



# FROM FARMING TO CHARCOAL PRODUCTION: AGRICULTURAL DECLINE, FOOD SECURITY AND DEFORESTATION IN BAGAMOYO DISTRICT, TANZANIA

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## ABSTRACT

Since the mid-1980s, rural livelihoods in Tanzania have rapidly transformed and become more commercialized, which is linked to a wave of changes in the local environments. This article explores the socio-economic and environmental interconnections between agricultural decline, food security, charcoal production, and deforestation in Bagamoyo district. The research methods involved questionnaire and thematic interviews, Rapid Rural Appraisal, and spatial analysis of land use/cover changes. Earlier studies from the area provided references for historical comparison. The results show that the recent decline in the agricultural output is linked to deteriorating environmental conditions, stagnation in agricultural technology and practises, livestock diseases, and the shift of labour to non-farm sectors. As most households were nearly self-sufficient in regard to basic staples yet in the mid-1980s, they now buy most foods from the market. Small businesses and particularly charcoal production have become important strategies for maintaining food security and improving the standard of living. Although charcoal production brings much needed incomes for buying food and other necessities, this phenomenon has diverse negative outcomes. As the local forest resources are

already depleted, and the food security situation remains vulnerable, determined and holistic efforts are needed to support small-scale farmers, sustainable livelihood diversification, and natural resource management.

**Keywords:** subsistence farming, food security, livelihood diversification, charcoal, deforestation, Tanzania

## INTRODUCTION

The global commitments to reduce poverty, malnutrition and promoting sustainable development call for more holistic understanding about the drivers, outcomes, and feedbacks that interact between food system activities, food security, socio-economic conditions, and natural environment (Ericksen 2008, 2009; Headey *et al.* 2010). The natural environment not only enables food production, but also provides other resources that can be converted to incomes that contribute to food security. As environmental and socio-economic changes may happen simultaneously and take place on different levels, these relationships are complex and may result in unexpected outcomes. Successful adaptation generally diminishes the vulnerability towards food insecurity and improves living conditions, but it may in some cases lead to adverse outcomes,



such as unsustainable use of water resources, socially unacceptable activities for income generation, or forced migration, which may cause new vulnerabilities in the future (Eriksen 2008, 2009; Codjoe and Owusu 2011).

This paper examines the interconnections between agricultural decline, food security, and deforestation in an area where subsistence farming continues to be the main source of livelihood. The study villages are located in the western part of Bagamoyo district, in the Coast region of Tanzania. The time frame of the study extends from the mid-1980s to 2011, covering a period when the socialist *ujamaa* policies and strict state control over the markets were abandoned and Tanzanian economy was liberalised.

Although several studies have explored changes in agricultural policies and production, food supply, food security, environment, and rural livelihoods in Tanzania during the post-*ujamaa* era (e.g. Bryceson 1989, 1993; Kikula 1997; Ponte 1998, 2002; Skarstein 2005; Sokoni 2008; Kangalawe 2012), more information is needed on the environmental linkages of food system change and the commercialization of rural life in general (Ponte 2002, Haapanen 2011). In particular, the focus of this study is on the dynamics and underlying factors of decreasing agricultural output of farming households, nutritional situation, and the shift of labour from agriculture to non-farm sectors and especially charcoal making, which has been the main contributor to rapid deforestation in the area.

According to Malimbwi and Zahabu (2008), nearly the entire coastal zone and also districts in the interior parts of the country produce charcoal for the growing number of consumers in Dar es Salaam. Madulu (2005) has connected increasing charcoal production with poverty in a study conducted in the communities by the Wami River in Bagamoyo district. Eriksen,

Brown, and Kelly (2005) who studied coping strategies in Kenya and Tanzania, observed when one strategy failed another one, such as charcoal making, was adopted. Barrett (2008) has also briefly discussed the linkages between the appeal for charcoal production and diminishing returns from agriculture, and the reports by the Tanzanian government, USAID, and FAO mention the possible connections of these with droughts and food security in Tanzania (GoT 2005; USAID 2010a, 2010b) and elsewhere in East Africa (FAO 2009; USAID 2009, 2010c). Nevertheless, the issue calls for closer examination, and not least due to the estimates that the forests on public lands in Tanzania will be fully depleted by 2035 if the current trend of deforestation is not halted (Mwampamba 2007).

The field work for this study was carried out in four phases: in October-December 2008, June-August 2009, December 2010, and July 2011. The study was conducted under a broader research project<sup>1</sup> focusing on rural development in Bagamoyo district (Haapanen 2010, 2011; Mhache 2010, 2012; Sitari 2010; Sokoni 2010; Ylhäisi 2010). Several other studies in the same geographical area (e.g. Mwelupungwi 1977; Muro 1979; Sitari 1983; Hurskainen 1984; Vuorela 1987; Mustafa 1989; Sendaro 1992) provided historical reference base for the present article.

## Study area

The study area covers eight villages—Pongwe Msungura, Msata, Saleni, Makombe, Mindu Tulieni, Lunga, Mboga, and Msoga—in Msata and Lugoba<sup>2</sup> wards

<sup>1</sup> Research Project on *Rural Settlement Development, Land Ownership and Food Security since Ujamaa era in eastern Tanzania*, funded by the Academy of Finland, 2008-2010.

<sup>2</sup> In 2010, the southernmost villages of Lugoba ward were attached to the newly established Msoga ward (information from Msoga village committee members and Lugoba ward office, December 2010).



in Bagamoyo district. These are located between -6.15 to -6.35 degrees latitude and 38.15 to 38.25 degrees longitude (Figure 1). The area has two rainy seasons as it is near to the equator and close to the coast of the Indian Ocean, where the annual monsoon cycle takes place. The long rains usually occur in February to May and the short rains in November to December. The

mean rainfall is around 600 to 1000 mm per year, but annual variation is large and the susceptibility to drought is moderately high (KNMI 2010; Haapanen 2011). In addition to the low level of precipitation, also erratic timing of rains creates problems for the farmers in the area who are almost completely relying on rain-fed agriculture.

