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Edited by Kerstin Potthoff

HUMAN LANDSCAPE ECOLOGY (MNFEL 330/RFEL 3031)

Selected Term Papers 2003/2004

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Preface

This publication contains a selection of term papers written for the graduate-level *Human Landscape Ecology* course (MNFEL 330/RFEL 3031) in the years 2003 and 2004. The course was jointly operated by the Department of Biology and the Department of Geography, and the responsible instructors were Gunilla Olsson and Kerstin Potthoff, and Kerstin Potthoff and Susanne Hanssen respectively.

The students had the possibility to improve their work prior to publication. Thanks to Asbjørn Aase, Axel Baudouin, Degefa Tolossa Degaga, Michael Jones, Gunilla Olsson, and George Owusu for providing feedback.

The first five essays deal with issues related to forests in African and Asian contexts. The last three essays focus on shrimp culture in Bangladesh, plantation agriculture in Malawi, and nature tourism in mountain areas of Norway.

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Mwepya Ephraim Shitima

DEFORESTATION, ARE THE POOR ENTIRELY TO BLAME? THE CASE OF THE COPPERBELT PROVINCE IN ZAMBIA

Abstract

The relationship between poverty and environmental degradation in general and deforestation in particular is widely presented in literature. There has been little attention given to the underlying factors that lead to unsustainable environmental practices which in most cases even impoverish people in the first place.

This paper surveys literature for evidence of the role of these factors in explaining deforestation on the Copperbelt province in Zambia. This is an area that has been greatly affected economically by the country's economic liberalisation policies under the Structural Adjustment Programme SAP. This economic reform programme spearheaded by the World Bank and the International Monetary Fund IMF, included privatisation of state firms, liberalisation of markets, interest and exchange rates, decontrol of prices and removal of subsidies on several items including agricultural inputs.

Several people lost their jobs during this reform programme and have turned to other means of sustaining their lives. But the paper demonstrates that it would not be correct to conclude that the poor are entirely to blame for deforestation. It has been shown that macro-economic framework, land tenure, foreign debt, lack of off-farm incomes or high unemployment are important factors explaining deforestation on the Copperbelt province of Zambia.

However, this is not denying the fact that the unsustainable practices that poor, engage in are important contributors to deforestation. The argument is that the policy and economic climate which shape poor people's decisions, in some cases even make them poor should be given due attention if we are to avoid dealing with symptoms and not real diseases of natural resource management and environmental sustainability.

1 INTRODUCTION

1.1 Introduction

This paper analyses the relationship between poverty and deforestation. It is generally accepted that the poor contribute significantly to the removal of forest cover due to the fact that they rely almost entirely on physical resources. There is also a belief that the poor are generally ignorant of the serious effects of their unsustainable practices. A divergent view is that it is fashionable to blame the poor, who in fact are victims of the policies which compel them to act the way they do. The paper surveys this argument with reference to the Copperbelt Province of Zambia, an area that has undergone drastic socio-economic changes due to the privatisation of the mines and subsequent loss of jobs for thousands of people.

1.2 Definition and background

The process of deforestation is the clearance or destruction of indigenous forests and woodlands. It describes the complete long-term removal of forest cover (Angelsen and Kaimowitz 1999, 73). This loss of forest cover has increased world wide for sometime now, particularly during the nineteenth and twentieth centuries. For example, the Food and Agriculture Organisation (FAO)

estimates that the loss of natural forest cover in the 1990s was 16.1 million hectares of which 15.2 million hectares occurred in the tropics. Deforestation is said to have been highest in Africa and southern America in some individual countries, with the highest net loss during the same decade including Argentina, Brazil, Democratic Republic of Congo (former Zaire), Zambia and Zimbabwe (FAO 2001). The Food and Agriculture Organisation estimated that 56,000 hectares of tropical forest are destroyed each day worldwide and if this rate continues, it will only take 177 years to clear all tropical rain forests. Most of these forests are in open landscapes with no restrictions on use as only around 12 % of the world tropical forests are under protection in parks and reserves (FAO 2001). The replacement of the cleared forests through afforestation is also insignificant with a ratio of 10 to 1 of cleared to planted forests (Dudik et al. 1992).

Historically, deforestation started with the practice of sedentary agriculture prior to which 40 % of the world's land area or 6,000 million hectares was covered with forests.

This was over 8000 years ago and since then farms and pastures have claimed most forest lands (Roberts and Rodgers 1999). At the beginning of the Christian era, removal of forests was well advanced in Mesopotamia and Mediterranean Basin (Rowe 1992). Later the industrial revolution in Europe put tremendous pressure on forests as a source of fuel and railway sleepers wherever industries were introduced in the world. As Rowe (1992) explains, between 1850 and 1980, 15 % of the world's forests and woodlands were cleared. The Food and Agriculture Organisation FAO (1999) estimates that world forest cover by 1999 had been reduced to 3,500 million hectares. This is mainly due to human exploitation and most of this clearance occurred in the latter half of the twentieth century.

The global distribution of deforestation is such that it is generally more serious in developing countries of Latin America, Asia and Africa than in the developed world (Anon 1996). However, the accuracy of how much of the world's forest have been cleared is distorted by the fact that there is no clear-cut and universally accepted definition of what constitutes a forest (WRM 2002). There are differences on what criteria to use such as tree density, tree height, and tree size. For example, the Food and Agriculture Organisation FAO only considers forest clearance as deforestation if it results into a permanent conversion into some other form of land use such as agriculture, built up area or pasture land. But ecologists and conservationists have a wider view of deforestation referring to degradation of entire forest ecosystems. In some cases exotic plantations set up to replace original indigenous vegetation are not regarded as "real" forests due to their lack of ecological complexity. These variations in definitions of what constitutes a forest make it difficult to have a clear and objective assessment of the real levels of global deforestation.

A major immediate cause of this landscape change is generally the conversion of forests to some other form of land use. This includes agriculture expansion, particularly shifting cultivation, overexploitation of forest products for industrial or domestic use such as lumbering and charcoal manufacturing, settlements and overgrazing.

The liberalised global trade in timber is also an important cause of deforestation particularly in developing countries. The World Resources Guide (Anon 1996) explains that the forest area in temperate, mostly rich countries, increased by 0.1 % during the 1980s, a decade when developing countries generally suffered a net loss of forest covers. This discrepancy can only be explained by international trade in timber and other forest products through which poor countries over-exploit their resources while rich ones engaged in conservation.

The causes of deforestation may be divided into immediate and underlying ones (Angelsen and Kaimowitz 1999). It has been fashionable and convenient to present the immediate causes such as poverty or small scale subsistence farmers as the principal causes of deforestation, ignoring

fundamental underlying causes which may include global trade, government policies, land tenure systems and general socio-economic climate within which the poor operate and which shape their decisions. The effects of deforestation range from ecological or environmental to socio-economic. Ecologically, deforestation not only results in the disturbance of ecological cycles such as the hydrological cycle but also contributes significantly to extinction of species and loss of biodiversity (Mayfield 1999). Environmentally, loss of trees result in increased soil erosion as the soil loses its holding power for plant roots, leading to general land degradation and ecosystem disturbance.

Most importantly, deforestation deprives the people who live in forests of their means of livelihoods. This is because forests provide these communities with edible plants, fruits, honey, shelter, firewood and many other tangible goods and intangible services such as cultural and spiritual values. Broadly, these goods and services are classified as wood and non-wood forest products (NWFPs). Deforestation also robs the local people of their orientation and identity as forest landscapes are altered irreversibly. The loss of forests changes landscapes to the extent that they can no longer perform most of their original processes or their functions. The effects of deforestation are so profound that they may not yet be fully understood. A number of countries in the tropics such as in Latin America, Asia and Africa are seriously affected by deforestation.

For example, Zambia is said to be losing 200,000 hectares of her forest cover annually, other sources put the figure even higher at 8500,000 to 900,000 hectares, (Chipungu and Kunda 1994, 27, Chidumayo 1996, ECZ 2001, 62). This is blamed on poverty in a country where over 70 % of the population is classified as poor (GRZ 2002, 21). Some of the immediate causes of this deforestation in Zambia include felling for wood, charcoal production, expansion and overexploitation of agricultural land and timber, not to mention clearance for new settlements (Chipungu 2000).

Notably, one form of shifting cultivation (Citemene) practised in Northern, Luapula and to some extent Central provinces of Zambia, is particularly responsible for deforestation. The practice involves the lopping of trees and the collection of branches at a central place where they are burnt to provide ash as fertilizer (WRM 2002). Although perceived as an efficient means of using tropical forests by indigenous people, the practice can only support sparse populations sustainably and must be entirely for subsistence; otherwise it results in widespread deforestation (Yudelman 1964). The manufacturing of charcoal by individuals is also an important cause of deforestation, particularly around the urban areas of Zambia such as those on the Copperbelt province and the capital, Lusaka.

For example, Roberts and Roger (1999) cite Lusaka city together with Niamey in Niger as two well known African cities around which there is a long ring of denuded land that has been stripped of all its combustible material by people trying to meet their basic needs. This is worsened by the fact that only about 10 % of the Zambian population has access to electricity, meaning that the majority of the people rely on one form of wood or the other for their energy requirements (Chipungu and Kunda 1994, 32).

1.3 Aim of the study

The aim of the paper is to establish whether it is the poor who are entirely responsible for deforestation in general. A lot of emphasis will be placed on encroachment on protected forests which has become serious on the Copperbelt province in Zambia.

While information from the study area was used as much as possible, it was not practical to obtain required empirical data from Zambia for this paper and inference has been utilised on conclusions drawn in studies conducted elsewhere where circumstances suit the situation under

study. This may ultimately affect the reliability of the findings as well as the accuracy of the conclusions drawn. However to rectify this problem only cases with similarities to the Zambian situation are used and their conclusions generalised to Zambia.

2 DEFORESTATION ON THE COPPERBELT PROVINCE OF ZAMBIA

Zambia is a landlocked country located between latitudes 8 and 18 degrees south of the Equator and 22 and 34 degrees east of the prime meridian. It has a total surface area of about 752,614 square kilometres. The country lies in the tropical region of Central–Southern Africa and therefore enjoys a warm, wet tropical climate. It is also located within the Zambezian region centre of endemism, which is characterised by a variety of ecosystems and biodiversity. In terms of forests, the country is part of the Miombo Ecoregion and about 55–60 % of the total land surface is covered with forests (Chipungu and Kunda 1994, 21).

However, this is changing rapidly mainly due to deforestation. Forest resources have immense value to the Zambian society as they do not only provide environmental or ecological services but also directly support livelihoods through provision of fuel, food, agriculture, medicines and building materials to mention just a few (GRZ 2003, 3). The forest landscapes form a variety of ecosystems giving rise to a diversity of habitats for fauna and flora estimated at 3,631 species. Some of these species are only endemic to Zambia.

The Copperbelt province of Zambia has a total land area of 31 014 square km about 4.2 % of the total land area of Zambia. The total land covered by one form of forest or the other is nearly 600,000 hectares of which 10 % comprise industrial plantation and the remaining 90 % is made up of natural woodland type of vegetation. A large part of this woodland forest is under the protected forest reserves.

All the districts in the province except one, Ndola Rural, have no more land left for agricultural purposes (Sutherland 2002). As a result, there has been mounting pressure on the forest resources resulting in people encroaching protected forests and even putting up settlements there such as on Mwekera Forest in Kitwe.

This has brought conflict between the state through its Forest Department and the local people. But due to mounting pressure, nine forest reserves have been identified for possible degazetment. Poverty and the poor are blamed for these problems in forest management in the province and the whole country.

The status of the Copperbelt is slowly changing from being Zambia's economic backbone to one of economic depression and high unemployment. Copper which is the country's major foreign exchange earner is found on the Copperbelt (UNDP 2002). 'The climax of ... privatisation ... was reached in the year 2000 when the mining conglomerate, the Zambia Consolidated Copper Mines (ZCCM) was unbundled and sold resulting in 13 000 people losing their jobs' (GRZ 2002, 73).

Other industries which depended on the mines through the supply of goods and services also faced economic problems and most closed down. In the country as a whole, poverty levels are estimated at 73 % (GRZ 2002). Therefore, income poverty is widespread in the province and some towns such as Luanshya have even been termed "ghost towns" forcing government to declare them as tax-free zones in order to attract investment in a bid to revitalise the province. So it is clear from this background why policy makers and conservationists find it easy to place the problem of deforestation in the province on the poverty and the poor.

2.1 Rich forests poor people? Empirical evidence

Empirical studies elsewhere on the relationship between poverty and environmental degradation and deforestation in particular, while acknowledging this link, have produced different conclusions. For example, while Swinton and Quiroz (2003, 1) established a clear environment-poverty link in their study of Altipano forest in Peru, they argued that natural resource sustainability was not correlated with poverty but rather with the management regime or system. This implies that it is not so much the prevalence of poverty that will result in resource depletion such as forests, but the way the forests are managed. This is in agreement with Angelsen and Kaimowitz, who also question the conventional environment-poverty thesis.

Using 140 economic models to analyse causes of tropical deforestation, the two assert that underlying causes such as “policy reforms included in current economic liberalization and adjustment efforts may increase the pressure on forests” (Angelsen and Kaimowitz 1999, 1).

These authors are emphasising the fact that the relationship between poverty and deforestation or environmental degradation in general is not as simple as it is made out to be. Other underlying factors are even more decisive. These underlying or fundamental imperatives leave the poor with no alternatives but to act in the way they do. Therefore, it is important to focus on these underlying factors; otherwise we will be treating symptoms instead of the disease. The other underlying factor of environmental degradation and deforestation in particular is that of land tenure. According to Vincent and Gillis (1998, 134), “without secure legal rights to forest land economic agents are understandably reluctant to make the investments in forest management...”

This point is echoed by Wilson (2003, 105) who reports that in most cases “poor people do not own the land they farm and they therefore have few or no incentives to conserve soils, harbour ground water or preserve trees”. Another study by the Biodiversity Action Network (1999, 4) in the Mau forest in Kenya found that the lack of protection of the rights of indigenous communities and their traditional role in forest management intensifies the destructive natural resource extraction. This study went further to explain that government ownership of the forest, and the lack of legal rights over the resources by local communities leads to a feeling of alienation from the land, ultimately in the high rates of illegal exploitation of the forest.

An extreme view is that in areas where formal title deeds are not given, clearing the forest is actually a form of asserting one’s rights to a piece of land. The point emphasised here is that while there may appear to be a correlation between poverty and environmental degradation, it would be simplistic to easily conclude that the relationship is causal. The land tenure factor highlighted here is a policy issue and therefore policy issues are very decisive in such matters. Such blame should be shifted from the poor to the policy makers both at national and international levels, as it is the policy makers who provide the framework within which the poor are forced to make their survival decisions which may result in forest clearance.

The role played by alternative sources of income as well as access to credit among forest communities is also important. According to economic models used by Angelsen and Kaimowitz, “higher rural wages reduce deforestation by making agricultural and forestry activities more costly”. Citing studies done in Honduras and Bolivia, the same authors emphasise the role of credit accessibility by concluding that there is a positive correlation between credit availability and deforestation (Angelsen and Kaimowitz 1999, 84). The issue of credit is closely related to that of agricultural subsidies as higher fertilizer prices lead farmers to adopt more extensive production systems that use more land than fertilizers. The higher fertilizer costs seem most likely to induce greater clearing when farmers are wavering between intensive sedentary agriculture and more extensive shifting cultivation systems.

