORUWASA is not in the financial position to handle the costs a second payment scenario was made. Here MORUWASA teams up with the Morogoro Municipality which would make an in-kind contribution by establishing an organic farmers market in town. ES providers would have 5 years free access and this would be valued as an in-kind contribution of TZS 200,000 from them. Hence costs for MORUWASA could be reduced by 57%.

The second research question

Are the payments the major incentives for farmers to provide environmental services?

The second research question has to be answered with the 0-hypothesis. The payments are not the major incentive for the farmers to provide environmental services.

The results have shown that the main drivers of farmers are on one hand environmental aspects which are soil erosion and water pollution and on the other hand financial reasons like higher yield, increasing income through forestry products and their use for home consumption. The author concludes that there is an interrelation between environmental and economical aspects since having the former one in balance, means to a farmer, to maximise the production in a sustainable way. The farmers have good knowledge about environmental destruction and its effects. They are furthermore aware, and have to a large extent already experienced that organic agriculture mitigates the impact on the environment.

The farmers are also aware about the government concern regarding the Morogoro River watershed. This was demonstrated by data from the questionnaire and from results of ranking the drivers for making terraces (6 farmers/9 points). Hence it can be concluded that the motivation to ease the situation with the government is a driver with low significance.

The payment incentive during ranking the drivers for making a terrace was for all of the farmers not of any significance. During ranking the drivers for planting trees two farmers ranked PES as their third preference.

An applied PES scheme in the Morogoro River watershed, by using organic agriculture as ES, would create opportunity costs only because of the labour intensive conversion period, and in some cases due to reduction of productivity which can occur in the first year. Hence it can be concluded that the farmers are self-confident regarding their financial situation. This was further demonstrated by the fact that all farmers would prefer to receive further training as in-kind contribution instead of a payment.

5.4 Policy Opportunities

- The watershed is small; hence additionality can be easily assessed. After a successful implementation this PES scheme can be scaled out in further watersheds in the Uluguru Mountains, which discharge water into Mindu dam.
- The conflict with the upstream farmers could be solved.
- PES schemes have to be implemented in a legal framework; hence this PES scheme could be monitored through the Water Basin Office in collaboration with other local institutions from private and public sector.
- This project would raise the awareness about organic agriculture among consumers and on policy level.
- In a growing economy PES schemes tend to become more expensive since the opportunity costs of farmers are expected to increase.

5.5 Directions for Further Research

There is already a lot of research conducted to gain better understanding about PES schemes. During intensive literature review the author found out that PES is not anymore a strict economical theory. Further aspects achieve more and more attention.

An important field for further research is to explore innovative PES approaches. The author demonstrated already to some extent that PGS has a great potential to be combined with PES. Here the focus could, be laid on monitoring costs. If a PGS would be designed by farmers and ES buyers the compliance costs would be probably minimized.

5.6 Conclusion

The Morogoro River watershed below the intake of the water treatment plant of MORUWASA is mainly populated by small scale farmers who live in this area already for generations. Morogoro is a fast growing city and has a permanent increase in water demand for domestic use. The agricultural practices from the upstream farmers have negative impact on water quality and quantity. According to the Coase Theorem the problem of externalities can be solved by the market if the polluter and the affected party can bargain exclusive of cost

over the allocation of resources and without facing transaction costs. In the case of this research the potential buyer is MORUWASA which is the water supplier for Morogoro City. The results have shown that the investment in ES would pay off if the ES results into the stipulated additionality.

In developing countries poverty is often caused by a broken linkage between human being and nature (FAO 2011:1). In the case of the upstream farmers the rapture was created because of shifting to new agricultural practices. This shift was made because of the increasing population density. The new practices which are mainly conventional technologies which highly depend on external inputs like fertilizers and pesticides have profitability only on a short term. As soon as the sensitive soil is depleted or eroded the agricultural businesses turn into diseconomies of scales. Organic agriculture is in such a situation the better solution and can increase the yields in a sustainable way. The problem is that it is knowledge intensive and demands skills. Some farmers in this watershed have experienced its potential.

The research objectives were on one hand to analyze the economical feasibility of a possible PES scheme in this watershed and on the other hand to gain information from farmers who already have made experiences with organic methods. The farmers were asked if they would increase their activities to conserve soil and to plant further trees. All of them are interested but the main driver is not the PES. Nevertheless it cannot be assumed that all other farmers who do not have experiences would have responded in the same way. By taking this assumption into account it can be concluded that if other farmers would follow because of payment incentives, many of them, after finalizing the contract, would continue with providing ES since it has been proven to pay off.