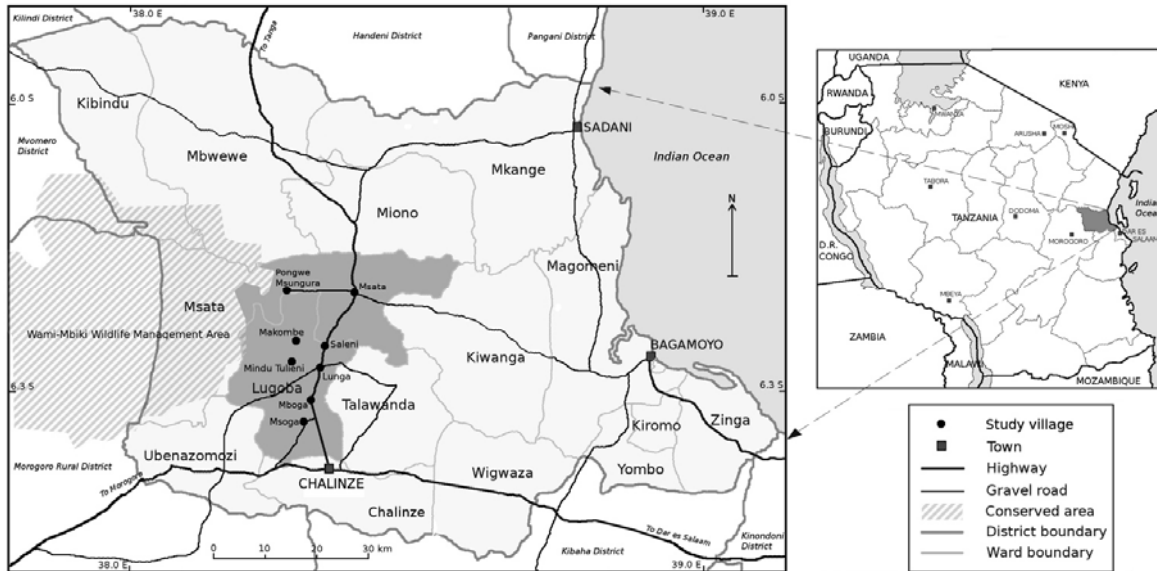


Figure 1: Location of the study area in Bagamoyo District.

Natural vegetation is largely bush and grass land, as the formerly widespread *miombo* woodlands have been largely cut during the recent decades (Sitari 1983; Mwampamba 2007; Mhache 2010; Ylhäisi 2010). Like elsewhere in the rural Tanzania, much of the population in the area were re-settled from scattered rural dwellings to large nucleated villages during the villagization campaign (Operation Pwani) that was part of the ujamaa policies in the 1970s. The purpose was to concentrate the population in *ujamaa* villages alongside or nearby the main roads where basic services were accessible (Sitari 1983). Agricultural production was, to an extent, collectivized and taken under state control. Nevertheless, unofficial markets continued to be important channels for the distribution of agricultural products, as the official state-controlled system had several flaws and

many farmers were reluctant to participate in it (Muro 1979; Vuorela 1987).

The population in the area has grown rapidly since the villagization, by over 3% annually. According to the data from the ward officials, the population in Lugoba ward nearly doubled from 9,086 to 17,924 between 1984 and 2006. The population density increased from about 18.5 to 36.5 people per km<sup>2</sup>. The largest ethnic group in the area are the Wakwere, which have traditionally been shifting cultivators. The pastoralist Parakuyo Maasai is the largest minority group.

Apart from small-scale cultivation, cattle keeping, charcoal production, and petty trading there have not been many opportunities for the majority of households to diversify their livelihoods.



Charcoal production was practised in the area in the 1970s already, but it was only in the late 1980s when the industry started to boom. Charcoal is mainly marketed to consumers in Dar es Salaam and minor urban centres such as Chalinze, Mlandizi and Kibaha, as the villagers consume only a minor part of the charcoal locally (Ylhäisi 2010; Mhache 2012; Haapanen 2011). Starting in the 1980s, several stone quarries have also been established in the area, providing employment for the local villagers.

## **METHODOLOGY**

Thematic interviews, structured questionnaire surveys and tools common in Rapid Rural Appraisal (RRA) were applied in the field work. Over one hundred semi-structured and thematic interviews were made with key informants including village elders and leaders, agriculturalists, charcoal producers, and government officials (on village, ward and district levels). Another substantial body of data consisted of two interlinked questionnaire surveys. The first questionnaire focused on the environmental changes and the utilization of forest resources with a sample size of 225 households. The second questionnaire concerned agricultural production, food purchases, and food security with a sample size of 140 households. Both questionnaires also involved questions on household characteristics, livelihoods, and land holdings. Thus, in total 365 structured questionnaire interviews were conducted with randomly selected household representatives, of which 199 were men and 166 women. These accounted for about 12.8% of the households in the studied villages and 6.8% of all households in Msata and Lugoba wards. An earlier survey (n=92) made by a team led by Sitari and Sendaro in the area in 1989–90 gave also good points of historical reference (see Sendaro 1992), and several questions from their questionnaire were included in our surveys. Statistical tools were applied to

analyse quantifiable information collected through the interviews.

In addition, group discussions and exercises common in Rapid Rural Appraisal provided effective means for collecting information on issues such as changes in agricultural production, food security, charcoal production, and forest management. The sessions included six transect walks, four seasonal calendar exercises, and 23 group discussions that were held with the villagers and officers in different parts of the study area.

Major changes in land use and forest cover were identified through analysing aerial photographs and satellite images. Aerial photographs of the study area taken in 1966 and 1982 were collected from the Department of Maps and Surveys. The most recent layer of the time series included Ikonos-2 satellite data, taken in February and July 2007 with about one meter resolution.

The essential documents collected from the state authorities on different levels included crop and livestock data, market data, as well as information on health and nutritional situation. Although much of the official data was incomplete, the holistic methodological approach, the triangulation of diverse data sets, and the information presented in the earlier studies enabled a comprehensive analysis of the historical events and the present situation.

As the data sets were collected through diverse methods and questionnaires that were designed for different objectives and focus groups, and not all interviewees could always answer every question, the sample sizes used for deriving the results are shown case by case in the following chapter. Several aspects that arose from this rather extensive amount of research materials, but which are out of the scope of this paper, are analysed in the doctoral dissertations by Haapanen (2011) and Mhache (2012).



## RESULTS AND DISCUSSION

### *Declining agricultural output*

According to the interview data (n=365), virtually all households in the area continue to be engaged in farming activities. The most important staple is maize, which is accompanied with other food crops including cassava, millet, different types of beans, Vegetables and fruits that are mostly grown for subsistence use. Generally, the engagement in cash crop cultivation is rather low, when about 30% of the households cultivated sesame for sale and only a few produced other cash crops. A minority of households were also selling part of their food crop yields although very few produced any excess of these crops. Most of the interviewed households, 65%, cultivated less than 4 acres in total, and about 90% less than 10 acres. The interviews and comparison of data to the 1989-90 survey show that clearing new areas for cultivation has become less common and the average size of landholdings is getting smaller while the scarcity of arable land in the vicinity of the villages is increasing.