As a result of this effect, Holden (1997) cautions about the possible negative impact of current policies aimed at reducing fertilizer subsidies in Sub-Saharan Africa such as Zambia. The removal of agricultural subsidies in most of these countries, including Zambia, has been part of the conditions for implementing the Structural Adjustment Programme SAP package. The SAP is an economic reform programme that the Zambian government has been implementing since 1992. It includes economic liberalisation, privatisation of public companies and decontrol of prices among other measures. Movik et al. (2003, 16) distinguish between endogenous and exogenous poverty. While the former is induced by the degraded environment, the latter is caused by other factors independent of the environment-poverty vicious cycle.

They conclude that it is exogenous poverty and its external causes that can be linked to environmental degradation. Endogenous poverty, which is usually blamed, is merely a feedback loop. This view dismantles the general belief of the poor acting both as agents and victims of environmental degradation and deforestation. The argument is that it is external factors that make the people poor (exogenous poverty) in the first place and not their unsustainable environmental practices.

While admitting the role of poverty in environmental degradation, Movik and others conclude that “the major cause of environmental degradation may not lie in the presence of poverty itself, but in the lack of secure arrangements ... institutional failure and the absence of a functioning property rights system (which) act as primary incentives to adopt unsustainable land use practices” (Movik et al. 2003, 16).

2.2 Discussion of results

It is clear from the literature surveyed so far that the linkage between poverty and environmental degradation in general and deforestation in particular has been interpreted in various ways. What is common in all the literature surveyed so far, however, is the rejection of a simple causal relationship between poverty and deforestation. There is a strong emphasis placed on underlying factors that compel the poor to engage in unsustainable practices in the first place. The over-consumption of resources by the rich is also cited as an important cause of environmental degradation.

The first underlying factor presented is policy reforms both at national and international levels. Zambia has undergone several policy and economic reforms including the Structural Adjustment Programme and its liberalisation. This has also meant removal of subsidies on agricultural inputs as well as loss of thousands of jobs through privatisation and liquidation of companies. Therefore, in line with the literature surveyed in this paper, these policy reforms are likely to have played a major role in the deforestation on the Copperbelt. For example, miners in Luanshya and other towns who lost their jobs more than five years ago have not been paid their pensions or terminal benefits (Sutherland 2002; GRZ 2003). This leaves them with no other alternative but to engage in survival strategies that may not be environmentally sustainable.

The land tenure system in Zambia is such that most of the land used by the communities is under customary tenure and they have no title to it. People only exercise usufruct rights or rights by virtue of using that land. Therefore, clearing land may be a way of asserting one's right to land and this may be another real factor contributing to deforestation.

Although the land Act no. 12 of 1996 provides for private ownership of land through leasehold, ordinary people do not easily access land due to lack of collateral requirements and general bureaucracy. Apart from the national policy and market failures which go a long way in explaining deforestation in Zambia, foreign debt and trade in forest products particularly timber are important factors of deforestation. The institutional capacity of government departments

responsible for forestry is cited in literature as an important determinant of forest status. In Zambia, the Forest Department does not have sufficient financial, material and human resources to manage forest resources effectively.

For example, the restructuring of the public service (part of SAP) has left it with few field officers to effectively manage the huge forest estate. Besides, there is an overlap in responsibilities with the Zambia Wildlife Authority ZAWA, the institution that manages the National Parks and game management areas. These areas (53 in total) and contain vast areas of woodlands over which the Forest Department whatsoever (Sutherland 2002). The Forest Department was due to be transformed into an autonomous institution Forest Commission which was intended to broaden participation in forest resource management as well as improve efficiency in forest resource management.

3 CONCLUSIONS

It has been shown through the several sources cited that the relationship between poverty and environmental degradation, and deforestation in particular, is not a simple causal one. The role of underlying factors such as national and international policies, market failure, land tenure and off-farm income sources are highlighted as crucial. What has been the major argument is that the decisions made by the people in resource utilisation are largely determined by macroeconomic and other forces beyond their control. The rich, particularly timber operators, are largely responsible for deforestation but this is usually down-played in preference for blaming the poor. The paper has also shown Zambia's status in most of these factors in order to infer, if only cautiously, the real causes of deforestation in the country. These range from the policy, economic and institutional frameworks.

The role of international policies such as trade and foreign debt has been presented as contributing factors to resource management in general and deforestation in particular. It seems reasonable to conclude that there are several factors contributing to this process in the country with the macro-economic and other external factors featuring prominently. The fact that deforestation is often found adjacent to impoverished areas should not delude us into concluding that the poor are entirely to blame.

While one can not fully deny the relationship between poverty and deforestation on the Copperbelt, it would be superfluous to draw simplistic causal relationship between them. Therefore, while the actions of the poor on the Copperbelt are not sustainable and may be linked to deforestation, they can not be entirely blamed for it. The framework within which the poor are left with no options is determined by government as well as international policy makers. It is these policies on employment, land tenure, international trade and debt, agricultural subsidies or lack of them, as well as the institutional capacity of forest authorities which are largely responsible for deforestation and encroachment.

References

- Angelsen, A. and Kaimowitz, D. 1999. *Rethinking the Causes of Deforestation: Lessons from Economic Models*, **The World Bank Research Observer**, Vol. 14 (1), pp 73-98.
- Anon. 1996. **World Resources: A guide to the Global Environment 1996-1997**, London, Oxford.

- Biodiversity Action Network 1999. **Addressing the Underlying Causes of Deforestation and Forest Degradation: Case Studies, Analysis and Policy Recommendations**, Rain Coast Conservation Society.
- Chidumayo, E.N. 1996. **Wood Used in Charcoal Production in Zambia**, Unpublished Interim Report for World Wide Fund for Nature (WWF)-BSP, Washington DC.
- Chipungu, P. M. and Kunda, D. M. 1994. **State of the Environment Zambia 1994**, Government Printers, Lusaka.
- Chipungu, J. 2000. *Deforestation on the increase in Zambia*, **Pan-African News Agency**, Lusaka.
- Dudik, D. Kelly, D. Dicknson, E. & Dwyer, D.1992. **Global Effects of Deforestation**, Virginia Polytechnic Institute and State University, Virginia.
- Environmental Council of Zambia ECZ 2001, **State of Environment in Zambia 2000**, ECZ, Lusaka.
- FAO 1999. **State of the World's Forests**, The Food and Agriculture Organisation of the United Nations, Rome.
- FAO 2001. *Deforestation continues at a High Rate in Tropical Areas*, **State of World's Forests**, The Food and Agriculture Organisation, (FAO), Rome.
- GRZ Government of the Republic of Zambia 2002. **The Poverty Reduction Strategy Paper (PRSP)**, Ministry of Finance and National Planning (MOFNP), Government Printers, Lusaka.
- GRZ Government of the Republic of Zambia 2003. **Summary: Privatisation Status Report for 2003**, Zambia Privatisation Agency ZPA, Lusaka.
- Holden, S.T. 1997. *Adjustment Policies, Peasant Household Resource Allocation and Deforestation in northern Zambia: An Overview and some Policy Conclusions*, **Forum for Development Studies**, Vol. 1, pp 117-34.
- Mayfield, P. 1999. *Forest Conservation and Deforestation Linked*, **Environmental News Network ENN**, June, 1 1999.
- Movik, S. Dejene, S. & Synnevaråg, G. 2003. *Poverty and Environmental Degradation in the Drylands: An Overview of Problems and Processes*, **Noragric Working Paper No. 29, July, 2003**, Agricultural University of Norway.
- Roberts, R. W. & Rogers. J .1999. *Deforestation: Tropical Forests in Decline*, **Forestry Issues**, CIDA, British Columbia.
- Rowe A. R. 1992. *Deforestation: Problems and Causes*, Narendra. P. (ed). **Managing the World's Forests: Looking for Balance Between Conservation and Development**, Iowa, Kendal/Hunt Publishing Co.
- Sutherland, N. 2002. **Zambia: From Copper to Cultivation**, Oxfam International, London.
- Swinton, M.S. & Quiroz. R. 2003. *Is Poverty to Blame for Soil, Pasture and Forest Degradation in Peru's Altipano?* **World Development**, Vol. 31 (11).
- United Nations Development Programme UNDP 2002. **Zambia Situation Update**, United Nations.
- Vincent, J. R. & Gillis, M. 1998. *Deforestation and Forest Land Use: A Comment*, **The World Bank Research Observer**, Vol. 13 (1) pp. 133-40.
- Wilson, E. 2003. The Earth's Environmental Woes: Is Agriculture Part of the Problem or Part of the Solution? **World Development**, Vol. 31 (11).
- WRM 2002. *The Causes of Deforestation and those Responsible for it*, **World Rain Forest Movement Bulletin no. 61, August 2002**, Montevideo.
- Yudelman, M. 1964. **Africans on the Land**, London & Harvard University Press.

Joseph Kofi Teye

DEFORESTATION IN GHANA

Abstract

This paper uses secondary data to examine the causes and effects of deforestation in Ghana. By relying heavily on the political ecology perspective on environmental degradation, the paper reveals that deforestation in Ghana is caused by the interaction of economic, social and political factors. Two groups of factors namely direct and indirect causes of deforestation were identified. Rapid population growth, international trade, structural adjustment programmes and misguided government policies were identified as the indirect causes, which interact to trigger the immediate or direct causes. The direct causes include human activities such as fuel wood production, mining, bush fires, settlements, and agricultural activities.

The paper reveals that the ecological and socioeconomic effects of this deforestation in Ghana are enormous and include climatic changes, loss of biodiversity, soil erosion, silting of rivers, drying up of rivers, loss of medicinal plants, declining productivity and food insecurity. It is argued that since so many Ghanaians directly depend on the forest for survival, any control measure that tackles only the direct causes is unlikely to achieve success. It is, therefore, recommended that in addition to strengthening the institutions charged with the management of forest resources, controlling the indirect causes such as rapid population growth, poverty and the adoption of economic policies that are environmentally friendly will all go a long way to reduce the rate of deforestation in Ghana. Community participation in forest management and the adoption of agroforestry have also been recommended.

INTRODUCTION

Forests are extremely important to humans and the natural world. For humans, they have many aesthetic, recreational, economic, historical, medicinal, cultural and religious values. One-third of the world's people depend on wood for fuel as a significant energy source (FAO 1993a). Forests also provide home for wild animals and are popular settings for ecotourism. Trees protect the soils against erosion and directly influence the amount of rainfall. They also control the rate of water released into watersheds. Despite this significant importance of forests, they are threatened by human activities. Approximately 2.4 acres of forest land are cut down every second. This figure equals 215000 acres per day (an area larger than New York)¹. Indeed more than 80% of the world's natural forests have already been lost (Hui 1997), and it is predicted that if the global deforestation continues at the current rate the world's rain forest will be gone within 100 years (Rainforest Report Card 2002). One negative effect of deforestation that has been a source of worry to many development thinkers and international organisations is the loss of biodiversity. Coined in the 1980s by the ecologist, Edward O. Wilson, the term biodiversity was conceived within the "politics of loss". Evans (1996) noted the loss of familiar and symbolic species. The loss of remote species barely discovered before they became exterminated. The loss of species even before they could be discovered together with the loss of cherished landscapes and places of exotic allure gathered into a political storm. The political storm on the need to maintain biodiversity came to a head at the 1992 Rio summit with the establishment of the Biodiversity convention. The convention recognises that in order to protect biodiversity, the current rate of deforestation must be controlled².

¹ <http://www.geocities.com/sapphire2021/forest.html>

² <http://www.un.org/esa/sustdev/agenda21chapter11.htm>

Despite all these concerns, global deforestation is still going on at alarming rates especially in developing countries. In Africa, between 1950 and 1983, forests and woodland areas dropped by 24% (Repetto 1988). Over half of the forest loss in Africa occurred in West African countries such as Ivory Coast, Nigeria, Liberia and Ghana where the rate of forest loss is seven times the world average (World Resources 1986, cited by Mann 1990). As discussed for the whole world, deforestation in Ghana has led through the ages to environmental damage, economic deterioration and human misery. At the beginning of the last century, Ghana's forests estates covered 8.2 million hectares. This has dwindled to only 1.4 million hectares by 1988, and it has been estimated currently that Ghana's tropical rainforest is just 25% of its original size. Since 1981, the rate of deforestation in the country is 2% annually or about 22 hectares per year in absolute terms (Gills 1988). Figures like these are very alarming and if nothing is done, the forest in Ghana may disappear forever in the near future. In fact, it is estimated that at the current rate of deforestation, the entire forest in Ghana will be lost within 45 years (ibid).

The negative ecological and socio economic effects of this high rate of deforestation in Ghana could be enormous. If it is not controlled, deforestation will not only worsen the poverty situation in Ghana but also be a threat to the survival of a significant part of the population. Understanding the factors causing deforestation as well as the effects of the problem will be important for designing policies and programmes that can be adopted to protect the forests of Ghana. Against this background this paper uses secondary data, mainly in the form of articles, books, journals, reports, and internet materials to examine the main causes of the forest loss in Ghana. The paper shall analyse the effects of the deforestation as well as suggest alternative measures that could be adopted to reduce the deforestation in Ghana.

COUNTRY PROFILE – GHANA

Ghana is located on the West Africa's Gulf of Guinea, only a few degrees north of the equator. Precisely, the country lies on latitude 5 degrees 36 minutes and longitude 0 degrees 10 minutes east. It has a total land area of 238540 square kilometres of which the land area constitutes 230020 square kilometres.

The climate is tropical and there are two distinct rainy seasons in the south (May-June and August-September). In the north, there is only one rainy season (June-July). Annual rainfall ranges from about 1100 mm in the north to about 2100 mm in the southeast. With the exception of the narrow coastal belt, the forests occupy the whole of the south-western part of Ghana where rainfall is very high³. There are two types of forests. One is the rainforest which is usually evergreen and located in the extreme southwest where rainfall is above 2500 mm. The other is the semi deciduous forest which is similar to the rainforest but the trees here have deciduous characteristics (Boateng 1970). The population of Ghana is currently estimated at 20.7 million (World Fact Book 2004). Agriculture is the backbone of the Ghanaian economy contributing about 45% of gross domestic product (ISSER 1999).

³ <http://www.ghanaweb.com>

THEORETICAL PERSPECTIVES AND CAUSAL CHAINS

The multitude of hypotheses regarding the causes of all forms of environmental degradation including deforestation can be grouped into four main camps namely the classical view, the neoliberal perspective, the political economists view point and the regional political ecologists view.

Classical view (Neo-Malthusian perspective)

The Neo-Malthusians view mounting demographic pressures on natural resources as the paramount factor causing environmental decline (Brown 1989; Ehrlich and Ehrlich 1990). It is argued that as population increases, natural resources decrease (an inverse relationship) and this in turn will lead to the destruction of forests. The classical view has been severely lambasted for a single hypothesis type of explanation (Chambers 1994). The most common counter movement against this view comes from Esther Boserup (1965). There is enough evidence to suggest that population growth is not a sufficient causal explanation for the growing abuse of land, destruction of forests, soils or other ecological problems. In fact, cases have been reported in parts of Kenya where increase in population densities has rather led to sophisticated sustainable farming systems (Tiffen et al. 1994).