According to the already successful adaptation of organic agriculture it can be concluded that this PES scheme would only need a one off payment since afterwards farmers would have even greater benefit than before. The payment would cover the time which farmers need to plant trees and to construct terraces. By using an alternative payment scenario which is in the case of this research an in-kind contribution from the Municipality of Morogoro the costs for MORUWASA could be reduced by more than 57%.

6. Abbreviations

BWB	Basin Water Board
CBA	Cost Benefit Analysis
CPR	Common Pool Resources
EPWS	Equitable Payments for Watershed Services
ES	Ecological Services
DAWASCO	Dar es Salaam Water and Sewerage Corporation
FAO	Food and Agriculture Organisation of the United Nations
FFS	Farmer Field School
FONAFIFO	National Forest Finance Fund (Costa Rica)
GEF	Global Environment Facility
ICDP	Integrated Conservation and Development Project
IFOAM	International Federation of Organic Agriculture Movements
LGA	Local Government Authority
MORUWASA	Morogoro Water and Sewage Authority
NEMC	National Environmental Management Council
NGO	Non Government Organisation
NTU	Nephelometric Turbidity Units
PAS	Pagos por Servicios Ambientales (PES Project in Costa Rica)
PES	Payment for Ecological Services
PWS	Payment for Watershed Services
PGS	Participatory Guarantee System
PRA	Participatory Rural Appraisal
SAT	Sustainable Agriculture Tanzania
SLM	Sustainable Land Management
SSA	Sub-Saharan Africa
TZS	Tanzanian Schilling
ULUS	Uluguru Land Usage Scheme
WTA	Willingness to Accept
WTP	Willingness to Pay
WWF	World Wildlife Fund

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Appendix 1 First Questionnaire

Questionnaire	Name:	No.
1.1	Age:	Sex:
1.3		
1.2	Practicing OA for how many years :	Children:
1.4		

2 TENURE

2.1	How much land do you own?	Total Acres	Total Plots
2.2	How much land have you inherited?	Total Acres	Total Plots
2.3	How much land have you bought?	Total Acres	Total Plots
2.4	Is the land you own under the Village Land Act?	Yes	No
2.5	Do you have any title deeds?	Total Acres	Total Plots
2.6	How much land do you rent?	Total Acres	Total Plots
2.7	Are you allowed to plant trees on the plot you rent?	Yes	No
2.8	Are you allowed to plant trees on the plot you own?	Yes	No
2.9	How much land would you like to have under terraces?	Total Acres	Total Plots
2.10	How steep is your average land?	flatter as 30%	steeper as 30%

3 OPPORTUNITY COSTS

3.1	For how many shilling would you build a terrace (one acre) for somebody else?	TZS
3.2	How much labour time has to be spent for terracing a one acre plot?	hours
3.3	How much labour has to be spent to produce compost to fertilize a one acre plot?	hours
3.4	How many times do you prepare compost during one crop cycle?	application

3.5	How much labour time has to be spent to produce plant tea to fertilize a one acre plot?	hours		
3.6	How many times do you need to prepare plant tea during one cropping season?	application		
3.5	How much time has to be spent to produce biological pesticides (one acre plot/one cropping season)?	hours		
3.6	How much are the costs to fertilize an acre with chemical fertilizers?	TZS		
3.7	How much are the costs to fight pests and diseases with chemicals (one acre/cropping season)?	TZS		
3.8	How much time does it need to plant 10 trees (1 acre has 144 trees if planted 5m*5m)?	hours		
3.9	How much are the costs to cultivate one acre with trees (144 trees 5m*5m)?	TZS		
3.10	Are you interested to sell your products directly to customers at the local market?	TZS		
3.11	How much money would you pay to get such a permit for one year?	TZS		
3.12	Does it need more hours work during organic conversion? If yes how many hours?	yes	no	time
3.13	Does the farm work reduce after successful conversion?	yes	no	
3.14	After how many years the work hours which are used per acre start to reduce?	years		
3.15	If the farm work is reducing, explain why?:			
3.16	After building a terrace, how many years does it need till the soil fertility has reached standard (kama kawa) level for production?	years		
3.17	How many years does it need after building a terrace till the soil fertility has reached optimum (bomba) level for production?	years		