In the second questionnaire the respondents (n=140) were asked to give more details about their agricultural practices and output. Nearly three-fourths of them reported an overall decline in per-acre crop yields from the mid-1980s, while only 4% considered that their per-acre yields had increased. It is difficult to establish in exact terms how much the productivity has decreased in the area, because reliable figures are largely missing. In regard to maize, the data acquired from the district office shows that the average maize yield in Bagamoyo district was about 350 kg per acre during 1985-89 and only 240 kg per acre during 2003-2007, confirming the declining trend. However, a part of this official data did not appear trustworthy, because the annual deviations between some of the years were too extreme, and no plausible explanation other than a statistical

error could be found (for further details see Haapanen 2011). Thus, exact quantification of the change has to be treated with caution.

On average, the respondent households (n=140) had consumed their own maize for five months during the latest year, while they said that in the mid-1980s they ate usually more than 11 months per year their own maize. Many interviewees claimed that they did not buy any maize during those days and some also said that maize flour was hardly available in local shops then. The interviews indicated that in the mid-1980s about a quarter of foods consumed by an average household were purchased from the market, while this share was clearly over half in 2008-09 (Haapanen 2011).

The most common reason given by the farmers to the decrease in the yields was poor or untimely availability of rains, which was often attributed to larger changes in the climate. However, the available rainfall data does not provide convincing evidence for drastic changes in total annual precipitation or monthly variability during the growing seasons. Rainfall in Bagamoyo town (some 65 km east from the study area) shows a slightly declining overall trend for 1964-2007, but high annual variation throughout the period rules out any far-reaching conclusions. Nevertheless, two of the lowest rainfalls in the 43-year period were recorded in 2001 and 2003 (TMA 2010).

Furthermore, the temperature data from Bagamoyo town (some 65 km east from Lugoba where the nearest functioning weather station was located) for the period of 1978 to 2008, shows over a 1.5-degree increase (linear regression) in minimum temperatures, and a less steep increase of about 0.25 degrees in maximum temperatures (TMA 2010; Haapanen 2011). Upward trends in temperatures are also found in the data from meteorological stations in the neighbouring Morogoro and





Tanga regions, as well as in Dar es Salaam (URT 2006; KNMI 2010). The rising temperatures have obviously increased evaporation from soil and water bodies and the transpiration rates of plants, which is likely to have influenced food production in the area.

In addition to the challenging weather conditions, the stagnation or decline in the usage of agricultural inputs explains the decline in the productivity, as noted by many respondents too. The traditional land use systems changed profoundly during the ujamaa period already, as sedentary field cultivation became prominent, and the practice of shifting cultivation diminished. When pressure on the land has increased near the ujamaa villages, but the technological transformation of agriculture has not taken place, degradation of soils and consequent decline in the yields has followed (Kikula 1997; Haapanen 2011).

Table 1 illustrates the usage of inputs for cultivation in the study area in 1989-90 and 2008-09. Notably, the application of chemical fertilizers has fallen from 22% to 5% during this period, particularly due to the rising prices of fertilizers, which has been attributed to the withdrawal of agricultural subsidies under economic liberalisation (The World Bank 2000; Ponte 2002; Skarstein 2005). The usage of organic manure has remained at a stagnant level, as less than 30% of the farmers apply it in their fields. This is particularly due to the fact that most of the cultivators in the area do not have livestock, as most of it is owned by a minority, the pastoralists. Therefore, most fields receive very few external inputs, which obviously has caused degradation of the soil's nutrient content. Furthermore, only one out of three (33%) respondents said that they had received advice or other services from the extension officers while the others had not been in contact with them.

**Table 1: Usage of inputs for cultivation by respondent households in 1989–90 (n=92) (Sendaro, 1992: Tables 10.5, 10.6) and 2008–09 (n=127).**

Input	% in 1989–90	% in 2008–2009
Hand hoe	100	96
Tractor	12	7
Plough	0	1
Improved seeds	36	58
Chemical fertilizer	22	5
Organic manure	28	27
Pesticide for cultivating	4	7
Pesticide for storing	49	

Livestock-keeping has also faced severe difficulties. During the recent decades, especially East Coast Fever (ECF) but also other diseases including pneumonia, bovine tuberculosis and bovine brucellosis have killed thousands of cattle in the area. Nearly all interviewed pastoralists (n=31) complained that they had lost considerable amounts of cattle. The comparison of data received from the Veterinary Office in Lugoba and an earlier study by Mustafa

(1989) showed that the cattle holdings of pastoralist households had declined from 93 heads on average in 1977 to as low as 30 heads in 2009 (Haapanen 2011). The situation has been worsened by poor access to veterinary medicines and the scarcity of grazing lands, so that the pastoralists can no longer avoid areas that they acknowledge as dangerous in regard to tick infestations (Giblin 1990). For example, the maintenance of cattle dips that could



effectively help with disease prevention has not been given due attention by the government institution or the pastoralists themselves. On the other hand, the fact that ECF does not affect other animals than cattle partly explains why the numbers of goats and sheep have steeply increased (Hurskainen 1984; Haapanen 2011). Nevertheless, most of the pastoralists had started to cultivate for their subsistence needs, and many had also sought incomes from other sectors due to the weakening conditions of livestock keeping.

In addition to the factors explained above, the shift of labour force from agriculture to non-farm sectors is a significant contributor to the decline in agricultural production and self-sufficiency. While Sendaro's (1992) study indicated that the share of population engaged in agricultural activities fell from 75% in 1975 to 57% in 1989, our results show a further decrease down to 43% by 2009. According to our findings, more than two-thirds (71%) of the households now had one or more non-agricultural income sources, of which the most important were small trading, service provision, remittances, charcoal production, stone quarry work, and brick making (n=365). The significance and consequences of charcoal production are further explored later in this article.

#### *Food security situation*

Despite the decreasing agricultural output of the farming households, our results show that the nutritional situation has generally not weakened, but may have actually improved slightly. The weight-for-age data compiled from the available child patient registries of Lugoba Primary Health Centre indicates that the proportion of underweight children under five years decreased from about 16% in the late 1990s to below 14% by 2009 (Haapanen 2011). All interviewed health workers and traditional healers (n=7) in the area made similar notions and considered that the nutritional situation was somewhat better now than in the mid-1980s. In addition to increasing incomes

from non-farm sectors, establishing a fresh water pipeline in the early 2000s also positively contributed to the situation; albeit that some remote villages do not have piped water yet. Nevertheless, the lack of essential micro-nutrients continues to be a severe problem in the area. The most common is iron deficiency, which is manifested through high levels of anaemia (Mwanri *et al.* 2000).