The Neo-Liberal economic perspective

The World Bank and the International Monetary Fund are the main proponents of this view. It is argued here that a faulty incentive system offered by governments is the main cause of environmental problems including deforestation. A reduction of government's influence on markets and trade liberalisation has been suggested as the solution to environmental deterioration. Proponents further posit that economic growth resulting from structural adjustment programmes would benefit poor countries both socially and environmentally. This view is based on the operation of the *Kuznets* hypothesis, which argues that at the initial stages of economic development, growth in income is accompanied by inevitable environmental problems due to intensive expansion of resource extraction. The situation changes after a while, when environmental awareness, technological development and structural changes emerge with growth. Critics argue that privatisation as suggested by this view can rather cause environmental degradation (Blaikie and Brookfield 1987).

The Political Economist view point

Proponents of this view argue that environmental problems must be explained in terms of economic forces, social relations, property rights and power. It is argued here that within rural areas, local elites drain resources from rural environments which in turn are shared by urban bourgeoisies. At the higher level, capitalism directs resources from poor countries through unequal exchange and capital investments (Amin 1997, Chambers 1994). This perspective identifies poverty and external factors as underlying causes of environmental degradation in developing countries. It is argued that poor countries tend to concentrate on increasing their economic performance at the expense of the environment (Blaikie and Brookfield 1987). Poverty alone, in fact, does not always lead to degradation since, traditionally, common property resources are governed by social rules established over time. It is rather the joint effects of population growth, poverty and policy changes that may break down these rules. The communally owned resources such as forests then become 'open resources regimes' where people can extract as many resources as possible, and it is under these conditions that environmental degradation takes place.

Regional Political Ecology Approach

Formulated by Blaikie and Brookfield (1987), this approach recognises multiple causation and multiple interventions to environmental problems. The approach combines the concerns of ecology and a broadly defined political economy. This implies that it encompasses the constantly changing dialectic between society and land-based resources within classes and groups in the society itself (ibid). In developing the theory, Blaikie and Brookfield highlight two key elements namely (i) the interaction between social and physical systems in a specific geographical region and (ii) the importance of the specific historical and other contextual settings of the region.

The application of this approach involves an analysis of the resource (forest) management decision making process, and this is referred to as *chains of explanation*. The chains of explanation are further broken down into three groups; (a) the relationship between forest managers and the forests, (b) forest managers and other forest managers and groups in the society, and (c) the state and the world economy. Thus the approach suggests that analysis must be done at three levels namely, the local, the national and the international level. At the local level, the analysis will have to take account of such factors as cultivation techniques, population densities and socio-cultural traditions. The national level analysis must focus on processes of national policy formulation and implementation of development strategies. The argument here is that national policies can have a significant effect on resource extraction. For instance, policies on agriculture, energy sources and land tenure can affect forest conservation. The last level of analysis must focus on the relationship between the state and world economy. In this case, Ghana is seen as being at the periphery of the global economy which is dominated by highly industrialised countries. Thus issues such as unequal terms of trade and the adoption of certain policies supported by international organisations will also have a marked effect on forest depletion in Ghana. Many scholars have used the political ecology approach in understanding deforestation. O'Brien (1995), in her studies of deforestation and climatic change in Selva Lacandonia argued that for a good understanding of deforestation, one must look at the interaction of economic factors as well as social and political relations.

In this paper, the problem of deforestation in Ghana will mainly be analysed within the wider framework of the "Regional Political Ecology" discussed above. The choice of the framework is due to its recognition of multiple causation and multiple interventions. This, however, does not suggest that the other theoretical perspectives are of no value. In fact, useful elements of some of these other theories will also be relied upon to aid explanation at certain stages of the paper.

Conceptual framework on causes and effects of deforestation in Ghana

A conceptual framework that incorporates several aspects of the theories discussed above is certainly most appropriate. In the frame below (Figure 1) the causes of deforestation in Ghana are grouped into two, namely the direct or immediate causes and the indirect or underlying causes. The indirect factors trigger the direct factors to cause deforestation. It must also be noted that there is a relationship among some of the direct causes and this will form smaller chains. For instance, high population growth will lead to poverty. The smaller chains are, however, not shown here for the purpose of simplicity. The model shows that there are several ecological and socioeconomic effects of forest loss in Ghana. Some of these effects are listed. Essentially, most of the socio economic effects have resulted from the ecological effects. For instance, climatic changes can lead to declining agricultural production and hence food shortage. In the same way, some of the socioeconomic effects may later serve as underlying factors to further trigger the direct causes of deforestation. For instance, low

production due to climatic changes may lead to poverty but poverty itself can also further aggravate the rate of deforestation.

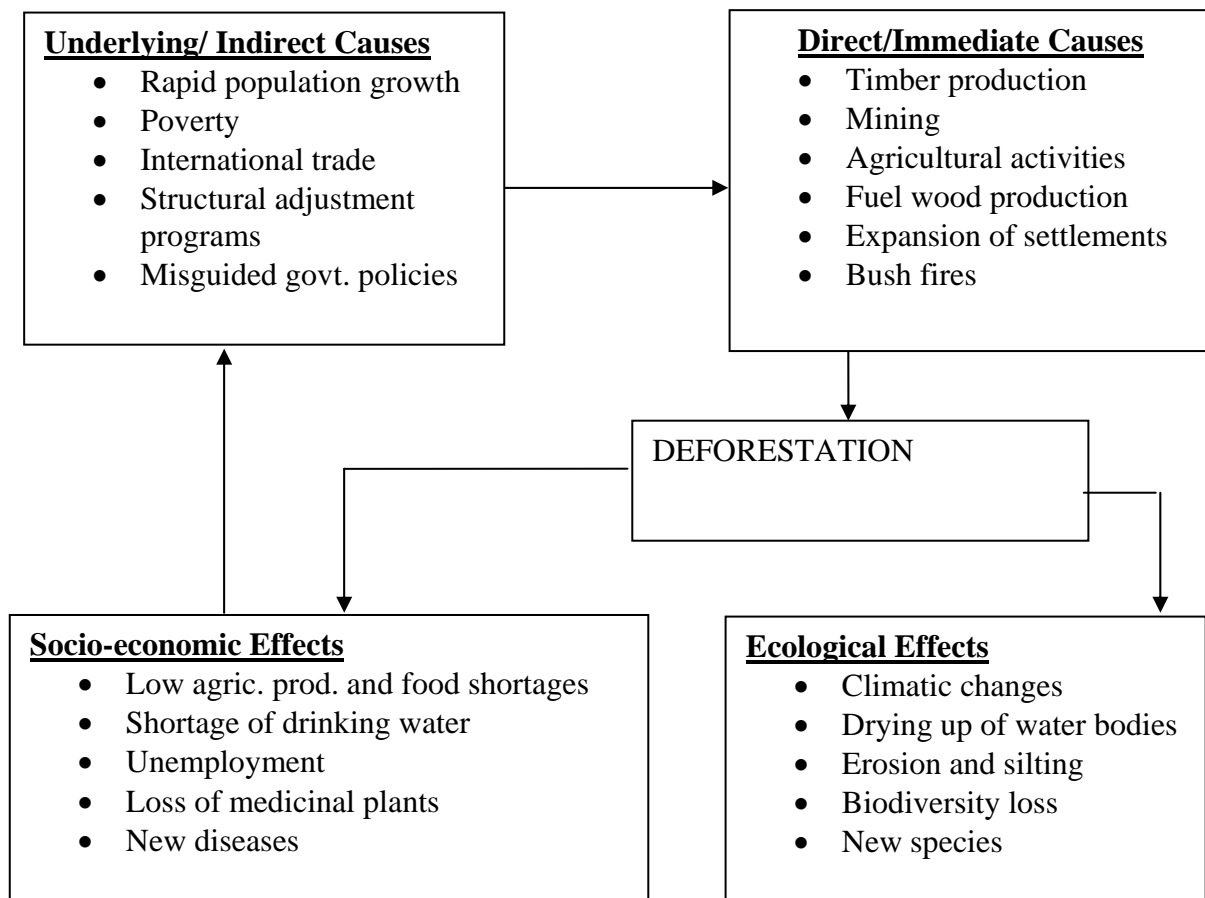


Figure 1: Conceptual framework on causes and effects of deforestation in Ghana.

CAUSES OF DEFORESTATION IN GHANA

The causes of deforestation in Ghana are multifactorial. A recent paper entitled “Background Document” which was presented during an African Regional Workshop in 1999 discusses the causes of deforestation in Ghana in terms of complex economic, social, political and natural resource management pressures (World Rainforest Movement 1999). The paper distinguished the causes of deforestation into two categories namely direct (immediate) and indirect or underlying causes. The direct causes are the direct human activities and include; logging, mining, agricultural activities, fuel wood production, bush fires and expansion of human settlements. The indirect (underlying) causes are those factors which trigger the immediate (direct causes). They include factors such as rapid population growth, poverty, inappropriate government policies, structural adjustment programmes, international trade and global economic situation. Each of these factors is now discussed in detail.

Logging and Timber production

Logging has been part of the Ghanaian economy since colonial times but the adoption structural adjustment programmes in 1983 has led to an astronomical increase in logging. The wood produced is mainly exported to several countries in order to earn foreign exchange that is badly needed to improve the ailing Ghanaian economy. The heavy machinery used in commercial logging is damaging to the forests. Also, the roads created by these graders open

up the thick forests for landless farmers to enter thereby further destroying the forests. Apart from large multinational companies, free-lance young men armed with chain saws are also cutting swathes through Ghana's timber reserves and sell timber to local craftsmen and small-scale industries.

Mining activities

Ghana is endowed with a lot of mineral resources. These include gold, bauxite, diamond and manganese. Coincidentally, all the mineral deposits are located at the south-western part of the country, which is also the main forest belt. The mining of these minerals has therefore led to the clearing of large hectares of the forests. The rate of mining has increased significantly since 1983 when the country adopted structural adjustment programmes. During this period, the government created incentives in the form of tax rebates and tax holidays to attract foreign investors, and this led to significant increase in mineral production. By 1990, there were 60 gold mining companies in Ghana (ISSER 1999). Mining activities of both large scale companies that use sophisticated machines and small-scale local miners who use simple tools has led to severe destruction of parts of the forest.

Clearing of forests for agricultural activities

Agriculture is the backbone of the Ghanaian economy constituting about 45% to Gross Domestic Product (ISSER 1999). About 60% of the population are engaged in agricultural activities, mainly crop production. The agricultural activities are directly related to deforestation in several ways. Firstly, significant portions of the forests are cleared annually for the production of cocoa. It is the second largest foreign exchange earner in Ghana but only grows well in the forest zone. Ironically, even though government is not able to stabilise the prices of many other crops, the price of cocoa has been relatively high and more stable. Many farmers have therefore been constantly clearing large portions of the forest in order to produce more cocoa to earn more income. In fact, the volume of cocoa exports rose by over 70% between 1983 and 1988 alone (ibid), mainly due to price increases. Apart from cocoa, the cultivation of annual food crops by peasant farmers who mainly practice shifting cultivation is also linked to deforestation.

Fuel wood and charcoal production

In Ghana, there is a high consumption of wood for energy and cooking, estimated at 14 million cubic metres annually and expected to rise to 20 million cubic metres by the year 2010. Fuel wood is the main source of energy used by rural dwellers that constitute about 60% of the population. Even in urban areas, about 69% of all households use charcoal. It is estimated that 91% of total round wood production in Ghana is used as fuel wood and for charcoal. The remaining 9% is used as industrial round wood⁴. The cutting of trees to meet this high demand for fuel wood is therefore a major direct cause of the depletion of forest resources in the country. For instance, the production of charcoal at Akate and Asewewa in the eastern region of the country has been identified as the main cause of the destruction of the Akate forest, which borders the Volta Lake (Many Krobo District Assembly 2000) More disturbing is the fact that trees cut for fuel wood are usually young and this will have severe negative impacts on the utilitarian ecological values of the forest.

Bush fires

Fires have long been identified as part of disturbances on the landscape (Turner 2001, 90–160). The main causes of bush fires, which have been rampant in Ghana in recent times, are

⁴ http://www.afrol.com/News2002/gha007_forestry.htm

human factors rather than natural causes. Most peasant farmers deliberately set fire to the forest through the slash and burn farming system. Hunting is another cause of bush fires in Ghana. Fires are used for directing the game in the hunting process. Charcoal production is another cause of bush fires. The high incidence of bush fires in the country is causing destruction to a large part of the forest, especially in the transition forest zones.

Clearing of forests for human settlements

The population of Ghana has been growing very fast since total fertility rate is still quite high, about 4.6 (Ghana Statistical Service 1999). With this high rate of population growth, existing settlements are expanding rapidly and this has led to the clearing of forests to build houses. Similarly, as the population increases, agricultural production in most existing villages decline due to pressure on the land. This forces most rural farmers to migrate and colonise new farming lands, which are mostly located in the forests where the fertility of soils is high. For instance, majority of farmers from other parts of the country have been migrating to the forest zone for cultivation of cocoa (Kotey et al. 1998) and large portions of the forest have been cleared for new settlement in this way.

I will now turn to examine the indirect or underlying causes of deforestation in Ghana.

Rapid population increases

The population of Ghana has been growing very rapidly. With a population of just over 2 million in 1921, the population quadrupled to 8.6 million in 1986 and then increased to 12.2 million by 1984 (Ghana Statistical Service 1985). The current population is around 20.7 million (World Fact Book 2004). These figures mean that more people are being added annually to the population and hence the exploitation of forests for such commodities such as bush meat, fruits, fire wood as well as the expansion of settlements and farm sizes will definitely lead to deforestation. Linking this population issues to the theories discussed, it is clear that the situation in Ghana, in a way, lends credence to the Neo-Malthusian perspective, which blames environmental problems on the high rate of population growth. The only difference here is that population growth alone could not be blamed since other factors such as misguided policies and corruption also accounts for the high rate of deforestation.

Poverty

Poverty as a concept is a complex and multidimensional phenomenon that does not lend itself to a single-touch definition. According to the UNDP, poverty is associated with weak endowments of human and financial resources, such as low level of education and few marketable skills and hence generally poor health status and low labour productivity (UNDP 1999). Poverty is also viewed as the socio-economic phenomenon whereby the resources available to a society are used to satisfy the wants of the few while many do not have their basic needs (Chambers 1994). The Ghana living standard conducted in 1992 (Ghana Statistical Service 1993), indicated that 31% of the total population had their annual expenditure below the country's poverty line of 132230 cedis (about 17 US dollars). While this is a national problem, it is more severe in the rural areas. In fact rural areas of Ghana constitute 65% of national population but they contribute 80% to national poverty. This widespread poverty especially among rural people, who depend directly on forests for fuel wood, food and game, partly accounts for forest loss. The argument is that Ghanaians use fuel wood and practise shifting cultivation not because they are ignorant but because they are poor. Gills (1988) argues that landless farmers are driven to migrate to the forest by poverty, hunger and population pressures. Durning (1989) similarly noted that poverty has become an increasingly environmental phenomenon. The poor not only suffer disproportionately from

environmental damage caused by the richer; they have become a major cause of environmental decline themselves. Pushed to the marginal lands by population growth and inadequate development patterns, they raze plots in rain forests, steep slopes and overgraze fragile rangelands. Economic deprivation and environmental degradation have thus come to reinforce one another to form a maelstrom – a downward spiral that threatens to pull ever more into its grasp (ibid).