4 FARMING PRACTICES

4.1	After how many years do you shift to another plot, because of low soil fertility (conventional production)?	Years		
4.2	If yes, for how many years do you leave the plot fallow?	Years		
4.3	After how many years do you change your plot (organic production)?	Years		
4.4	If yes, for how many years do you leave the plot fallow?	Years		
4.5	Does organic agriculture reduce the pressure on land? (for instance no need to move to another plot since soil fertility is not decreasing)	yes	no	

4.6	Do you think organic farming can positively change your life?	yes	no	
4.7	Are you aware about soil conservation?	yes	no	
4.8	Are you aware about deforestation?	yes	no	
4.10	Could you imagine planting (fruit) trees on these plots close to the forest, since you don't need any more so much land for cultivation?	yes	no	
4.11	If no, would it change your decision if you would get a title (MKURUBITA) for your plot?	yes	no	
4.12	Have you received farming Voucher (governmental fertilizer subsidy program)?	yes	no	
4.13	If yes, do you use it?	yes	no	
4.14	Do you face environmental problems caused by human beings?, if yes which	yes	no	
4.15	What are the benefits from terraces?			
4.16	What are the disadvantages of having terraces?			
4.17	Regarding terraces what is for a farmer bigger: the advantages or the disadvantages	advantages	disadvantages	same
4.18	How many trees do you own ?	fruit trees:	other trees:	
4.19	What are the biggest challenges regarding planting trees: (Two major challenges)			

5. SOCIOECONOMIC STATUS

5.1	How did you define yourself compared with other villagers before OA production organic producers)	(only	very poor	poor	normal	rich	very rich
5.2	How would you define yourself compared with other villagers		very poor	poor	normal	rich	very rich

5.3	If there is a change why (only organic producers):					
5.4	How was you engaged in group/community work before you started practicing OA (compared with other villagers)(only organic producers)	very little	little	normal	big	very big
5.5	How much are you engaged in group/community work (compared with other villagers)	very little	little	normal	big	very big
5.6	Has the engagement in group /community work influenced your life more positively or more negatively?	believe postively		believe negatively		
5.7	Have you better market access since organic agriculture conversion?			yes	no	
5.8	Creates tourism opportunities for you?			yes	no	
5.9	Do you benefit already from tourism			yes	no	
5.10	How many days a week do you eat vegetables?			days		
5.11	Have you faced food insecurity in the last 10 years, if yes which years and why?					

6. CONSUMER

6.1	Are the vegetable buyers aware about the nature benefits?	no	few	many
6.2	If yes, is this encouraging for you to produce organic agriculture?		yes	no
6.3	Are the vegetable buyers aware about the health benefits?	no	few	many
6.4	If yes, is this encouraging for you to produce organic agriculture?		yes	no

7. ENVIRONMENTAL PERCEPTION & PAYMENTS FOR ENVIRONMENTAL SERVICES

7.1	Are there negative side effects of conventional farming regarding water quality	I belief	I don't belief
7.2	Are there negative side effects of conventional farming regarding water quantity	I belief	I don't belief

7.3	Are there negative side effects for deforestation regarding water quantity	I belief		I don't belief		
7.4	Does an organic farmer depend on timber from the forest like other farmers				yes	no
7.5	if not, why?					
7.6	Are you afraid that MORUWASA is not happy that agriculture takes place in the mountains.				yes	no
7.7	Are you afraid that Government forces you to resettle?				yes	no
7.8	How do you believe does the Government perceive organic agriculture	negative	neutral	positive		
7.9	Do you think that villagers would convert to OA if MORUWASA would pay them to build terraces?				yes	no
7.10	How many of them would convert:	< 25%	< 50%	< 75%	< 100%	
7.11	Would you prefer an in-Kind contribution like trainings or would you prefer cash?				In-Kind	Cash
7.12	Have been initiatives from the government in this water catchment in the last 5 years?				yes	no
7.13	Have you heard that in the old days British rulers were forcing people to build terraces during colonialism?				yes	no

Appendix 2 Second Questionnaire

Name: _____

No: _____

A	Compost production for 1/2 acre plot	hour/s
	hour/s needed to collect dry material	
	hour/s needed to collect green material	
	hour/s needed to collect manure	
	hour/s needed to chop the material and to make a pile	
	hour/s needed to turn the compost (3 times)	
	Total	

B	Plant tea production for 1/2 acre plot	hour/s
	hour/s needed to collect green material	
	hour/s needed to chop the material	
	how many times a plant tea is produced during four months	
	Total	