The survey responses, however, present a somewhat different picture, as nearly half of the respondents said that food security in their household had gone worse since the mid-1980s. Two-thirds (67%) of the questionnaire respondents said that their household has sometimes had food insecure periods, and almost as many (63%) said that they had had to skip meals during the last 12 months due to lack of food (n=131). 27% considered that the amount of food that they have access to usually being not sufficient for the needs of the whole household (n=138).

Essentially, nutritional intake and perceptions on food security should not be equaled. The interviews show that many people are discontented with the decreasing availability of self-produced food, and the weakening roles of subsistence cultivation and pastoralism that their cultural identities have been based on. For example, most respondents identified themselves as farmers even if their main sources of livelihood were clearly in non-farm sectors.

Undoubtedly, the nutritional situation continues to be severe in many families and it can easily get worse along with, e.g., a crop failure, livestock loss, death or illness of a household member, an increase in food prices, or other shocks. According to the interviews, the most common means to get over food insecure periods included seeking additional sources of income such as charcoal production, agricultural wage labour, or other casual work. Borrowing was another common strategy and many families have become indebted to



shopkeepers. Governmental food aid, which has been delivered about every second years, was considered insufficient for alleviating the situation for any longer period than a few days at a time (Haapanen 2011).

#### *Charcoal boom and deforestation*

Since the 1980s, people have increasingly acquired incomes from the non-farm sectors in order to buy foods from the market and meet other basic needs such as medical care, schooling, housing, clothing, and transportation that also require more money nowadays (Haapanen 2011: 146). Among the other factors that relate to the commodification of rural life and cultural change towards favoring urban life-styles, the interviews show that the diminishing returns from agriculture have strongly contributed to the growing reliance on non-farm livelihoods, of which charcoal business is one of the most important.

Charcoal is now the most common energy source for cooking in Dar es Salaam and other urban centres in Tanzania. The study area is within the peri-urban zone that has access to both forest resources and the urban markets, and charcoal business has been booming in the area since the 1980s (Monela *et al.* 1993; Malimbwi and Zahabu 2008; Ylhäisi 2010). According to our

interviews, very few people were making charcoal yet in the beginning of 1970s, which was explained by better opportunities to gain food and income from agriculture, as well as lesser needs for money in general.

Some respondents claimed that the charcoal production would have slightly declined since the late 1990s due to stricter control measures by the authorities. However, all respondents did not share this view and insisted that the production rate had rather increased further. In any case, in 2011, on average 166 bags (about 15,000 to 16,600 kg) of charcoal was produced in Msata and Lugoba wards every day, and this amount only concerns the charcoal that was legally registered at the check-points (Figure 2) (Mhache 2012). Legislative efforts to restrict charcoal production have not been successful in bringing the production to a sustainable level and the halting quantity of now largely illegal logging activities (Luoga *et al.* 2005; Madulu 2005; Malimbwi and Zahabu 2008). According to Malimbwi and Zahabu (2008) and an interview with the district forest officers in Bagamoyo, not more than one-fifth of the charcoal that is sold to Dar es Salaam is legally produced, i.e., an appropriate license is obtained and the taxes are paid at the check-points.





**Figure 2: Charcoal bags ready for transportation to Dar es Salaam (photo taken in Msata on 17.10.2008).**

Mostly men but also women are involved in the charcoal business. According to our observations, the majority of the actual producers were young men from different ethnic groups, but adults and older people were also cutting the wood and operating the earth kilns where the charcoal is prepared. Some producers and traders also come to the area from outside. In 2008–09, about 32% of the surveyed households were involved in charcoal production (see also Mhache 2010). Due to the largely illegal nature of the business, the share of households receiving incomes from charcoal production may be even higher than what our survey indicates (Ylhäisi 2010).

Large-scale deforestation has taken place in the area during the last three decades, as confirmed through the spatial analysis of aerial photographs taken in 1982 and the satellite data obtained in 2007. The two maps (Figures 3 and 4) visualize the land use/cover change in Lunga, Msoga, Makombe and Mindu Tulieni, which represent both the roadside and more remote villages. On average, almost four-

fifths of the forest cover<sup>3</sup> disappeared in these villages between 1982 and 2007. When nearly 36% of the total land area was forested in 1982, the figure had dropped down to around 8% by 2007. Bush and grass lands now dominate the landscape. The areas under this category have increased by about 40% from covering about 57% to as much as 80% of the total area between 1982 and 2007. Also bare lands have expanded, especially along the cattle tracks (Haapanen 2011). The remaining relics of natural forests are usually conserved due to their sacred nature to the locals (Ylhäisi 2006).

<sup>3</sup> Forests were identified through FAO's (2000: 5) definition, which includes wooded areas holding over 10% crown cover of trees above 5 meters' height in the minimum area of 0.5 hectares.