It must also be noted that, many urban dwellers in Ghana are poor and depend on fuel wood and charcoal as they can not afford electricity and gas. Thus urban demand for fuel wood is another cause of deforestation. The links between poverty and deforestation also manifest themselves at the national level. The percapita income of Ghana is only 400 dollars. The external debt alone is about 6 billion US dollars (ISSER 1999). Trapped in this web of national poverty and as a result of corruption and misguided policies, the government often emphasises the exportation of primary commodities, mainly gold, timber and cocoa but as already noted, the productions of these commodities directly cause deforestation. This situation thus buttresses the point of the political ecologist and political economist that poverty is a major cause of environmental degradation.

International trade and global economic situation

As the political ecologist perspective has pointed out, external factors cannot be ignored in the analysis of causes of deforestation. Ghana exchanges mainly primary products such as gold, cocoa and timber for manufactured goods from Europe and the United States. Attempts by governments to diversify the composition of exports have not yielded much due to structural problems as well as trade restrictions by developed countries. For instance, the European Union, until recently, does not accept banana from Ghana. To worsen the situation, there has been rapid depreciation in the Ghanaian cedi in recent years. The combined effects of these unfair terms of trade and depreciation have put pressure on the government of Ghana to emphasise the exportation of gold, cocoa and timber despite the fact that the exploitation of these commodities directly cause deforestation.

Structural adjustment programmes

Faced with serious economic crises, Ghana adopted structural adjustment programmes (SAP) between 1983 and 1989. The SAP entailed huge external borrowing. These loans were to be used to increase the exportation of primary products so as to solve the balance of payment problems. The economy was liberalised and many state properties privatised as prerequisites to get these loans. Subsidies on agricultural production were removed and user fees were introduced for water and health. At the macro level, the adjustment programmes made significant gains as inflation, for instance, fell from three digits to below 30%. There was also an increase in gross domestic product (Britwum et al. 2001). Despite these gains, the environmental impacts of the adjustment were negative. Overexploitation of minerals and timber during this period led to severe deforestation and pollution of water bodies (ibid). Again, privatisation led to the redeployment of many workers who were previously in urban centres (Takyiwaa 1997). These people, having lost their work in the towns went back to their “roots” at the rural areas and the only occupation for them was farming, thereby increasing the pressure on the forests. At the macro level, over borrowing under the SAP program led to increased debt. Ghana’s external debt which was less than 1.1 billion US dollars in 1981 rose to 5 billion US dollars by 1997 (ISSER 1999). It is therefore my thesis that since poverty has a direct impact on deforestation, and the adjustments increased poverty, then by a chain rule, the adjustments partly led to deforestation. If this is the case, then the position of the neo liberal economists that liberalisation will eventually lead to improvement in environmental degradation is seriously challenged by the Ghanaian experience.

Inappropriate policies

There is enough evidence to show that the current rapid deforestation is also influenced by inappropriate and misguided government policies. For instance, in their desire to attract foreign investors, successive governments in Ghana have created unnecessary incentives which tend to cause overexploitation of forest resources. For instance, the 1985 investment code gave a five-year tax holiday and 20% tax rebate to newly established companies operating in rural areas. Unfortunately, most of the companies attracted to rural Ghana by this policy tend to concentrate on the extraction of land-based resources. Thus this misguided investment code led to over-investment in the logging and mining sub-sectors leading to deforestation. Another issue is that there is so much corruption among Government officials charged with forest management and this has also been leading to deforestation in Ghana. To conclude this section, it is clear that the underlying factors are interrelated and work together to trigger the direct human activities to cause deforestation in Ghana. Thus the political ecologists' viewpoint best explains the causes of deforestation in Ghana.

ECOLOGICAL EFFECTS OF DEFORESTATION IN GHANA

The ecological effects of deforestation in Ghana are enormous and include climatic changes, soil erosion, drying up of water bodies, silting of rivers, biodiversity loss and the emergence of new plant species (Mann 1990; Brown 1992, FAO 1993b). With regards to climatic changes, deforestation has partly led to increase in temperatures and declining amount of rainfall. Rainfall amount in Ghana, especially within the southwestern part had been very high; above 2100 mm. Unfortunately, the rainfalls are not reliable in recent years. This is attributed to the depletion of the forest in those areas due to human impacts. The combined effects of the high evaporation due to rising temperatures and declining amount of rainfall has led to significant fall in the volume of water in many water bodies in Ghana. One case worth citing to buttress this point is that of Lake Bosomtwi which is the largest natural lake in Ghana. The level of water in the lake fell by 2.4 metres between 1972 and 1987 and this is attributed to deforestation around the lake (Mann 1990). A similar case is that of the Volta Lake which is used for the production of hydro power. In recent times, there has been a significant decline of water in the lake and this is attributed to rapid deforestation along the banks of the river due to human impacts. Soil degradation is another negative effect of deforestation in Ghana. Most parts of Ghana are covered by lateritic soils, which harden on exposure to the high temperature of the sun. This leads to the formation of hardpans, which have low agricultural potentials. Again, the removals of the forest cover have led to increased soil erosion in many parts of the country (FAO 1993b).

Another indirect impact of deforestation in Ghana is the silting of rivers. As discussed already, the removal of the forest vegetation is causing a lot of erosion but the eroded materials are carried by small streams and deposited onto the beds of many big rivers. For instance, it is reported by the Volta River authority that recent increases in the silting of the lake is linked to erosion occurring along the banks of the river (Manya Krobo District Assembly 2000). Another serious impact of the deforestation in Ghana is biodiversity loss. Indeed many species are almost if not totally extinct. At the present rate of timber extraction, most Ghanaian hardwood like mahogany and odum would soon disappear. A lot of wild animals like elephants and the antelope have also almost gone extinct in Ghana. Conversely deforestation in Ghana has resulted in the invasion of some savannah plant species in the forest zone in recent times (Brown 1992).

SOCIO-ECONOMIC EFFECTS OF DEFORESTATION IN GHANA

There are several socioeconomic effects, most of which stem from the ecological effects discussed already. To begin with, the declining amount of rainfall as well as soil erosion is affecting crop production since most farmers in Ghana do not use irrigation or fertilizers. As a result, the government has to spend a lot of hard earned foreign currency to import food. This creates balance of payments problems. The result of the fall in water level in the Akosombo dam due to deforestation has led to a significant decline in the quantity of energy produced leading to energy crises in Ghana. Ghana which used to export power to neighbouring African countries now imports power from Cote d'Ivoire. This energy crisis is affecting socioeconomic development. Power rationing is now practiced during the dry season and recently the Volta Aluminium Company had to redeploy about 80% of its workers as the company is forced to cut down production due to energy shortage. The drying up of small streams affects rural dwellers who depend on these streams for drinking water. Silting of rivers and lakes due to deforestation poses problems to economic development. The Volta River Authority, for instance, has to spend a lot of money on dredging. The disappearance of forest animals and trees is affecting ecotourism in Ghana as the aesthetic qualities of tourist sites are significantly reduced by the loss of biodiversity. Similarly, hardwood needed for furniture is now scarce in Ghana. Deforestation is changing the habitats of disease-carrying insects and creating conditions that may help to spread diseases. For instance, the worms that cause river blindness or onchocercosis are transmitted by cytoforms of a blackfly found in savannah regions. These cytoforms are beginning to spread into cleared forests in Ghana. Deforestation in Ghana is threatening yet another sector linked to the well being of the people of Ghana: Pharmacopoeia. The majority of Ghanaians, especially in rural areas rely on herbal medicines. Doctors at the Mampong centre for traditional medicine say that more than 250 indigenous tress and plants have been scientifically catalogued. But as Dr Ampofo said, "time may be running out" He worries that the tress will be lost to deforestation before they can be catalogued⁵. One positive side of deforestation in Ghana, however, is the fact that it has led to the elimination of tsetse flies in many parts of the forest zone where the insects used to affect humans and livestock

Discussion of policies being adopted by the Ghana government to reduce deforestation

Both past and present governments in Ghana have formulated several policies aimed at reducing the rate of deforestation. The Forestry Department has, since 1909, been the main institution charged with the management of the forests in Ghana. Two major forest policies were formulated in 1948 and 1994. The 1948 policy emphasised the conservation and protection of permanent forest estates on a sustainable basis and to promote all aspects of scientific forestry (Kotey et al. 1998). The 1994 policy emphasises the conservation and sustainable development of the nation's forest and wildlife resources for maintenance of environmental quality and perpetual flow of optimum benefits to all segments of society. It aims at doing this by the involvement of local people in forestry management.

Apart from these, there have been other measures taken by governments. For instance, in 1995, the government banned the exportation of raw timber logs and quite recently, there has been a national ban on the use of chain saw to cut wood (Kotey et al. 1998). Defaulters of these laws are made to pay fines. Despite these attempts the problem continues and this is due to several factors. Firstly, the institutions charged with the management of the forests are weak and lack both human resources and technical ones too. Another issue is linked to the collection of bribes by the forest guards from the illegal chainsaw operators. The reason for

⁵ <http://www.american.edu/TED/GHANA.HTM>

this behaviour is partly because of low remunerations for the guards. Due to this same bribery and corruption, officials do not strictly enforce the rules governing the granting of concession and permits. Another problem is the weakness of the forest laws. For instance, the level of fines imposed on illegal timber operators is far below the market price of the timber. Another flaw is the fact that local people are not usually included in the designing and implementation of forest protection policies in Ghana and this has often led to a conflict of interests.

RECOMMENDATIONS

Based on the findings of this study, it is clear that any measure that tends to concentrate only on controlling the direct causes of deforestation by enactment of laws as it is the case now is not likely to succeed since the majority of Ghanaians depend on the forest directly for survival. Hence the starting point of solving the forest problems must be the control of the indirect causes. Firstly, the government must try to control population growth and poverty. Population growth can be reduced by promoting female education and encouraging modern contraceptives use. Rural poverty can be controlled by training rural people in alternative income generating activities such as dress making, soap making etc. This will reduce their direct reliance on land-based resources for survival. Government must critically examine some of its investment policies and incentives that tend to lead to over mining and over logging. It must be stated here that the situation in Ghana whereby economic policies are formulated only by economists with little environmental considerations must stop. It will be useful if the likely ecological and socio economic impacts of economics policies are analysed and presented as different scenarios. This will mean the involvement of ecologists, planners and other professionals in the formulation of economic policies. The international community also has a role in the reduction of deforestation. Here, developed countries must eliminate trade restrictions and help poor countries like Ghana to diversify the composition of exports. Such a move can lead to a reduction in the exploitation of primary commodities which have adverse effects on the forests.

Apart from controlling the indirect causes, it will be important to control the direct causes too by using laws. There must, therefore, be strong environmental laws. The main institutions tasked with the management of forest resources in Ghana must be strengthened by providing them with both human and technical resources. Local communities must be involved in the management of forest resources in Ghana. This is because, as Greider and Garokovich (1994), noted, a single landscape has different meanings to different people. Most rural farmers in Ghana depend directly on the forest which to them is an inheritance from their ancestors. One does not know where these farmers will go if they are totally banned from stepping into the forests. Hence, the best solution can be the creation of forest reserves. After all it is said that “management practices must be culturally acceptable” (Turner et al. 2001, 306). Another possibility is to encourage agroforestry system.

CONCLUSION

From the above discussion, it is concluded that deforestation in Ghana is caused by the interaction of economic, social and political factors and this has supported the regional political ecologist perspective. Population growth, poverty and the global economic situation interact to trigger the direct human causes of deforestation, which include logging, mining, fuel wood production, agricultural activities, human settlements and bush fires. Several ecological and socio economic effects such as biodiversity loss, climatic changes, drying up

of water bodies, diseases and low agricultural productivity were identified. It is argued that whilst it is important to enact tougher laws to protect the forests, any ad hoc method that attempts to solve the problem by focusing only on the direct causes such as the imposition of laws and outright bans is bound to fail since so many people depend on the forests directly for subsistence. Controlling the indirect causes of deforestation such as poverty and rapid population growth and the adoption of economic policies that are environmentally friendly will all go a long way to reduce the rate of deforestation in Ghana. It is further recommended that in addition to strengthening the institutions tasked to manage the forests, local people must be included in the management of forests resources. It will also be good to create forest reserves and encourage the adoption of agroforestry systems.

References

- Amin, S. (1997). *Capitalism in the age of globalisation*, Zed Books, London.
- Britwum, A. Jonah, K. & Tay, F.D. (2001). *Structural Adjustment Participatory Review Initiative (SAPRI)*. Ghana Country Report.
- Blaikie, P. & Brookfield, H. (1987). *Land degradation and society*. Methueum, London.
- Boateng, E. (1970). *Geography of Ghana*. Cambridge University Press.
- Boserup, E. (1965). *The conditions of agrarian change under population pressure*. Chicago, Aldine Publishing Company.
- Brown, L. (1989). *State of the world: a world watch institute report on progress towards a sustainable society*. Norton, New York.
- Brown, P. (1992). Parasites move in when forests cleared. *New scientist*.
- Chambers, R. (1994). The poor and the environment. Whose reality counts? *IDS working paper*.
- Durning, B.A (1989). Poverty and the environment. Reversing the downward spiral. *World watch paper*, 92.
- Ehrlich, P.R. & Ehrlich, A.N. (1990). *The population explosion*. A touchstone book, New York.
- Evans, P. (1996). Biodiversity: nature for needs? *Ecos*, 17(2).
- Food and Agricultural organization of the United Nations (1993a). The challenge of Sustainable Forest Management: What Future for the World's Forests? Rome.
- Food and Agricultural organization of the United Nations (1993b). An agency search the alarm on soil damage.
- Gills, M. (1988). *Public Policies and use of Forest Resources*. Cambridge University Press, Cambridge.
- Greider, T. & Garkovich, L. (1994). Landscapes, the social construction of nature and the environment. *Rural Sociology*, 59 (1).
- Ghana Statistical Service (1985). *Population Census Reports*. Statistical Service. Accra.
- Ghana Statistical Service (1993). *Ghana Living Standards Survey (GLSS)*. Accra, Ghana.
- Ghana Statistical Service (1999). *The 1998 Ghana demographic and Health Survey (GDHS) Report*. Accra
- Hui, S. (1997). *Deforestation: Humankind and the Global Ecological Crisis*. Electronic document. <http://www.aquapulse.net/knowledge/deforestation>, retrieved on 12-03-03.
- Institute of Statistical Social and Economic Research (ISSER) (1999). *The state of the Ghanaian economy*. University of Ghana, Legon.
- Kotey, N.A., Francois, J., Owusu, J.G.K, Yeboah, R., Amanor, K.S. & Antwi, L. (1998). *Policy that works for forests and people, No 4*. International Institute for Environment and Development, United Kingdom.