C	Biological Pesticides production for 1/2 acre plot	hour/s
	hour/s needed to collect botanical plants	
	hour/s needed to prepare (e.g. soak or dry)	
	how many times bio-pesticides are produced during four months	
	Total	

D WATER CONSUMPTION

	Does organic agriculture needs less water for irrigation, if yes for how many percent OA production needs less water?						
d1		same	10%	20%	30%	40%	50%
d2	How many times do you irrigate an organic vegetable plot (Sukuma) a week?						Times
d3	How many times do you irrigate a conventional vegetable plot (Sukuma) a week?						Times

E	FERTILIZER USE		
e1	Do you still use fertilizers from shops?	yes	no
e2	Do you still use pesticides from shops?	yes	no
e3	Do you still use Vocha for buying fertilizer and pesticides?	yes	no

F	OA PRODUCTIVITY COMPARED WITH CONVENTIONAL FARMING											First year more
	less first year											
f1	-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%	40%	50%	

f2		less			second year				more		
		-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%	40%
f3	only Ruvuma	less			third year				more		
		-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%	40%

No.:

H PRACTICES

h1	Did you slash and burn before using organic methods?	yes	no
h2	Do you still practice slash and burn practices?	yes	no

h3	How many acres do you cultivate during a year?	acres
h4	How many acres do you cultivate during dry season?	acres
h5	How many acres do you cultivate during rainy season?	acres

h6	During which months do you irrigate how many plots?	
	Month	Acres
	January	
	February	
	March	
	April	
	May	
	June	
	July	
	August	
	September	
	October	
	November	
	December	

h7	Is it possible with enough compost, manure and practicing crop rotation to produce on one plot without leaving it fallow (permanent yearly crop production)?	yes	no
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Appendix 3 Third Questionnaire

Name: _____

Village: _____

- 1 You told me already how much you would pay for having access to a market.
If it comes to a payment would you agree that we count yearly TZS 40.000/= (that is the average of all bids) as in-kind contribution for duration of five years by offering you an access to an organic farmer market in town.

Yes	No
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- 2 Where do you sell your products? (rank them: where you sell most products is equal to 1)

☐	☐	Morogoro Soko
☐	☐	Morogoro at road sides
☐	☐	Restaurants
☐	☐	Directly to customers
☐	☐	Dar es Salaam
☐	☐	Others reasons _____

- 3 What is your major reason to want access to an organic market in town.

Appendix 4 Abstract

During the last decade Payments for Environmental Services (PES) have become more and more popular in developing countries. With this approach it is possible to give externalities a value and to bargain them. Hence, if seller and buyer come to an agreement, it can solve the market failure. In the case of the mountain farmers from Morogoro Municipal, who live in an important watershed, it is clear that their choice of agricultural practices has influence on the downstream population, who depends on water in terms of quality and quantity. In the context of the externalities two scenarios are developed. In the first one the value of the Environmental Service (ES) is calculated by assuming that through the use of terraces and reforestation a reduction of the chemical pollution and sedimentation can be achieved. This would result into a 34% decrease of treatment costs for the Morogoro Urban Water and Sewage Authority (MORUWASA). In the second scenario next to the water quality also the water quantity is increased during the dry season which would create further income for MORUWASA, since water shortages are very common in this period. The research includes as well two scenarios of payments. In the first one MORUWASA execute all the costs. In the second one the Municipality of Morogoro offers an in-kind contribution which is 5 years free access to an organic farmers' market access in town. This in-kind contribution would reduce the costs for MORUWASA up to 57%. The opportunity costs of the farmers were calculated by conducting a 2nd reverse auction. Moreover a cost benefit analysis was conducted to assess the difference between conventional farming inputs and organic inputs, which showed that it is a benefit for farmers using the latter. The second part of the research was to analyse data which was gained through three semi-structured questionnaires, a group discussion and a participatory ranking. By using purposive sampling in total 30 farmers out from three villages were interviewed, who all had different degrees of experience in organic agriculture. By placing the multifunctionality in the centre, a triangulation method was used to analyse quantitative and qualitative data from economical, ecological and environmental factors. The analysed data showed that payments are not the significant drivers for these farmers to provide ES. Incentives for farmers to apply organic agriculture by using a Participatory Guarantee System (PGS), which implies as well planting trees and constructing terraces, are economical and environmental reasons. Moreover there was significance that farmers want to ease the situation with the government, which aims to conserve the watershed. The results indicate that the probability is high that farmers will continue providing ES after the end of the contract since organic agriculture has many benefits to them.