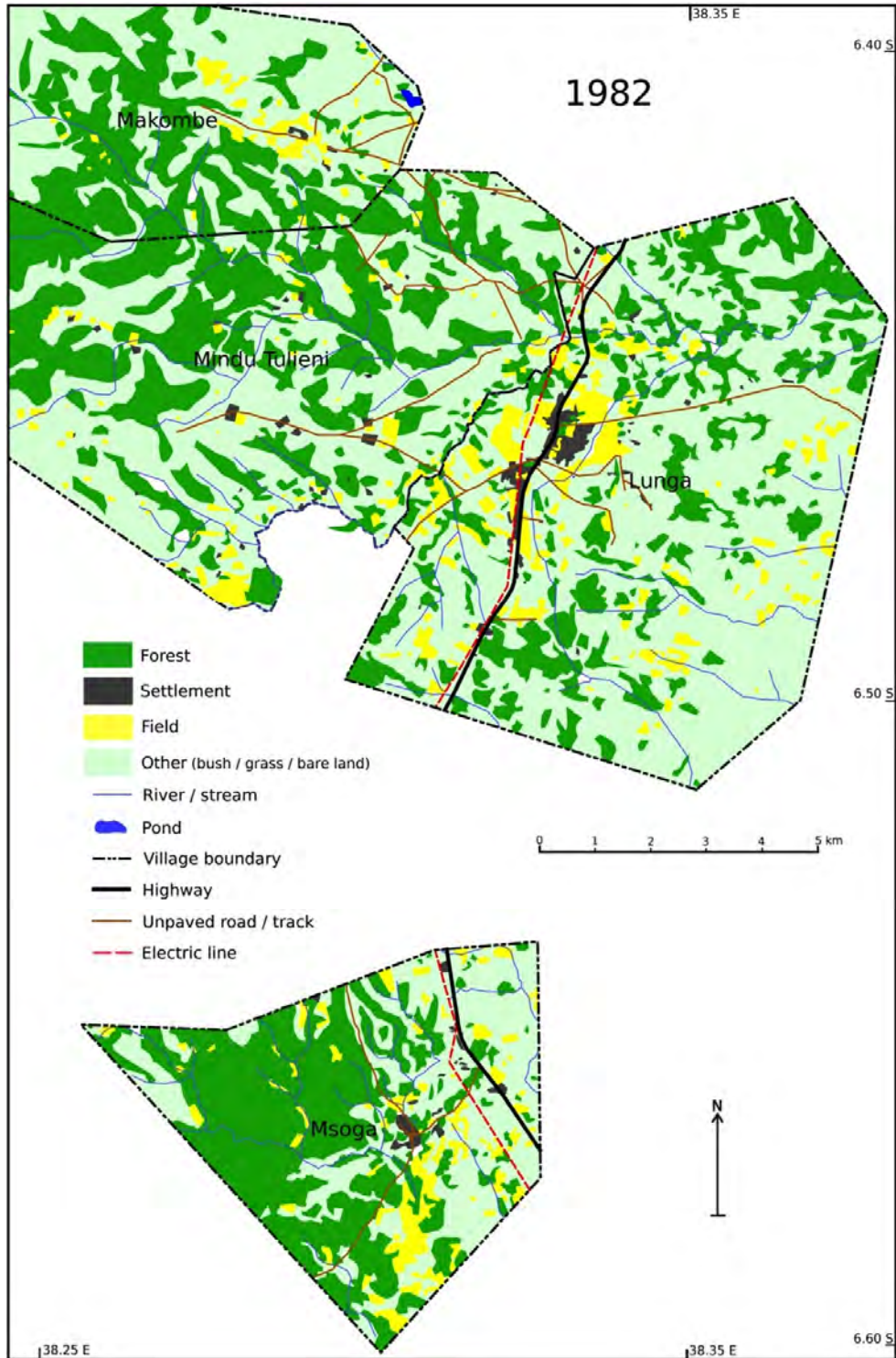


Figure 3: Land use/cover in Lunga, Msoga and eastern parts of Mindu Tulieni and Makombe villages in 1982 (Haapanen 2011).



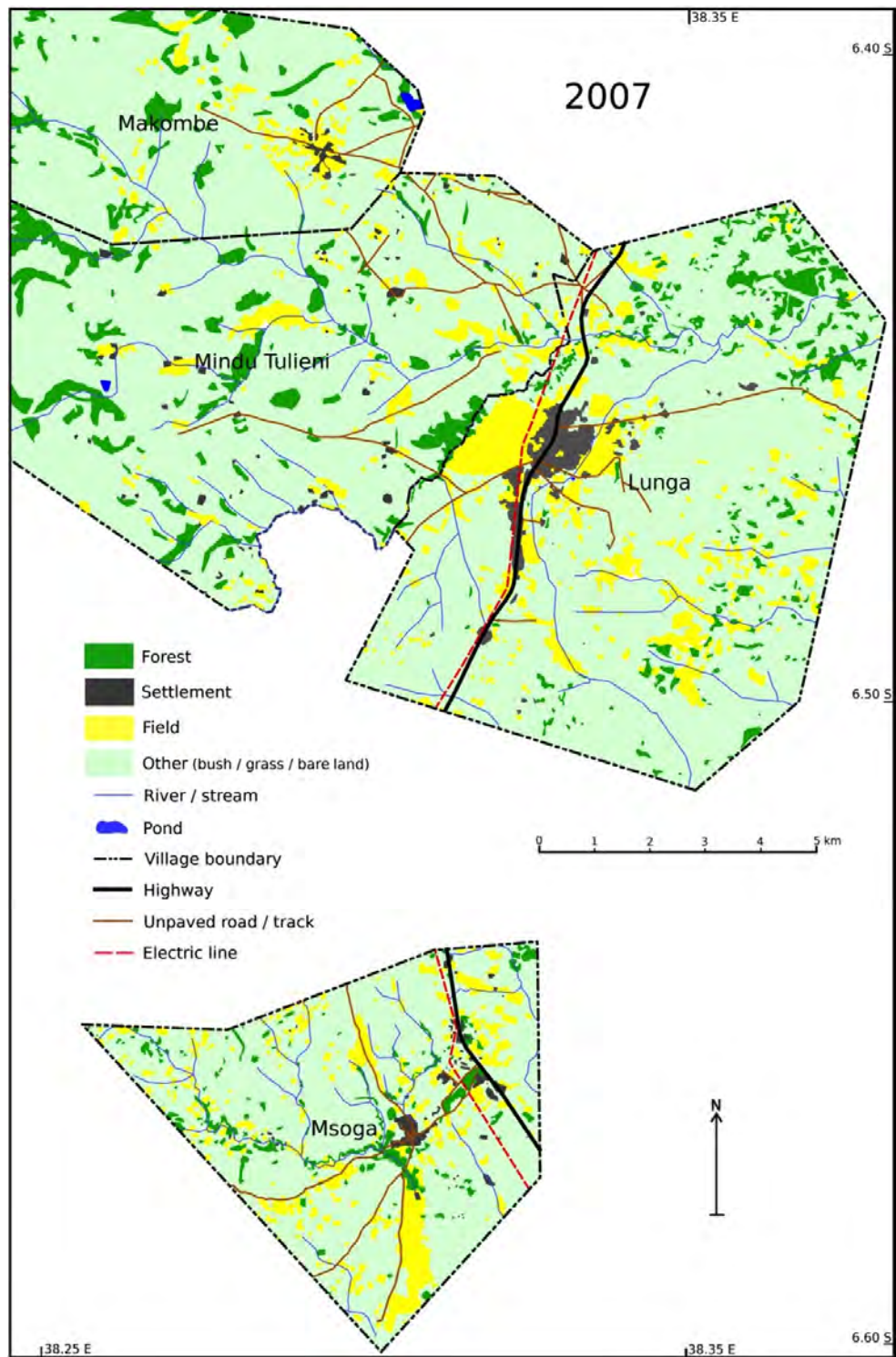


Figure 4: Land use/cover in Lunga, Msoga and eastern parts of Mindu Tuli and Makombe villages in 2007 (Haapanen 2011).



Although the collection of firewood for cooking and making bricks, the extraction of timber for construction and carpentry, livestock grazing, expansion of cultivated areas, and burning the undergrowth for growing fodder have all contributed to forest degradation and finally deforestation, there is no doubt that the most significant factor to the loss of forest resources has been charcoal production (Mhache 2010; Ylhäisi 2010; Haapanen 2011). According to Malimbwi *et al.* (2005), felling cycles from 8 to 15 years are recommended for sustainable charcoal production in the area, provided the use of trees with the minimum size of 10 cm diameter at breast height. However, sufficient regeneration is not allowed to take place in the study area, as nearly any tree species and young trees are used for charcoal production. Also the inefficient charcoal production technology has its share in the unsustainable use of forest resources. Charcoal is produced in traditional earth kilns, which do not control effectively the carbonization process of the woods (Woods and Hall 1994). The energy efficiency of this technology is estimated to be below 20%, and hence a lot of energy is being lost in the burning process.