- Mann, R.D. (1990). Time running out: The urgent need for tree planting in Africa. *The Ecologist*, 20 (2).
- Manya Krobo Distric Assembly (2000). Environmental management report. Odumase Krobo.
- O'Brien, K.L. (1995). Deforestation and climate change in Selva Lacandonia of Chiapas, Mexico: Some preliminary results. *Norsk geografisk Tidsskrift*, 49 (3).
- Repetto R. (1988). *The forest for the Trees? Government policies and misuse of forest resources*. Washington D.C. World Resource Institute.
- Takyiwaa, M. (1997). Ghana: Women in the public and Informal Sectors under the Economic Recovery Programme. In Visvanathan, N., Duggan, L., Nisonoff, L., & Wiegersma, N. (eds.) *The Women, Gender & Development Reader*, 277-283. Zed Books Ltd, London.
- Turner, M.G., Gardner, R.H. & O'Neill, R.V. (2001). *Landscape ecology in Theory and Practice. Pattern and Process*. Springer-Verlag, New York.
- Tiffen, M., Mortimore, M. & Gachuki, F. (1994). *More People, Less Erosion: Environmental Recovery in Kenya*. John Wiley & Sons. New York.
- UNDP (1999). Fighting poverty together for a better tomorrow. *National Poverty Reduction Programme*, 1 (1).
- World Fact Book (2004). <http://www.cia.gov/cia/publications/factbook/geos/gh.html>, 11-10-04.
- World Rainforest Movement (1999). Document on underlying causes of deforestation and forest degradation. <http://www.wrm.org.uy/deforestation/Africabackground.html>, 03-04-03.

Other websites

- <http://www.geocities.com/sapphire2021/forest.html>, 12-10-04.
- Bad management in Ghanaian forestry sector.
http://www.afrol.com/News2002/gha007_forestry.htm, 01-04-03.
- Deforestation: Humankind and the Global Ecological Crisis.
<http://www.aquapulse.net/knowledge/deforestation>, 01-04-03.
- Ghana Forest Loss <http://www.american.edu/TED/GHANA.HTM>, 27-03-03.
- Geography of Ghana <http://www.ghanaweb.com>, 30-03-03.
- Rainforest Report Card (2002) <http://www.bsrsi.msu.edu/rfrc/deforestation.html>, 01-04-03.
- United Nations Sustainable Development, Agenda 21
<http://www.un.org/esa/sustdev/agenda21chapter11.htm>, 19-03-03.

Shumete Gizaw Woldeamanuel

DEFORESTATION IN ETHIOPIA: CAUSES AND CONSEQUENCES

Abstract

This literature study tries to answer some questions about what causes deforestation and what its consequences are in Ethiopia. Ethiopia, with only a few small patches of natural forest left after hundreds of years of ongoing deforestation, is one of the most affected countries. There are several causes and consequences of deforestation. The major include: Overgrazing, expansion of agricultural land with increasing population, increasing demand for firewood and charcoal, etc. The consequences are: soil erosion, change of the local climate and dwindling of the water table, loss of biodiversity, and other social consequences.

There is no easy solution to the problems with deforestation, which are very complex and connected to other socio-economic problems in society. Hopefully, not only the future but also the state and local people hold the answers for Ethiopia.

1 INTRODUCTION

1.1 Background

At the end of the twentieth century, there are approximately 3,500 million hectares of forests in the world, representing 27% of the land cover. Of this total forest area, 2,000 hectares are found in developing countries, mostly in tropical and sub-tropical regions (FAO 1997).

Ethiopia is situated on the so-called horn of Africa, in the north-eastern part of the continent. It is located from 3°N to 15°N latitude and 33°E to 48°E longitudes. The area of the country is about 1,098,000 Square kilometer. This mountainous country is characterized by the great contrasts in altitude, from 110 meters below sea level in the Dallol depression to 4620 m above sea level at Mt. Ras Dejen (Bekele 1993). Most people in Ethiopia live in the highlands (at elevations between 1500 and 2500 m) (Tekle 2001). Due to human activities most of the deforestation is in the highlands which ranges from 80,000 to 200000 hectares per annum (Desalegn 2001).

Ethiopia is one of a few African countries that has managed to withstand foreign invasions (Bekele 1993), and was ruled by emperors until 1974, when the leninistic dictator *Mengisto* put an end to the empire. Until 1991, when he was overthrown, the country suffered from several conflicts and wars, and in combination with dry periods the result was devastating, with severe deforestation and soil degradation that resulted in famine (Basset & Crummy 2003).

Even though the politic situation today is better, the ever-increasing population growth with 3 % a year creates immense problems (Desalegn, 2001, Sida 2000). Today population is about 70 millions (CSA 2003) compared to approximately 25 millions in 1969, including Eritrea that then was a part of Ethiopia (Sida 1969). Eritrea became independent in 1993, after several years of war of liberation (Sida 2000). This might confuse older facts about e.g. ground cover, where sometimes Eritrea is included in the numbers. Ethiopia is one of the poorest countries of the world. Even though about 85% of the population is earning its living from agriculture the efficiency in this subsistence agriculture is so low that Ethiopia still is not self-sufficient in food (Pausewang et al. 1990) and as an alternative way of livelihood strategy, rural people are highly pressing forests.

The estimates of the extension of the different forest types today and in the past vary a lot.

Estimates from 1994 indicates a present forest cover of 2,7%, while historical sources indicate that once more than 35% of the total land area was covered with closed forests Eshete (1999). Rudén (1991) says that natural forests cover 4% compared to 40% five decades earlier. Whatever the extent of the land surface covered by forests might have been, today most of it has disappeared. In 1969 the Sida Forestry Team in Ethiopia wrote: "Due to the speed of exploitation, illegal cutting and burning, the forests are diminishing rapidly. If the present misuse is allowed to continue, natural forests of any importance will have been destroyed before the turn of the century" (Sida 1969). Today only a few scattered and relatively small areas of forest remain, largely confined to inaccessible steep hill slopes, escarpments and mountains far from motorways (Bekele 1993), mainly in the Southwest and south-central parts of the country. Plantations have been made to compensate the decreasing forest areas, mainly with eucalyptus (Rudén, 1991).

1.2 Statement of the problem

The process known as deforestation involves the cutting down, burning, and damaging of forests. Forests, apart from their short to long term positive effects on weather and climatic conditions, are instrumental in controlling soil erosion, land degradation, and desertification, problems that appear to have reached their climax in Ethiopia (Desalegn 2001).

The sustainable management of our trees and forests would contribute highly for the enhancement of the wellbeing of Ethiopians through reduction in soil erosion, and land degradation, and improved weather and climatic conditions and especially by availing rain water for agricultural activities. The current top environmental agendas of the country have become deforestation, and the highly interrelated problems of soil erosion, desertification, loss of biodiversity, local climatic change and famine.

Therefore, I try to assess the following issues: Who is doing the deforestation? There is considerable debate about who is doing the deforestation and why they are doing it. Small farmers? Commercial farmers? Loggers? Cattle ranchers? And why? What have been and are the consequences of deforestation? Do these consequences have social, environmental, and political implications?

1.3 Objective of the study

The over all aim of the study is to assess the situation of forest resources in Ethiopia. To achieve this, the study has the following objectives.

- It assesses the past and present situation of forest resources in Ethiopia;
- It tries to identify some major causes of deforestation in Ethiopia; and
- It assesses the consequences of deforestation in the country.

1.4 Methodology

A literature survey was conducted to synthesize empirical studies examining the causes and consequences of deforestation in Ethiopia. This literature study tries to answer some questions about the nature, extent and more importantly what causes deforestation and what the consequences of deforestation can be. It focuses on Ethiopia, a country that in the last century has lost most of the natural forests and where many effects of this change are visible (Ruden, 1991). Information has been found through literature search in the NTNU library, written books, articles, journals, and also from the internet. Some consequences of deforestation on a global scale are much debated and this paper will not have the answer to all questions about deforestation, but hopefully it will present some understanding on the subject under discussion.

2 DEFORESTATION IN ETHIOPIA-OVERVIEW

The deforestation narrative is the dominant narrative in the environmental debate in Ethiopia. The core of this narrative is that there has been a massive loss over the last hundreds years of the country's forest cover (Desalegn, 2001). In Ethiopia, when the conditions in the forest change, for instance when cultivation types change or human population increases, deforestation has been likely the result (Sponsel et al. 1996). Consequently, degradation and deforestation have been going on for hundreds if not thousands of years (Bekele-Tesemma et al. 1993).

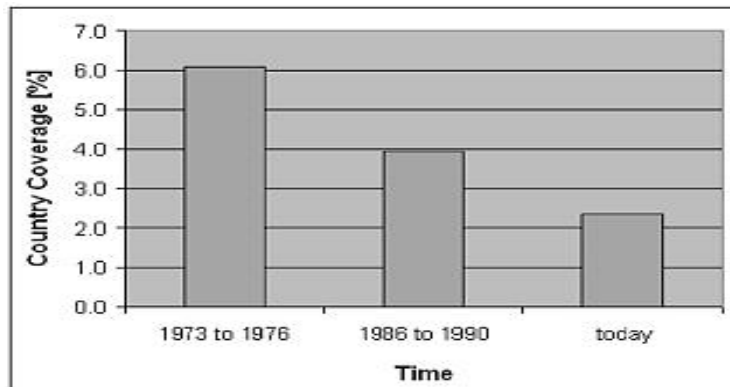


Figure 1. Deforestation rates in Ethiopia (Source: MOE, 2000, reproduced with the permission of the author).

As it can be seen from Figure 1, the rate of deforestation is extremely high in Ethiopia. In 1973-1976, about 6% of the country was covered with natural forests. After 10 years it declined to 4%. More importantly, today only about 2% of the country is forested. Therefore, by examining historical records and literatures, it is possible to identify proximate causes and underlying causes of deforestation. Both the proximate causes (infrastructure extension, agricultural expansion, etc.) and underlying causes (population growth, economic problems, etc.) jointly result in severe deforestation, which in turn has consequences like loss of biodiversity, local climatic change, decrease in productivity, etc. Figure 2 is an analytical model of causes and consequences.

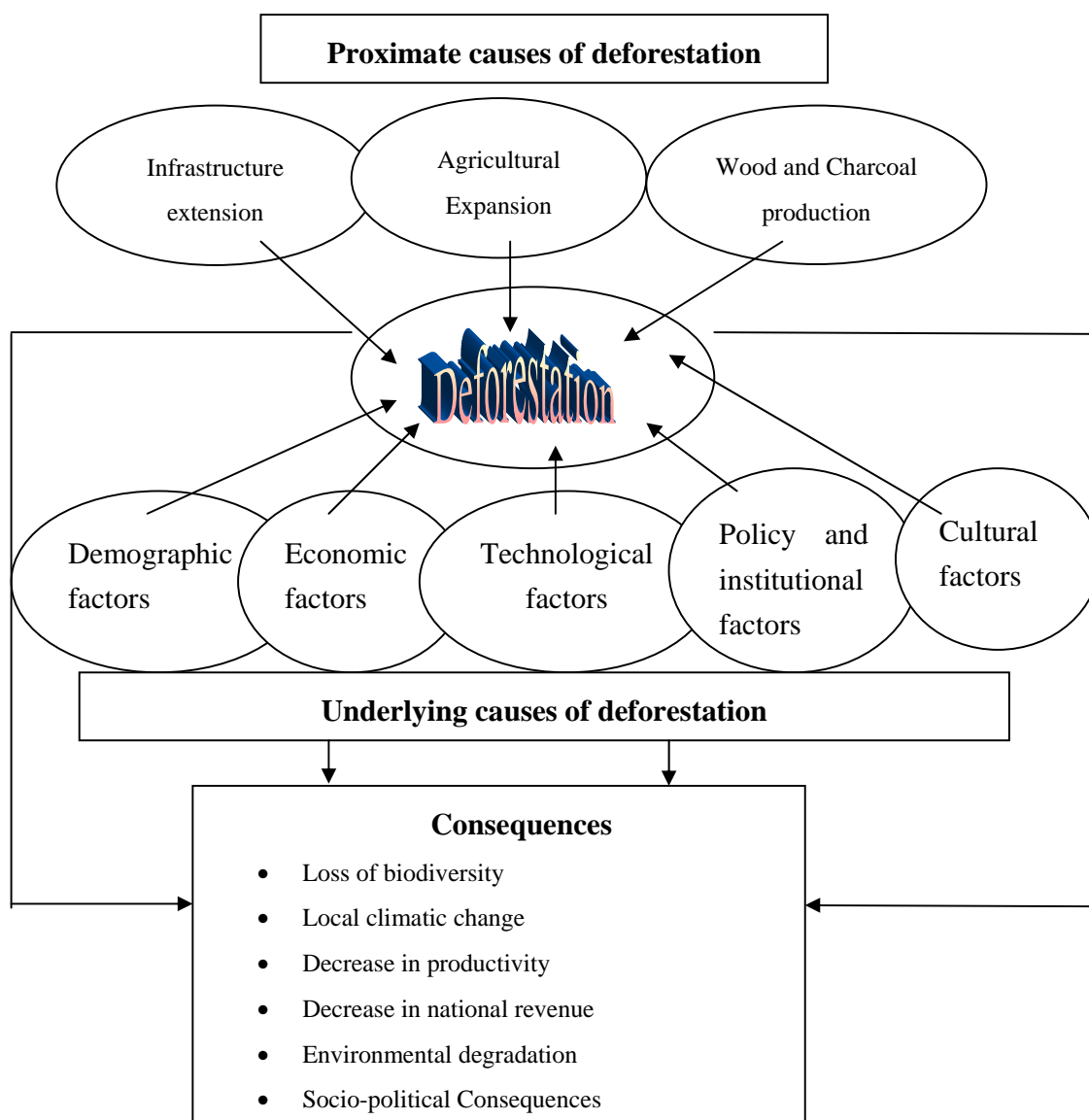


Figure 2. Analytical model of causes and consequences of deforestation.

2.1. Causes of deforestation

There are many factors contributing to deforestation all over the world. In Ethiopia some of them are more important than others and some were more important in the past than they are today. **Firstly**, with the growing human population the demand for agricultural land increases. This leads to clearing of trees to open up land for agriculture and settlement. Population growth, therefore, is said to lead to greater pressure on the land and hence greater natural degradation (Desalegn, 2001). **Secondly**, Ethiopia has the largest population of livestock in Africa. Thus, grazing pressure has increased the rate at which tree and shrub species (more than 100 different in Ethiopia) are becoming scarcer (Bekele 1993). Livestock production is the most important source of deforestation in Ethiopia today. According to the World Resource Institute (2001) indicated in Tekle (2001), overgrazing is highly affecting the diverse forest resources of the

country and leads to aggravated land degradation. Some parts of the country especially in the eastern part natural forest areas are changing to degraded lands (see Figure 3).



Figure 3. Overgrazing in East Ethiopia (Source: World Resource Institute, 2001, reproduced with the permission of the author).

Thirdly, the increasing population growth means the increased demand for fuel wood and construction materials. In 1993 fuel wood was scarce in 75% of the 14 old regions in Ethiopia (including Eritrea), while still 77% of the nations energy sources were derived from wood and tree residues (Bekele-Tesemma et al. 1993).