Appendix 5 Zusammenfassung

In den letzten Jahren gewannen *Payments for Environmental Services* (PES) in Entwicklungsländern zunehmend an Bedeutung. Mit diesem Konzept ist es möglich externen Effekten, welche durch Umweltverschmutzung und -zerstörung verursacht worden sind, in Geldwerte einzuteilen, um damit zu handeln. Kommt es hierbei zwischen Käufer und Verkäufer zu einer Abmachung, kann das Problem vom Markt selbst gelöst werden. In dieser Forschung sind die potenziellen Verkäufer die Bauern und Bäuerinnen des hydrologischen Einzugsgebiets vom Morogoro-Fluss. Aufgrund nichtnachhaltiger Anbaumethoden verursachen sie Kosten für die *Morogoro Urban Water and Sanitation Authority* (MORUWASA), welche mit diesem Fluss über 20% der Stadt Morogoro mit Trinkwasser versorgt. Für die Veranschaulichung der externen Effekte sind zwei Szenarien entwickelt worden. Im Ersten werden die *Environmental Services* (ES) so berechnet, dass aufgrund von Terrassenbau und Aufforstung die Wasserverschmutzung bei starkem Regen um 34% Prozent reduziert werden kann. Im zweiten Szenario wird folgernd darauf angenommen, dass die Wassermenge des Flusses in der Trockenzeit ansteigt. Diesbezüglich sind zwei Bezahlungsvarianten ausgearbeitet worden. In der Ersten werden die Kosten für die ES alleine von MORUWASA getragen. Im zweiten Fall kommt eine Eigenleistung von der Stadt Morogoro hinzu, welche die Kosten für MORUWASA um 57% senkt. Die Opportunitätskosten der Bauern und Bäuerinnen wurden mit den *2nd Reverse Auctions* ermittelt. Zusätzlich ist eine Kosten-Nutzenrechnung erstellt worden, in welcher konventionelle Inputmittel den biologischen gegenübergestellt worden sind. Die erhobenen Daten zeigen einen größeren Nutzen der Letzteren. Im zweiten Teil der Arbeit wurden 30 Bauern und Bäuerinnen interviewt, welche bereits Erfahrungen im Bio-Landbau gesammelt haben. Ausgehend von der Multifunktionalität der Landwirtschaft wurde die Triangulation als Forschungsstrategie gewählt, um qualitative und quantitative Daten aus ökologischen, ökonomischen und sozialen Bereichen auszuwerten. Die Ergebnisse weisen darauf hin, dass bei den Befragten Umweltschutz und ökonomische Vorteile eine größere Gewichtung haben, als die Bezahlung um den Service weiterzuführen. Ebenso hat die Analyse gezeigt, dass die Motivation besteht, einen Konsens mit der Regierung zu finden, welche daran interessiert ist das Gebiet zu konservieren. Zusammengefasst zeigt sich, dass bei entsprechender Bezahlung für ES, die Wahrscheinlichkeit hoch ist, dass deren Anwendung nach Beendigung des Vertrages und damit deren Bezahlung unentgeltlich weitergeführt wird. Daraus folgt, dass biologische Landwirtschaft einen größeren Nutzen gegenüber der konventionellen aufweist.

Appendix 6 Curriculum Vitae

Curriculum Vitae (CV) Alexander Wostry

Personal Information:

Surname:	Wostry
First name:	Alexander
Sex:	Male
Marital status:	Married
Date of birth:	3 rd November 1978

Education Background:

1994 – 1998	Apprentice ship mechanical engineering (Co. Lingenhoele)
2003 – 2004	Certified tutor for mentally handicapped people
2004 – 2006	Evening classes for mature entry to the university
2006 – Present	Studying International Development (University of Vienna)
2007 – 2008	Swahili course (African Science – University of Vienna)
2009 – 2011	Studying Agriculture (University of Natural Resources and Applied Life Science - Vienna)

Work Experience:

1994 – 1999	Mechanical Engineering - Lingenhöle company, Vorarlberg, Austria
1999 – 2000	Civil Servant - Lebenshilfe, Vorarlberg, Austria
2000 - 2001	Mechanical Engineering - Pegasus Personalberatung, Vorarlberg-Vienna, Austria
2001 – 2006	Social Worker - Jugend am Werk, Vienna, Austria
2005 - 2009	Management - Kulturverein Einbaumöbel, Vienna, Austria
2009 – Present	Coordination/ Finance Management – Sustainable Agriculture Tanzania (SAT), Morogoro, Tanzania