According to the interviewees, deforestation has already had consequences on the local environment and livelihoods. Several people believed that deforestation had brought irregularities and decrease in the local rainfall. They had also encountered problems with finding building materials and firewood for their own consumption. It was reported that formerly there was abundance of wild animals including elephants, giraffe, lions, wild beasts and pigs, which are no longer seen in the area. In addition to game, many respondents also reported the loss of edible forest products like fruits, mushrooms, tubers and other plants, which earlier had an important role for food security, especially during scarcities.

### **Linkages between agricultural decline, food security, and deforestation**

Since the mid-1980s, the access to monetary incomes has become relatively more important in the area due to the decreasing yields from subsistence activities—like cultivating food crops and raising livestock for the consumption needs of the rural households—as well as the growing expenses on school fees, health services, housing, transportation and other necessities. According to the interviews, and also Vuorela (1987), most households were nearly self-sufficient in regard to basic staples yet in the mid-1980s, while as they now buy clearly more than half of the foods from the market (Haapanen 2011). While decreasing agricultural production has not yielded excess which could be sold, while the small business sector along the main road is already quite crowded and competition is intense, and while the capacity of the local stone quarries to employ more people is limited, charcoal production has provided a reliable income source for the villagers.

In 2009, the mean daily income in the area was TZS 6,070 (USD 4.54) per household, or TZS 2.2 million per year, and the average share of food expenditures was 62% (Haapanen 2011). Earlier studies along the Dar es Salaam-Morogoro highway show that the household incomes from charcoal reached TZS 1 million per year in 2002 already, exceeding the minimum wages of most employees in public and private sectors (Malimbwi and Zahabu 2008).

Several interviewees considered that they were now making more charcoal than in the 1980s, because they get less output from agriculture and need money for food and other necessities. The same was concluded by the group of over 40 village leaders and ward officials in the seminar in Msata in December 2010. One woman from Lunga explained:

*“In the past we used to harvest high yields but nowadays they are lower. The*



*yields have decreased due to lack of rain and prolonged droughts. Maize, which is the main food here, is drying up while paddy cultivation has disappeared. Therefore, most people are engaging in charcoal and brick production which has contributed to deforestation."*

On the other hand, the causality also holds in the opposing direction; agricultural produce may have decreased partly due to the higher involvement in charcoal production. The veterinary officer in Msata said:

*"It is a quick business for getting money nowadays. Young people are running to the forest to make charcoal. That's why they are not cultivating."*

Other livelihood opportunities have been relatively scarce due to low levels of education, lack of assets for enhancing agricultural production, and the low availability of credit services for especially poorer households to expand their small enterprises (Haapanen 2011). Furthermore, unlike most crops, charcoal can be produced throughout the year, or when the need for additional incomes arises.

The shift to charcoal production has been a matter of survival for many families. A seasonal calendar exercise made in Makombe, which is a remote village with relatively good access to wood resources, revealed that charcoal is mostly produced during times when there is less work to do in the fields, starting after the *masika* (long rains) harvest in July. However, some interviewees considered that charcoal production reaches its peak already before the *masika* harvest when incomes are quickly needed for food purchases. During *vuli* (short rains) season fields are cultivated less intensively, so the high season for charcoal continues well until December. Other group discussions and individual interviews clearly indicated that charcoal is produced more during the years when the crop harvests have been poor. As one man from Makombe put it, answering a

question on how to overcome food insecure periods:

*"I just take an axe and go to the forest."*

Many respondents were well aware of the adverse environmental outcomes and longer term unsustainability of charcoal production, but felt that they had no viable alternatives. An elder man in Lunga explained:

*"Charcoal production is poverty driven. However, with charcoal making I have managed to feed or sustain my family, send my children to school, buy clothes for my family and I have built a small brick house with three rooms. Although charcoal making is destroying the forest, there is no way you can convince me and others to stop making charcoal unless you assure me or provide us with stable income generating activities. I have not gone to school. I am old now and my family is depending on me."*

A pastoralist man in Mindu Tulieni concluded:

*"Charcoal is the main cause of deforestation as people are cutting trees in order to produce charcoal and sell it to the market to get money. We know that charcoal production is a threat to the forests but we don't have other means of getting money for food, medical treatment, and the school fees of our children."*

## CONCLUSION

This study has shown that the agricultural output has considerably declined in the majority of households in western Bagamoyo district after the mid-1980s. The production of food and cash crops have both been adversely affected by the shift to sedentary cultivation, lack of fertilizers and other inputs, irregular rainfall and rising temperatures, as well as cultural changes which have encouraged especially the youth to seek labour opportunities from the non-farm sectors. Livestock production has stagnated especially due to cattle diseases. As the population in the area has nearly





doubled during this period, the availability of new suitable areas for cultivation and grazing has also diminished.

The role of self-produced staples, which were eaten throughout most of the year yet in the mid-1980s, has diminished. The majority of foods consumed in the households are now purchased from the market. Despite the magnitude of these changes in the local economy, the nutritional situation in general appears to have slightly improved in the light of the weight-for-age indexes and interviews of health workers. Nevertheless, nearly half of the survey respondents considered the food security situation to have gone worse, in part due to losing self-sufficiency and the related profound changes in the traditional livelihoods and culture.

Incomes have been increasingly needed for buying food and other necessities. In particular, the maintenance of food security through charcoal production instead of traditional small-scale farming was addressed in several interviews and group discussions. More money has also been needed to pay school fees, health services, and improve housing. Charcoal has become one of the most important sources of income although the interviewed people seemed to be rather well aware of its negative environmental impacts and unsustainable production volumes which threaten the subsistence base of the rural communities in the long run. Most of the charcoal production is also illegal and the producers often have to work fearing a penalty. As more people produce charcoal, also less labour force is available for agriculture, so the increase in charcoal production is not only a result of the decline in agricultural production but also a factor contributing to it.

Evidently, there is a vicious cycle consisting of strong interconnections between the adverse agricultural conditions, poverty, food insecurity, and the over-utilization of forest resources that

has led to massive deforestation in the area. Other income opportunities have been limited due to the lack of assets for enhancing agricultural production, low levels of education, and the poor availability of credit services for especially poorer households to expand their small enterprises.