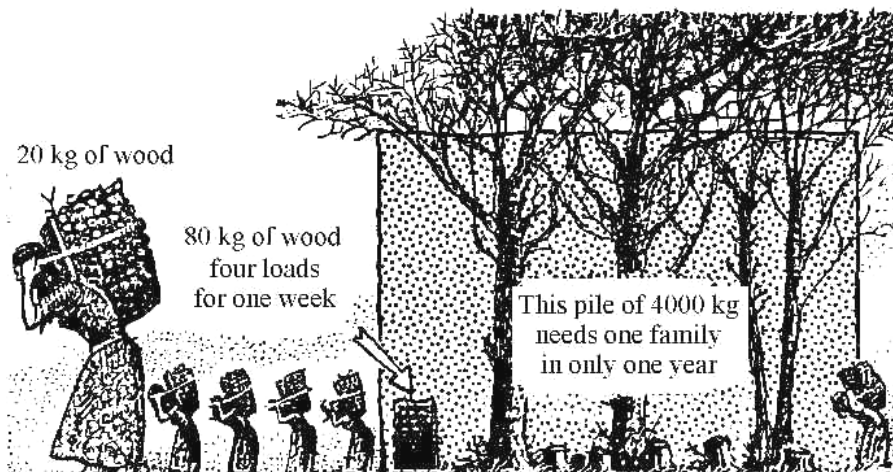


Figure 4. Fire wood collection in Ethiopia (Source: Solar cooker project in Ethiopia, 2001, reproduced with the permission of the author).

In average 4000 kg of wood is needed to fulfill the annual consumption of fuel wood per family per year (Figure 4). With a lack of fuel wood people are forced to use manure instead, which leads to soils depleted of nutrients. This creates a vicious circle, since poor soils give fewer yields and an even greater demand for more agricultural land at the expense of the forests (Bekele-

Tesemma et al. 1993, Ashagrie 1998). Sponsel et al. (1996) write: "In developing countries that depend on oil imports the rural poor can barely afford even the least expensive source of energy for cooking - wood from local trees - and the situation worsens with inflation of oil prices, economic decline and population growth. Women and children may sacrifice disproportionate amounts of time and energy just gathering fuel wood. The number of cooked meals may decline, contributing to malnutrition. Where the wood supply is inadequate, crop refuse and animal dung may be burned for fuel. Thus in many parts of the third world the ongoing energy crisis of fuel wood is a major cause of deforestation and linked to many other problems." Deforestation by local people needing firewood has therefore left the country bare and empty. Besides home consumption, a large number of urban poor particularly women and children, depend on fuel wood collection and marketing for their livelihood (Desalegn, 2001).

Fourthly, together with agricultural activities and charcoal burning, another important cause of deforestation in Ethiopia is fire. Fire can be both naturally occurring in the forest or man made. Farmers in order to clear forests and burn charcoal use fire. They also attempt to increase the fertility of the land by burning the residues of crops. Consequently, uncontrollable fires rise from the clearing of the forest and burning of charcoal that destroy many hectares of forests in a small period of time (Table 1). According to the paper records of Ministry of Agriculture in 2000, Ethiopia has lost about 100966 ha of forest between 1990 and 2000. Fire has been out of the control of the country in 2000 and could only be controlled with the help of international community. One has to understand that these are only officially recorded figures and therefore the total deforested area by fire could be more than this. (Ministry of Agriculture 2000)

Table 1. Forest fire statistics of Ethiopia for the period 1990-2000 (Source: Ministry of Agriculture 2000).

Year	Total no. of fires on forest and other wooded lands	Area of forest burned (ha)
1990	4	1 072
1991	2	153
1992	1	32
1993	20	3 159
1994	1	1 550
1995-1999	No data	No data
2000	> 120	95 000

Finally, often mentioned as causes of deforestation are the demand for forest products and the demand for other goods that are produced on deforested lands (FAO 1997). Clearly with out any demand there would be no economic reason for cutting down the trees. In the northern Ethiopia because of absence of natural forests people are forced to cut planted trees like eucalyptus and

sell them to fulfill their needs (Figure 5).



Figure 5. Wood market in Mekele, North Ethiopia, June 2002 (Source: Ministry of Agriculture, 2002, reproduced with the permission of the author)

2.2. Consequences of Deforestation in Ethiopia

Firstly, one of the most visible consequences of deforestation is soil erosion, which is a big problem in Ethiopia with its changing topography. The wind speed is reduced in the tree canopies and with bare soil stronger winds contribute to soil erosion. According to Desalegn (2001), most of the erosion takes place on land under cultivation. The problems with **erosion and soil degradation** also increase with higher population density and settlement (Bekele-Tesemma 1993).

Secondly, when the forest is cut down the albedo of the land surface is changed and this might lead to **changes in the local climate**. The water cycle can also be affected, causing severe flooding. On a larger scale deforestation contributes to global warming through released carbon dioxide to the atmosphere (Sponsel et al. 1996).

Thirdly, deforestation not only removes the trees, but does also lead to the **loss of other renewable natural resources**, such as non-timber products used for trade, e.g. rattan, and wildlife products such as fur, skin and meat.

Fourthly, tropical forests can also be of important economical value through eco-tourism that can generate foreign income. Deforestation **decreases the possibilities to develop such an industry** due to the loss of various species of plants and wild animals.

Fifthly, another much discussed consequence is the **loss of biological diversity**. Tropical forests are usually very species rich with many endemic species. Extinction is irreversible and means the loss of unique genetic information. Fragmented stands of trees left during deforestation are usually not large enough to be self-perpetuating in terms of maintaining even an altered balance of biodiversity. Deforestation is eroding this precious resource of biodiversity. In the last two decades many of Ethiopia's wild animals have migrated to the neighboring countries and some floras disappeared totally (Sponsel et al. 1996).

Finally, consequences perhaps not as obvious as many other are the direct and indirect socio-political consequences. Sponsel et al. (1996) write: "Among the more serious human aspects of deforestation is its connection with warfare and other forms of violence by creating social unrest in countries like Ethiopia, Guatemala, Haiti, El Salvador and India (Sponsel et al. 1996) (See also figure 2).

3 CONCLUSION AND RECOMMENDATIONS

3.1 Conclusion

Deforestation is a huge problem that needs to be taken seriously all over the tropical world. In Ethiopia the situation today is driven so far, that it will probably be impossible to restore the natural forests, mainly due to the ever-increasing needs for wood. The trees are removed long before they have a chance to reproduce. Basset & Crummy (2003), Sponsel et al. (1996), and Desalegn (2001) in one and another way write about traditional cultivators being both victims and villains in the deforestation process because they have no choice. I think this is very much the case in Ethiopia today, too. Most people realize they destroy their own future when they destroy the forest, but they lack alternatives if they want to survive. With increasing population growth it is very difficult to see an end to these problems. There is ongoing research to replant trees in Ethiopia but it is a slow process and the solution is not within the near future. In many other countries deforestation is not as severe as in Ethiopia and there is still time to prevent it from going that far. Hopefully people can learn from mistakes in the past, enabling a more sustainable forest use in the future. To conclude, any effort to combat deforestation must be based on a complete understanding of who the agents of deforestation are, on direct and underlying causes of deforestation, as well as on looking for alternatives for sustainable development.

3.2 Recommendations

Based on this account, the following recommendations are suggested. The Ethiopian community, government and NGOs should take actions and look for alternatives in order not to end with nothing. These actions and alternatives include:

- Protection and management of remaining forests; greater support is needed to establish new protected areas and maintain existing national and local networks of protected areas and biological corridors, strategically chosen as representative of the country's ecosystems and their biodiversity.
- Improve productivity of subsistence agriculture; of particular concern for the forest sector is the low productivity of subsistence agriculture. This can also be promoted by the use of agro-forestry.
- Restore degraded lands; tree planting and the protection of existing vegetation from fire, grazing, and land clearing should be encouraged and the appropriate incentives offered.
- Enhance participation decision making and benefit sharing with local communities, regional governments, and other land users;
- Determine the social and economic value of forests; traditionally, forests have been under evaluated. If the forests are to survive, they must be of value to the people who might otherwise destroy them and the benefits derived from them must be distributed fairly.

- Support education and awareness about the forest sector.

References

- Ashagrie, Y. 1998. *The contribution of Trees to the soil chemical properties in the Croton macrostachys - Based Indigenous Agroforestry System in Northwestern Ethiopia*. Ethiopian MSc in Forestry Programme thesis works, Report No 1997:28, Skinnskatteberg.
- Basset, T.J. & Crummey, D. 2003. *African Savannas: Global Narratives & Local knowledge of Environmental Change*. Reed Elsevier inc., Oxford.
- Bekele, T. 1993. Vegetation ecology of remnant Afromontane forests on the Central Plateau of Shewa, Ethiopia. *Acta phytogeographica suecica* 79.
- Bekele-Tesemma, A., Birnie A. & Tägnäs, B. 1993. *Useful trees and shrubs for Ethiopia - Identification, Propagation and Management for Agricultural and Pastoral communities*. Regional Soil Conservation Unit, Swedish International Development Authority.
- CSA (Central Statistical Authority) 2003. *Annual population Estimate*, Addis Ababa, Ethiopia.
- Desalegn, R. 2001. *Environmental Change and State Policy in Ethiopia: Lessons from Past Experience*. FSS Monograph series 2. Forum for Social Studies, Addis Ababa, Ethiopia.
- Eshete, B. 1999. Assessment of Fuelwood Resources in Acacia Woodlands in the Rift Valley of Ethiopia. Towards the development of planning tools for sustainable management. *Acta Universitas Agriculturae Sueciae* 104.
- FAO 1997. *Forestry and Agriculture*, Geneva.
- Ministry of Education (MOE) 2000. *Text book of Geography for grade 10*. Mega publishing Enterprise, Addis Ababa, Ethiopia.
- Ministry of Agriculture 2000. *Paper records of the Ministry for Agriculture. Annual report*. Addis Ababa.
- Pausewang, S., Cheru, F., Brune, S. and Chole, E. 1990. *Ethiopia, Options for rural Development*, London and New Jersey.
- Rudén, D. 1991. *Regeneration of some indigenous tree species in natural forests in Ethiopia. A minor field study*, Uppsala.
- Sida 1969. *Report of the SIDA Forestry Team in Ethiopia April-May 1969*, Team leader Söderström, G.V. *Forestry in Ethiopia*, Stockholm.
- Sida 2000. *Etiopien, Landfakta*. Stockholm.
- Solar cocker project in Ethiopia*, 2001, Addis Ababa.
- Sponsel, L.E., Headland, T.N. and Bailey, R.C. 1996. *Tropical Deforestation. The human dimension*. New York.
- Tekle, K. 26-11-2001 oral, course lecture on Environmental Degradation.

Phanice Sella Webi

WOOD FUEL USE AND ITS SOCIO-ECONOMIC AND ECOLOGICAL EFFECTS: A COMPARATIVE STUDY OF EMBU AND MARSABIT DISTRICTS IN KENYA

Abstract

In many parts of the world, limitations on the availability of energy services create barriers to socio-economic development. Worldwide, approximately two billion people use traditional solid fuels for cooking and heating, and almost as many lack electricity. Much of the energy use in developing countries involves consumption of traditional fuels by poor households. The production and use of energy have environmental consequences at local, regional and global levels. These impacts extend throughout the fuel cycle of an energy chain, the entire chain of activities from resource to use. The impacts can manifest themselves over short, medium or long-time scales, or have cascading effects through the combination with other environmental problems.

In Kenya, most poor people live in rural areas, and they are largely women. The fuels and devices available to people living in poverty are typically less efficient, more hazardous to users and more damaging to the environment than those enjoyed by the better-off. The damage to the environment can impact on health in a wide variety of ways, from increasing pressure on food production, water shortages etc., in the local setting, to the potentially widespread and major impacts that global warming may have – particularly on the countries of Sub-Saharan Africa. Household energy supply and use in Sub-Saharan Africa has impacts on both local and global environments, although the latter are small relative to industrialized countries. In general, environmental impacts should be viewed in the wider context of poverty, population pressures, and political factors.

The resultant deleterious ecological and socio-economic effects of wood fuel consumption are similar, but vary in intensity between ASALs (arid and semi-arid lands), and cool wet regions. In the Kenyan situation, this is shown in a comparative study between two such regions – Marsabit and Embu districts respectively. It reveals that the ASALs are more hard-hit, and urgent intervention should be sought. The remedial interventions should be introduced through participatory and holistic approaches that seek to integrate the local people, their indigenous knowledge and practices into environmental conservation activities in order to secure sustainability for such activities.

INTRODUCTION: HUMAN-ENVIRONMENT RELATIONSHIP

For thousands of years, ancient and traditional societies have viewed physical and biological environments as interlinked in a web of relationships with humans and non-humans, or what western science sometimes terms as ‘ecosystems’ (Berks et al. 1998; cited in Amodah-Darteh 1995). Throughout the literate history, there have been opinions expressed upon the world of nature and of human’s role in it. One is a teleological view deeply rooted in Judeo-Christian tradition which saw design and order in the world, and ascribed this to God. Humans were seen as part of a wider environment in which they are caretakers; stewards of God, with the task of improving the primitive nature of the earth geared towards their sustenance. This basic assumption was that, in the natural order of things, humans would use the environment, change it for their own ends and improve its natural state in the process (ibid.).

Another viewpoint examines the extent of human impact on the environment. Over time the notion of humans subduing nature was formulated into a philosophy of science in which

knowledge and intervention were combined in order to give humans control over nature. Humans were considered to be superior to the rest of nature. This gives them the right to dominate and exploit nature. Such dominance was deemed necessary in order that humans could put finishing touches to God's creation by changing its primitive condition (Simmons 1975).

The above viewpoint was challenged by various scholars among them, George Perkins Marsh Mary Sommerville. Sommerville reiterated the unexpected results that occur as humans dexterously avail themselves of the powers of nature to subdue nature. Marsh then presented an eloquent chronicle of the impact of human existence upon nature in his work where he emphasized what he saw as the upsetting balance within nature by unwise action (Adomah-Darteh 1995).

From about 1910, the term 'human ecology' was used to describe the study of man and environment and to assert the place of humans in the 'web of nature' (Stoddart 1967; in Adomah-Darteh 1995). Since the 1960s, cultural ecology has evolved and it is deeply rooted in human ecology and Marsh's articulation on human influences on the environment. Cultural ecology gives prominence to cultural processes, as the understanding of society-environment interrelationships is next to impossible without analyzing values, beliefs, and social organization (Brookfield 1964; cited in Adomah-Darteh 1995).

BACKGROUND OF THE STUDY

The desire for most developing countries to integrate into the global economy or to offset losses in financial crises has motivated many of them to increase their exploitation of natural resources. Although globalization has increased overall prosperity and stimulated growth, it has also increased income inequality and environmental degradation. In most industrialized countries, use of wood for fuel was minimal and declining until the oil crisis of 1973. As oil prices rose in the following years, the use of wood increased.

More recently, concerns over global warming and acid rain have resulted in a call for increased reliance on renewable sources of energy such as wood. The fuelwood crisis, also referred to as the '*other energy crisis*', began to emerge during the oil crisis in the 1970s and has been aggravated by agricultural policies that aim at making African countries self sufficient in food production (Eckholm 1976; in Leach & Mearns 1988). The United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil 1992 forged a new global partnership for environment and development. The conference made it plain that we can no longer think of environment, economic and social development as isolated fields. Hence, there should be a balance between economic growth with concerns for social equity and environmental protection.

Worldwide, nearly 2 billion people continue to rely on biomass fuels and traditional technologies for cooking and heating, and about 1.5–2 billion people have no access to electricity. Wood fuel is mainly used by the economically poor in the society. National programs tend to overlook the relationship between food and forest, so that the focus has been either wood or forest. This has been achieved at the expense of existing forest lands, which are the main sources of fuel wood. This implies that wood energy is not being exploited in a manner that is sustainable in African countries (Ardayfio 1986). It appears that a more acceptable means of safe and sustainable energy production is yet to be found. Before this is achieved, a good understanding of the African energy situation needs to be established as a basis for formulating a sustainable energy agenda.

The generic term '*wood fuels*' is generally used to refer to firewood and charcoal. (In this paper the terms '*wood fuel*' and '*fuel wood*' are used interchangeably). Wood fuels rarely

figure in the energy balances drawn up by national statistical offices or international organizations (Foley 1992). Nevertheless, the importance of wood fuels at both a family and a national level is clear. Environmental degradation (especially land degradation) is particularly important to rural folk whose well being is contingent on a healthy and functioning environment.

During pre-colonial Kenya, land was communally owned. During the colonial rule, the colonial government allocated themselves land, which they referred to as White Highlands. The colonial government introduced individual land ownership. The introduction of taxes in monetary terms introduced the cash economy, a new phenomenon, which marked the beginning of migratory patterns in colonial Kenya. The men moved in search for work in white settlers plantations, leaving women behind to care for the family. The colonial land acts took communal land considered as uncultivated and uninhabited by the British (Chirui 1996; in Njoki & Chandler 2002) from Kenyans and made it government property. However, the majority of land taken away from Kenyans was divided among white colonial farmers. Women did not have land or tree rights.

Before the Land Adjudication Acts in Kenya of the 1950s, collecting fuel wood was a free, communal act, and there was little or no commercialization of fuel wood or charcoal (Riley & Brokensha 1988). Before the colonial invasion, there was no landlessness. The concept was a colonial creation. Colonialism and the imposition of English land tenure and land use patterns, disrupted indigenous practices and interfered with the free access to land use that many enjoyed through their lineage or marriage. These changes severely influenced natural resource management, agricultural practices and women's access to fuel wood. The consequences of colonial land tenure legacy have impoverished many Kenyans. Many family members in rural Kenya who could not find gainful employment resorted to charcoal burning. Charcoal burning has contributed gravely to deforestation.

Beginning in the 1970s, charcoal production increased uncontrollably in the rural areas to meet the growing demand for fuel in the urban areas and export (Riley & Brokensha 1988). During that decade, Kenya exported 96 % of the total charcoal from Africa, mostly to the Middle East, estimated to be about 58,000 tons (Bussmann 1996; in Njoki & Chandler 2002). The Government of Kenya in due course realized the grave environmental results of intensive charcoal production which, depending on the size or the species, produces only 5 to 20 bags of charcoal from each felled tree. Today, most forest products, mainly timber and firewood, remain within the country although the phenomenal indigenous species deforestation of the 1970s has yet to be replenished (ibid.). In Kenya, many people plant trees for fruit, timber, shade and ornament, and seedlings are sold by the roadside in cans. However, few people plant deliberately for fuel wood, expecting to obtain it from trees planted for other purposes (Timberlake 1988). Deforestation related to wood gathering for charcoal making is an urgent problem, a problem that emphasizes the need to promote improved charcoal-making practices.

STATEMENT OF THE PROBLEM

According to conservation experts, fuel wood consumption in Africa has doubled since 1950 (Wallmo 1998; in Njoki & Chandler 2002) with the fuel wood demand in Kenya outstripping the supply by at least 4 % per year (Wamukonya 1995; in Njoki & Chandler 2002). In Kenya wood fuel accounts for about 70–75 % of the total energy used (Riley & Brokensha 1988) which includes both fuel wood for cooking and heating in the rural areas and charcoal in the urban areas. In most rural areas of Kenya, about 90 % or more of the energy for household

use as well as for most cottage industry which includes fish smoking, brick burning, pottery making, beer brewing, tobacco curing as well as schools or clinics depend on wood fuel.

Kenya's current population is approximately 33.8 million with a growth rate of 2.56 % (World Fact Book 2005). The steady rise in population over the years has had implications on fuel wood supply. For example in some rural areas, fuel wood is sometimes sold which was uncommon in the past. Hence densely populated areas face a more severe scarcity than less populated areas. Kenya is still a predominantly rural country with up to 85 % of the 30 million people living in rural areas where biomass provides 93 % of the energy demands (ibid.). The impact of the use of fuel wood on the environment varies between arid and semi-arid lands (ASALs) (dry) and forested (wet) areas. The reliance on biomass fuels results in reduced agricultural productivity by depriving the soil of recycled nutrients that would have been available from tree, crop and animal residues and could be a cause of deforestation and desertification in some areas (Cecelski et al. 1987; in Njoki & Chandler 2002).

The upsurge of population growth has short and long term consequences for the existing forest resource base, land use, and fuel wood production. The economic crisis, with its concomitant high rates of unemployment and very low incomes, has encouraged the use of fuel wood in most African cities (Ardayfio 1986). Thus, urban centres have become as it were, a lucrative market for fuel wood because it seems to be relatively available and cheaper than modern fuels, which hitherto have not proved a viable alternative in either rural or urban centres. With growing population pressure on land use, a fuel wood gap is created, putting more pressure on the producing rural areas. Ultimately, it is not only the sustainability of the environment that is at stake but the very survival of the urban poor and rural people, with women being the worst hit victims.

Causes and effects of the diminishing supply of fuelwood resources are summarized in Figure 1 below. As the diagram below illustrates, the causes and effects of the fuel wood crisis are an outcome of various social and environmental factors. A range of land use practices leads to a decrease in the supply of available biomass fuels which result in a range of social and ecological effects. In addition, individual household practices and ways of life also lead to an increased demand of forest biomass fuels with consequent diverse social and ecological effects. To mitigate this situation, an all-encompassing approach is needed at the household, local and national levels.

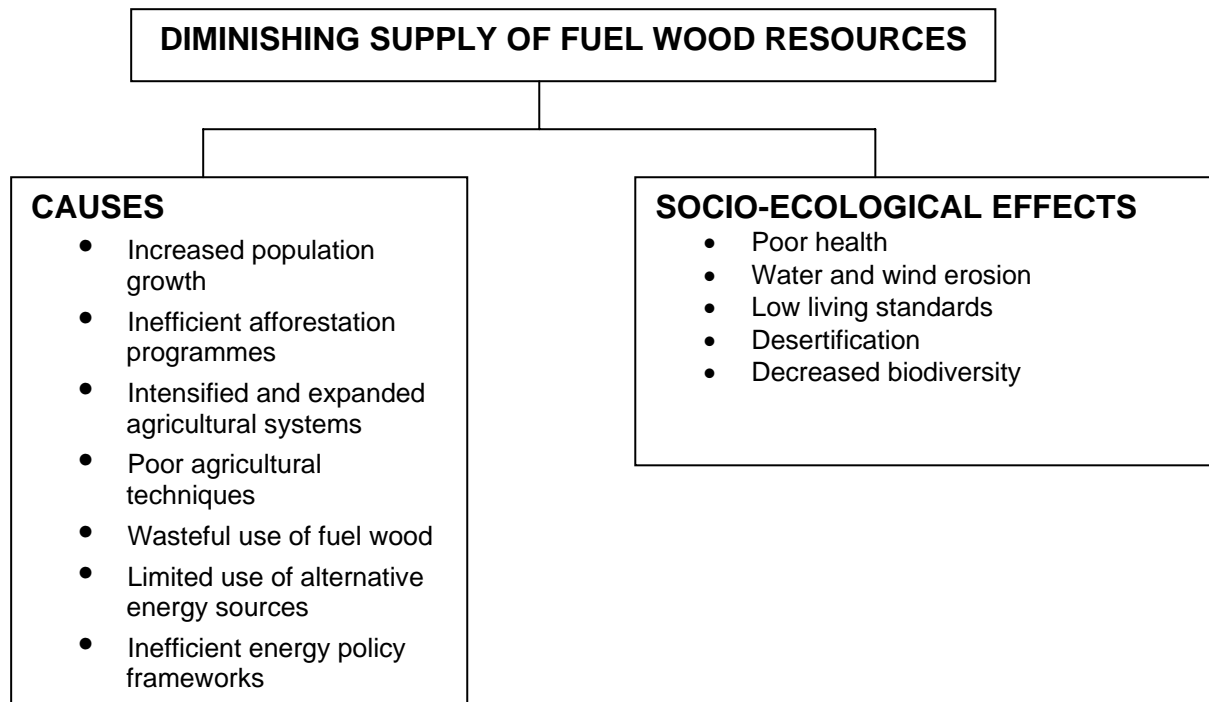


Figure 1. Causes and effects of the diminishing supply of fuel wood resources.

STUDY AREA

The study area is in the Eastern Province of Kenya, probably the most diversified province in the country with its landscape ranging from near-desert to the north, to large expanses of grassland in the south. The clear distinction between the Embu and Marsabit districts validates a comparative study of fuel wood use in the two areas.

Marsabit is the largest and driest district lying in the northern part of the country. On the slopes of Mt. Marsabit (1,865 m), rainfall averages 944 mm annually, while potential evaporation is 1800–2200 mm annually. Thus, most of Marsabit district lies within the semi-desert-eco-climatic zone. There is only one gazetted forest in the district, the Marsabit Forest, covering an area of 15,280.7 ha. It is a natural forest, owned by the government¹.

In Embu district, variations in altitude, rainfall and temperature between highlands and lowlands, coupled with differences in geology, give rise to varying land potential and to different soil types in the district which influence different levels of development in the district. Embu District shows the typical agro-ecological profile of the windward side of Mt. Kenya. The upper highlands and most of the north-eastern parts of the lower highland areas are cool, wet and steep and forestry is the main land use. In the lower highlands coffee and tea are grown. In the low lying areas cash crops such as cotton and tobacco are grown. The central and southern parts of the district covering areas are relatively dry, receiving less than 550 mm of rainfall per year, while the area around Mt. Kenya is quite wet with 2,000 mm of rainfall annually. Embu District has a total forest area of about 165 sq km. Of these about 120 sq km are gazetted as Forest Reserve and/or National Park on the slopes of Mt. Kenya. The upper and lower midlands are covered with tall trees and dense undergrowth. Some areas

¹ <http://www.kenyaweb.com/regions/eastern/marsabit/marsabit.html>

of the lower zones either have isolated scrubby trees and tufts of tough grass, or are just sandy plains of huge expanses of rocky ground².

OBJECTIVES

The overall objective of the study is to assess the role of woodfuel production and consumption in environmental degradation in Kenya. Specifically, the study endeavors to achieve the following:

- 1) To assess wood fuel consumption in Embu district and the ASAL region of Marsabit district.
- 2) To find out the socio-economic and ecological effects of wood fuel use in Embu and Marsabit districts.
- 3) To find out the remedial interventions of wood fuel use in the two regions and give further recommendations.

METHODOLOGY OF THE STUDY

Data for the study will mainly be a comprehensive review of literature both published and unpublished, i.e. books, journals and articles. Internet sources will also be extensively used. This comparative study gives an overview of wood fuel use of the two case studies, in Embu and Marsabit districts. The two districts are chosen because they depict a scenario of distinct ecological variability which influences wood fuel use in the wet and dry region respectively. They are also both adjacent to forests (Mt. Kenya and Mt. Marsabit forests respectively) which are usually affected by wood fuel consumption. Moreover, they show important variables such as population, urban contact, resource distribution, occupational structure, and land quality/use patterns which are important in studying socio-economic and ecological problems related to wood fuel use.

RESULTS

1 Wood fuel use in Embu district

Embu district is a small section of the relatively prosperous, well-watered, densely settled and agriculturally productive highlands surrounding Mt. Kenya Forest. Although thick forests once covered much of the highlands, population growth, wood fuel extraction and agricultural expansion over the past few hundred years have gradually reduced the forest and pushed the boundary between forest and agricultural land closer to the mountain.

In Embu, as elsewhere in Kenya and Africa, rapid population growth, agricultural expansion, and growing commercial demand for wood are speeding the depletion of woodstock and affecting the ability of rural families to meet their basic needs. Wood fuel imbalances in Embu are associated with differences between ecological zones, rural and urban needs, and wealthy and poor households.

a) Ecology and agriculture

As one descends from northwest to southeast across Embu district, rainfall, population density, agricultural potential, and economic prosperity decline. Administrative, market and

² <http://www.kenyaweb.com/regions/eastern/embu/embu.html>

social services are better developed in the high potential, densely settled areas closer to the mountain than in the medium and lower potential less densely settled regions (Angelique 1984).

At lower altitudes, subsistence farming becomes more prevalent, and cash crop production as well as cash inputs to agriculture less common, particularly below 1280 m. Cash cropping opportunities of widely differing profitability are defined by altitude zones: tea is grown in the high potential belt closest to Mt. Kenya (1680–2135 m a.s.l.), arabica coffee is grown between 1340 and 1980 m, and cotton, a less profitable crop, is grown below about 1340 m in a zone of poorer agricultural potential (ibid.).

b) Population and wood fuel transfers between ecological zones

As people in Embu's agriculturally productive higher altitudes exhaust that region's land and woody vegetation, there is a trend towards migration to less densely settled lower altitudes and importation of wood fuel from the lower zone. Both developments are speeding the exhaustion of land and depletion of woodstock in lower Embu. These wood fuel transfers include both non-cash transactions and sales by lower zone residents of firewood and charcoal produced from local woodstock. In Embu's lower and drier areas, one frequently sees along major unpaved roads, bundles of cut firewood and bags of charcoal for sale to passing vehicles. These fuels are purchased by traders who sell it to upper Embu shop keepers and salaried workers. Upper Embu, where the district's people, markets, and services are more concentrated, has a high demand for the wood fuel still considered to be plentiful in lower Embu. Heavy demand from upper Embu, availability of trees, and lack of alternative income sources encourage greater rates of charcoal production by lower zone farmers. Charcoal production is often an important dry season activity during non-peak labour periods in the agricultural cycle. However, more important, poor cash returns for cotton mean that in lower Embu charcoal production is a very attractive alternative to cash crop production (Angelique 1984).

In upper Embu where the population density has been high for a long time residents plant trees, where possible, and obtain firewood by cutting branches so that the tree itself does not die. Despite such practices, trees are increasingly threatened by population growth, agricultural intensification, and growing demand for wood for other uses such as furniture, fences, and houses. In lower Embu, where agriculture is neither as intensive nor land as scarce, the presence of large uncultivated tracts of land full of trees makes the need for tree planting and conservation less obvious to residents. Commercial wood fuel trade is still largely confined to transactions between rural sellers and urban buyers. Residents and business operators in the district's many small market centres have a high demand for purchased wood and charcoal from rural areas. The implications of woodstock depletion vary for households with different land, labour, and cash resources (ibid.).