According to the estimates by the FAO, the total forest cover in Tanzania was about 334,280 km<sup>2</sup> or 37.7% of the land area in 2010. Between 1990 and 2010, as much as 80,670 km<sup>2</sup> (19.4%) of the forests were lost with an average annual deforestation rate at 0.97% (Mongabay, 2012). In order to prevent the projected loss of all forests on public lands within the next two decades (Mwampamba, 2007), more attention needs to be given not only to direct measures for halting deforestation, but also indirect factors such as the weakening conditions of small-scale farming and lack of sustainable rural livelihood opportunities, as well as long-term planning for rural development in general.

Even when this case study has focused on a relatively small geographical area, the findings may also apply to other parts of the rural Tanzania and Sub-Saharan Africa, particularly those in the semi-periphery of large urban centres. Development interventions should take into account the impacts of the on-going processes of de-peasantization and gradual urbanization of rural spaces (see also Lerner and Eakin, 2010), and find holistic approaches that truly support the small-scale farmer households, sustainable livelihoods, and sound natural resource management.

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## REFERENCES

- Barrett, C. 2008. Food systems and the escape from poverty and ill-health traps in Sub-Saharan Africa. Working Paper Series, Cornell Food and Nutrition Policy Program. Accessed 17.6.2013.  
<[http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1141840](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1141840)>
- Bryceson, D.F. 1989. Nutrition and the commoditization of food in Sub-Saharan Africa. *Social Science & Medicine* 28:5, 425–440.
- Bryceson, D.F. 1993. *Liberalizing Tanzania's food trade: The public and private faces of urban marketing policy, 1939–88*. James Currey, London. 320 p.
- Bryceson, D.F. 1999. African rural labour, income diversification & livelihood approaches: A long-term development perspective. *Review of African Political Economy* 80, 171–189.
- Codjoe, S.N.A. & G. Owusu, 2011. Climate change/variability and food systems: Evidence from the Afram Plains, Ghana. *Regional Environmental Change*. Published online 19.3.2011.
- Ericksen, P.J. 2008. Conceptualizing food systems for global environmental change research. *Global Environmental Change* 18, 234–245.
- Ericksen, P.J. 2009. Food security and global environmental change: Emerging challenges. *Environmental Science & Policy* 12, 373–377.
- Eriksen, S.H., K. Brown & P.M. Kelly, 2005. The dynamics of vulnerability: locating coping strategies in Kenya and Tanzania. *The Geographical Journal*, Vol. 171, No. 4, December 2005, pp. 287–305.
- FAO 2000. FRA 2000. *Comparison of forest area and forest area change estimates derived from FRA 1990 and FRA 2000*. Working Paper 59. Food and Agriculture Organization of the United Nations, Rome. 67 p.
- FAO 2009. *State of the world's forests 2009*. Food and Agriculture Organization of the United Nations, Rome. 152 p.
- FAOSTAT, 2011. FAOSTAT. Food and Agriculture Organization of the United Nations, Rome. Accessed 30.11.2012.  
<<http://faostat.fao.org>>
- Giblin, J.L. 1990. East Coast Fever in socio-historical context: A case study from Tanzania. *The International Journal of African Historical Studies* 23: 3, 401–421.
- GoT, Government of Tanzania, 2005. *Rapid vulnerability assessment report on drought affected areas in Tanzania for the 2004/2005 short rains "vuli" season*. Disaster Management Department of the Office of the Prime Minister and the National Food Security Division of the Ministry of Agriculture and Food Security & Tanzania Food Security Information Team (FSIT), Dar es Salaam. 14 p.
- Headey, D., S. Malaiyandi & S. Fan, 2010. Navigating the perfect storm: Reflections on the food, energy, and financial crises. *Agricultural Economics* 41, Issue Supplements 1, 217–228.
- Haapanen, T. 2010. Maendeleo ya mfumo wa chakula vijijini baada ya enzi ya ujamaa. Uchunguzi kifani kutoka Lugoba, Tanzania. *Turku University Department of Geography Publications B* 15, 55–73.
- Haapanen, T. 2011. *Rural Food System Change in Tanzania during the Post-Ujamaa Era: A Case Study from Western Bagamoyo District*. Annales Universitatis Turkuensis Biologica-Geographica-Geologia AII: 265. University of Turku, Turku. 191 p. Accessed 17.6.2013.



<<http://urn.fi/URN:ISBN:978-951-29-4848-2>>

Harvey, D. 2007. *A brief history of neoliberalism*. Oxford University Press, New York. 234 p.

Hurskainen, A. 1984. Cattle and culture. The Structure of a pastoral Parakuyo society. *Studia Orientalia* 56. Helsinki. 275 p.

Kangalawe, R.Y.M. 2012. Food security and health in the southern highlands of Tanzania: A multidisciplinary approach to evaluate the impact of climate change and other stress factors. *African Journal of Environmental Science and Technology* 6: 1, 50–66.

Kikula, I.S. 1997. *Policy implications on environment. The case of villagisation in Tanzania*. The Nordic Africa Institute, Uppsala. 227 p.

KNMI 2010. KNMI Climate Explorer. Royal Netherlands Meteorological Institute, Ministry of Transport, Public Works and Water Management. Accessed 30.11.2012. <<http://climexp.knmi.nl>>

Luoga, E.J., E.T.F. Witkowski & K. Balkwill 2000. Subsistence use of wood products and shifting cultivation within a miombo woodland of Eastern Tanzania, with some notes on commercial uses. *South Africa Journal. Bot.* 66: 72-85.

Luoga, E.J., E.T.F. Witkowski & K. Balkwill, 2005. Land cover and use changes in relation to the institutional framework and tenure of land and resources in eastern Tanzania miombo woodlands. *Environment, Development and Sustainability* 7, 71–93.

Madulu, N.F. 2005. Environment, poverty and health linkages in the Wami River basin: A search for sustainable water resource management. *Physics and Chemistry of the Earth* 30, 950–960.

Malimbwi, R.E., E. Zahabu, G.C. Monela, S. Misana, G.C. Jambiya & B. Mchome, 2005. Charcoal potential of miombo woodlands at Kitulangalo, Tanzania. *Journal of Tropical Forest Science* 17 (2): 197-210.

Malimbwi, R.E. & E.M. Zahabu, 2008. Woodlands and the charcoal trade: The case of Dar es Salaam city. *Working Papers of the Finnish Forest Research Institute* 98, 93–114.

Mhache, E.P. 2010. Ongezeko la watu na athari zake katika misitu magharibi mwa Bagamoyo, Tanzania. In Sokoni, C.H. (ed.). *Maendeleo ya makazi vijijini baada ya ujamaa, magharibi mwa wilaya ya Bagamoyo, Tanzania*. Turku University Department of Geography Publications B Nr 15, 25–36.

Mhache, E. P. 2012. *Impacts of Population Change on Forests and Woodlands in Western Bagamoyo, Tanzania*. Doctoral dissertation. Department of Geography, University of Dar es Salaam, Tanzania.

Monela, G.C., A. O'Kting'ati & P.M. Kiwele, 1993. Socio-economic aspects of charcoal consumption and environmental consequences along the Dar es Salaam-Morogoro highway, Tanzania. *Forest Ecology and Management* 58: 249–258.

Mongabay 2012. Tanzania Forest Information and Data. Accessed 30.11.2012. <<http://rainforests.mongabay.com/deforestation/2000/Tanzania.htm>>

Muro, A. 1979. *Women in agricultural production and their education and training: a case study of Diozile I village in Bagamoyo district*. BRALUP workshop on women's studies and development, September 24–29, 1979, paper No. 11.

Mustafa, K. 1989. *Participatory research and the "pastoralist question" in Tanzania*:



*a critique of the Jipemoyo Project experience in Bagamoyo district.* Development and culture research 1989, 7. Institute of Development Studies, University of Helsinki. Yliopistopaino, Helsinki. 188 p.

Mwampamba, T.H. 2007. Has the woodfuel crisis returned? Urban charcoal consumption in Tanzania and its implications to present and future forest availability. *Energy Policy* 35, 4221–4234.

Mwanri, L., A. Worsley, P. Ryan & J. Masika, 2000. Supplemental vitamin A improves anemia and growth in anemic school children in Tanzania. *The Journal of Nutrition* 30, 2691–2696.

Mwelupungwi, B.J. 1977. *The introduction of monetary economy and rural differentiation in Lugoba ward, Bagamoyo district.* History Department, University of Dar es Salaam. 20 p.

Pechlaner, G. & G. Otero, 2008. The third food regime: Neoliberal globalism and agricultural biotechnology in North America. *Sociologia Ruralis* 48: 4, 351–371.

Ponte, S. 1998. Fast Crops, Fast Cash: Market Liberalization and Rural Livelihoods in Songea and Morogoro Districts, Tanzania. *Canadian Journal of African Studies / Revue Canadienne des Études Africaines*, Vol. 32, No. 2.

Ponte, S. 2002. *Farmers & markets in Tanzania. How policy reforms affect rural livelihoods in Africa.* Mkuki na nyota, Dar es Salaam. 197 p.

Sendaro, A.M. 1992. Technical stagnation, aging population and agricultural production in Tanzania: The case of Lugoba, Msata and Mboga villages in Bagamoyo district. In Forster, P.G. & S. Maghimbi (eds). *The Tanzanian peasantry: Economy in crisis*, 151–168. Avebury, Aldershot.

Sitari, T. 1983. Settlement changes in the Bagamoyo District of Tanzania as a consequence of villagization. *Fennia* 161:1, 1—90.

Sitari, T. 2010. Mabadiliko ya makazi vijijini Tangu Enzi ya Ujamaa magharibi mwa Wilaya ya Bagamoyo. In Sokoni, C.H. (ed). *Maendeleo ya makazi vijijini baada ya ujamaa, magharibi mwa wilaya ya Bagamoyo, Tanzania.* Turku University Department of Geography Publications B 15, 11–24.

Skarstein, R. 2005. Economic liberalization and smallholder productivity in Tanzania. From promised success to real failure, 1985–1998. *Journal of Agrarian Change* 5: 3, 334–362.

Sokoni, C.H. 2008. Commercialisation of smallholder production in Tanzania: implications for sustainable resources management. *Geographical Journal* 174: 2, 149–175.

Sokoni, C.H., 2010. Uhusiano wa miji na vijiji na mchango wake katika maendeleo vijijini. In Sokoni, C.H. (ed). *Maendeleo ya makazi vijijini baada ya ujamaa, magharibi mwa wilaya ya Bagamoyo, Tanzania.* Turku University Department of Geography Publications B 15, 74–86.

TMA, Tanzania Meteorological Agency (2010). Bagamoyo total monthly rainfall (mm) 1964–2007. Data collected from Tanzania Meteorological Agency, Dar es Salaam.

URT, United Republic of Tanzania, 2006. *National Adaptation Programme of Action (NAPA) for Tanzania.* Division of Environment, Government of Tanzania. 55 p.

USAID 2009. Kenya food security alert. April 9, 2009. USAID Famine Early Warning Systems Network (FEWS). Accessed 17.6.2013.



<[http://www.fews.net/docs/Publications/kenya\\_alert\\_04\\_2009\\_final.pdf](http://www.fews.net/docs/Publications/kenya_alert_04_2009_final.pdf)>

USAID, 2010a. Tanzania food security outlook. July to December 2010. USAID Famine Early Warning Systems Network (FEWS). Accessed 17.6.2013. <[http://pdf.usaid.gov/pdf\\_docs/PNADS942.pdf](http://pdf.usaid.gov/pdf_docs/PNADS942.pdf)>

USAID, 2010b. Tanzania food security outlook. October 2010 through March 2011. USAID Famine Early Warning Systems Network (FEWS). Accessed 17.6.2013. <<http://reliefweb.int/node/372604>>

USAID, 2010c. Uganda food security outlook. July to December 2010. USAID Famine Early Warning Systems Network (FEWS). Accessed 17.6.2013. <[http://www.fews.net/docs/Publications/Uganda\\_OL\\_July\\_2010\\_final.pdf](http://www.fews.net/docs/Publications/Uganda_OL_July_2010_final.pdf)>

Vuorela, U. 1987. The Women' question and the modes of human reproduction. An analysis of a Tanzanian village. *Transactions of the Finnish Anthropological Society* No 20. 234 p.

Waters, T. 2007. *The persistence of subsistence agriculture. Life beneath the*

*level of the marketplace.* Lexington Books, Plymouth. 252 p.

Woods, J. & D.O. Hall, 1994. Bioenergy for development: technical and environmental dimensions. FAO Environment and Energy Paper No. 13. Food and Agriculture Organization of the United Nations, Rome.

The World Bank, 2000. *Agriculture in Tanzania Since 1986. Follower or Leader of Growth?* A World Bank Country Study. Government of the United Republic of Tanzania, The World Bank & International Food Policy Research Institute (IFPRI), Washington, D.C. 167 p.

Ylhäisi J. 2006. *Traditionally Protected Forests and Sacred Forests of Zigua and Gweno Ethnic Groups in Tanzania.* Publicationes Instituti Geographici Universitatis Helsingensis A139. Department of Geography & Institute of Development Studies, University of Helsinki. 244 p.

Ylhäisi, J. 2010. Sustainable land privatization involving participatory land use planning in rural areas: An example from Tanzania. *Land Tenure Journal* 1, 91–120.