There is substantial inequality in the distribution of land in Embu. As population and wood scarcity grow, this unequal land ownership will increase inequality of access to wood fuel. Those with large holdings and surplus land left not cleared are more likely both now and in the future to have access to adequate wood of their own than those with very small, intensively cultivated parcels. Many employed town dwellers tend to use charcoal for long hours of cooking in the evening, and paraffin for faster cooking tasks such as preparing tea in the morning. Charcoal is not only less expensive, but people think it gives food a better flavour. Firewood, the fuel used by most rural households, is seldom used by urban dwellers unless they have separate living and cooking quarters, and are cooking outdoors. Where use of firewood is possible, it is often preferred for the same reasons that charcoal is preferred over paraffin. Urban commercial users' preference for wood or charcoal rather than paraffin magnifies the threat to rural families' wood fuel supplies (ibid.).

Land, labour and cash resources of most Embu households are so limited that increases in labour and cash requirements of obtaining fuel will seriously impair their ability to meet basic needs for food, water, shelter, health care and education. Disappearance of 'free' fuelwood, in combination with existing inequalities in the distribution of land and capital, worsens the welfare of most rural households (especially women); while enhancing the position of a wealthy minority (ibid.).

c) Ecological effects of woodfuel consumption in Embu district

The case of Embu resembles that of many other smallholders making up the bulk of Kenya's population and its agricultural economy, the differences being not in kind but in degree. Environmental degradation mostly occurs and affects rural dwellers because the rural areas serve as sites of extraction for wood fuel, and the majority of the rural folk are poor and depend on wood fuel not by choice but by necessity.

Firewood is generally obtained from local sources, and this exerts growing pressure on the trees, bushes, and shrubs near inhabited areas. Long before the extraction of firewood from the forest leads to complete destruction of the tree cover, it can cause serious environmental degradation. Excessive pruning of the branches may reduce a tree's capacity to grow. Removing the more easily felled younger trees may reduce the regenerative capacity of the forest. Removing too many trees, and thus, opening the forest's canopy may make the forest susceptible to wind and sun, cause erosion, and reduce biodiversity. Removing all residues also removes the nutrients that should return to the soil and which maintain fertility, and removing stumps, bushes, and shrubs can destroy the soil's remaining protective cover and binding. Where wood is unavailable, women cook with inefficient fuels such as animal dung or crop wastes, depriving livestock of fodder and soils of natural fertilizer (Kirubi et al. 2000). Deforestation is leading to losses of top soil and nutrients, mostly through wind and water erosion. This subsequent decline in soil fertility in turn results in loss of agricultural production and degraded pastures. The net effect is an unstable ecosystem that cannot support a sustainable livelihood system for either humans or animals. Charcoal production has similar but more adverse environmental effects than firewood production, from which most charcoal is obtained (ibid.).

Forests are being cut down faster than they can grow, partly to make room for new farmland and partly to harvest trees as fuel. As a result, erosion destroys upland areas, and the resulting sediments fill reservoirs. The north-western and south-western parts of the district are well served with rivers which may accelerate soil erosion in adjacent areas if the trees are depleted. Soil erosion and deforestation in the upstream regions may cause downstream flooding which destroys cultivable soil and food crops (ibid.).

2 Wood fuel use in the ASAL region of Marsabit Forest

In the arid and semiarid lands (ASALs) of Kenya, fuel wood and charcoal constitute 95–98 % of the total energy demand for cooking, heating and lighting. The resultant deleterious ecological effects are severe and need urgent remedial interventions. Marsabit Forest is located in one of the designated ecologically sensitive sites in Africa (IUCN, UNEP 1987; in World Bank 1993a). The forest has a high biodiversity, complex ecosystems and habitats, and supports vital abiotic and biotic processes. Furthermore, the high altitude favourably modifies the microclimate within the forest and the surroundings. The rising human pressure has been triggered by four background factors: the rapid expansion of Marsabit Township, which was upgraded to a municipal council in 1997, the sedentarization of former pastoral communities around the forest, rapid population increase within the Central Division; the Government policy which encourages construction of more boarding educational institutions in ASAL regions such as Marsabit District.

a) Wood fuel consumption by sector

The sectors studied included the local urban and rural households and institutions in Marsabit Central Division where Marsabit Forest is located. The high wood fuel demand (58 %) by urban households can be explained by the fact that every urban household was found to use charcoal, compared to only 27 % of the rural households. Furthermore, a considerable proportion (42 %) of urban households was found to use the low efficiency traditional metal cooking stoves. Given that charcoal was produced using the traditional earth kilns with a conversion efficiency of 10 %, then for every unit of charcoal consumed, at least ten units of wood were needed for its production (Kirubi et al. 2000). Thus, the high charcoal consumption by the urban households led to more felling of trees.

The destructive practice of felling trees to produce charcoal is rampant within the areas immediately outside the official forest boundary and in other smaller vegetation units in the lowland areas, such as the Gof Chopra Hills. Moreover, the high demand for charcoal in the urban areas and the fact that the charcoal producers did not pay any money for the trees they used to make charcoal, made charcoal production a profitable enterprise, particularly for the rural community (ibid.).

b) Fuel wood 'surplus' and 'deficit' areas

The fuel wood 'surplus' and 'deficit' areas were determined on the basis of fuel wood availability. The availability variable was, in turn, measured as a function of the time spent gathering wood. It was clear that fuel wood consumption increased with a decrease in time spent gathering it and vice versa. This suggests that the demand of wood for fuel was elastic in nature, that is, more availability of wood led to more consumption of fuel wood. There was also higher fuel wood demand in the areas situated close to Marsabit Forest hence indicating both the importance and vulnerability of the scarce forest resources in the ASAL areas. Forest resources constitute the primary sources of wood for fuel and construction, as well as meeting other needs for the local communities (ibid.).

The marked difference in fuel wood demand between the areas that are near and those that are far from a forest reflects the crucial role played by the scarce forest resources in the ASAL areas, not only in the provision of energy but also other needs to the local communities. Consequently, the degradation of such resources was found to increase with the increase in human pressure and was exacerbated by the prevailing adverse climatic conditions.

c) Socio-economic effects of wood fuel consumption

The provision of fuel wood was found to be the domain of the women and children; hence, shortages of wood affected them most directly. Women and children spent an enormous amount of time and energy in gathering wood for fuel at the expense of other more productive activities, such as farming, childcare, education and other income-generating activities. Moreover, the cost of both fuel wood and charcoal increased by approximately 10 % annually between 1994 and 1997. Consequently, the proportion of household income spent on fuel increased at the expense of other essential needs such as food, education, medical treatment and water (Kirubi et al. 2000).

The regular silting up of the water sources such as boreholes, wells and springs that are within Marsabit Forest was used as an indicator of soil erosion. Due to this silting up, extra time and energy were needed for fetching water. Large herds of livestock were required to move longer distances for watering, exacerbating the soil erosion problem by trampling the forest (MALDM 1995; in Kirubi et al. 2000). In addition, substantial amounts of human, material and financial resources were expended on the maintenance of the water sources.

Other long-term effects include a possible decline in water yield from the forest's catchment zones due to increased run-off and evapotranspiration, which limits water percolation into

ground water aquifers. Continued degradation of Marsabit Forest, which is a crucial reserve for pasture and water particularly during droughts, would destroy the local community's principal source of livelihood, which is sale of livestock (ibid.).

Marsabit Forest, like other forest resources in the ASALs of Kenya, is subjected to the so-called '*tragedy of the commons*' type of exploitation. Consequently, every member of the community wants to maximize their individual and/or collective benefit(s) from the common resource, without consideration to its sustainability. However, the resource-poor local community was found to exploit the forest and other smaller vegetation units out of sheer necessity, to ensure their basic survival due to lack of other affordable alternatives. Indeed, from the perspective of the affected community, wood scarcity is seldom an isolated problem, but rather a manifestation of a much broader and complex problem of poverty and vulnerability (ibid.).

d) Ecological effects of wood fuel consumption in the ASALs of Marsabit district

Deforestation

In this study, deforestation refers to the tonnage loss of wood removed from Marsabit Forest specifically to meet wood fuel demand by the different sectors studied. The total tonnage loss from the forest amounted to approximately 56,000 tons. Institutions such as schools, prisons and hospitals accounted for only 3 % of the total wood consumption, yet they caused more deforestation per unit of wood consumed, owing to large-scale logging of dead and/or live wood from the forest (Kirubi et al. 2000). According to Kirubi et al. (2000), this observation agrees with a UNEP report from 1989, which indicated that in other parts of Kenya, fuel wood demand by large-scale catering institutions posed a considerable deforestation threat to Kenya's wood resource base. On the other hand, urban households caused more deforestation than the rural households for two reasons. Every urban household was found to be using charcoal, whereas only 27 % of the rural households used charcoal produced from within and without the forest. Over 12 % (1023 tons) of the total fuel wood demand by urban consumers (households, hotels and bakeries) was met by wet wood, particularly the young growing trees in the forest, which were felled and/or lopped by women for sale (ibid.).

As a direct consequence of harvesting the trees for use as fuel, the tree density had declined remarkably within a 5-km radius of the Marsabit Forest's main entrance. Moreover, a vast radius of over 1–5 km, from the main entrance to the forest, had been cleared of the young trees and wildlings and the leaves swept away. The encroachment into live trees, particularly young ones, and sweeping up the leaves, contributed to deforestation, limited the natural regeneration process and encouraged soil erosion within the forest. Consequently, if the trees were not replaced at the same rate as they were harvested, and taking into account the typically low rate of vegetation regeneration within the ASALs, the resultant short- and long-term ramifications on the local environment and beyond are bound to be severe (Kirubi et al. 2000).

Loss of biodiversity

Woodfuel demand does not only result in the explicit tonnage loss of dead and/or live wood, but also involved the loss of tree species through deliberate species selection by the local consumers to satisfy their unique preferences. Typically, the local people exhibited distinct preferences towards particular species for wood fuel production and consumption, subject to the availability and/or accessibility of wood. However, more often than not, these preferences were met through particular species selection, without due consideration of the ecological limitations prevailing in the study area with regard to natural regeneration of the preferred species. For example, institutions were found to rely exclusively on *Olea* spp. *Olea* spp. and *Teclea* spp., which are indigenous species, were harvested to meet 39 % and 53 % of the total

wood consumed by urban consumers (households, hotels and bakeries), respectively (Kirubi et al. 2000).

Olea spp., *Teclea* spp. and *Diospyros* spp. are hardwood species and high-density woods, whose multiple uses by the local community include fuel wood, charcoal, timber, panelling, poles, wood carving, fermentation and flavouring milk, medicine (stem and bark), and bee-keeping. For instance, the women respondents and institutions observed that *Olea* spp., unlike the rest, burnt with less smoke and produced large pieces of charcoal, thus, it required less tending and cooked food faster. Hence, the noted high preference for *Olea* spp. by the local community was attributable to such desirable characteristics. The rapid loss of these indigenous species was an important indication of the serious loss in biodiversity from Marsabit Forest (Kirubi et al. 2000).

It has been estimated that 99 % of a typical forest's biodiversity was accounted for by its non-tree component. Therefore, the massive removal of trees and vegetation from the forest continues to have a destructive impact on the remaining trees and other vegetation, particularly the arboreal plants (Gamboa 1997; in Kirubi et al. 2000). In addition, the removal of all the residues, removed the essential nutrients which should otherwise return to the soil to maintain its fertility and soil binding structure. In the process of gathering the residues, the women were also found to remove and/or trample the undergrowth of wildlings, which was critical for forest regeneration, not to mention the opening of the canopy through logging by the institutions (Kirubi et al. 2000).

Another notable danger is that the lost indigenous species might not be replaced successfully by other exotic tree species, as the latter might not withstand the prevailing ASAL ecological conditions. Moreover, attempts to replace indigenous species with exotic ones could, in the long term, disrupt the indigenous genetic pool and its characteristics by interfering with the breeding or reproductive systems within the forest (ibid.).

DISCUSSION

The wood fuel factor is a critical issue as far as environmental degradation in Kenya is concerned. Because of commercialization of wood fuel trade, there has been a shift from dependence on dead wood and wood from farm clearings, to the cutting of live trees for use as fuel. Agricultural expansion with an emphasis on large-scale cash crop production, coupled with rapid population growth, has had both direct and indirect negative impacts on forests and the environment as a whole. Under high population pressure the demand for wood fuel increases and wood removal exceeds the rate of natural regeneration and this implies deforestation. Hence, dead wood used as fuel may as well imply that the once self-regenerating trees are now dying. Therefore, it is crucial to assess the historical aspect of tree cover and tree species within a locality to conclude on abundance of wood fuel and the ecological effects of its exploitation. There is a great deal more at risk from tropical deforestation than just trees. The effects of deforestation are complex, interrelated and wide-ranging affecting peoples far and removed from places where it is occurring. At the global level, there is concern on issues such as the extinction of biodiversity, global warming and soil erosion. Although, wood fuels are being used increasingly in both rural and urban areas, there seems to be a consensus that in so far as deforestation is the result of wood fuel needs, it springs from urban, not rural needs. Population size, growth, distribution and movement help to determine the relationship between people and their environments. Similar numbers of people can have very different impacts on the environment, depending, for example, on social institutions, means of production, property rules and forms of governance. Access to

education, consumption levels and gender differentials (the 'quality of human capital') all have an influence.

From the case studies above, we can explicitly deduce the consumption patterns and environmental effects of wood fuel use. The Kenyan landscape distinctively varies from rich farmlands to barren dry lands and this influences wood fuel utilization patterns. The social and environmental effects in the two regions are basically the same but vary in degree, and are also influenced by local socio-economic and ecological conditions. For example, the poor performance of cotton in the lower zones of Embu makes the unsustainable situation of wood fuel extraction worse. The upper zone dwellers, despite their closeness to the Mt. Kenya Forest, did not encroach the forest for fuel wood trade but instead relied on tea and coffee farming for cash income. They instead depended on fuel wood supply from the lower zone. On the contrary, in Marsabit, areas close to the forest were more encroached, hence, showing the increased vulnerability of forests in ASALs of Kenya as compared to the well-watered fertile areas. On the whole, there is a need to conserve the two forests through continued research and sound management.

Poverty levels are apparently higher in Marsabit than Embu (especially among rural households), and this also has implications for environmental degradation. Impoverished communities are compelled by force of circumstances over which they have little or no control, to over-exploit their resource base. Poverty prevents households from breaking from the reliance on wood fuel because poor families cannot afford the higher cost of cleaner fuels and the appliances required. Consequently, environmental degradation is higher in the rural areas of both districts where poverty levels are relatively higher. This is most evident in Marsabit where environmental conditions are more adverse. On the other hand, despite the higher population density in Embu district in comparison to Marsabit district, the effects were higher in the latter due to the prevailing adverse environmental conditions.

In a general perspective, fuel wood collection in rural areas is mostly done by women and girls. As fuel wood becomes scarce, women are forced to spend more time and effort in walking longer distances to collect firewood. This extra burden affects the quality of life substantially as it reduces the time and attention women could pay to nurturing their families, and engaging in other income-generating activities. From a gender perspective, women in Kenya constitute a higher overall national incidence of poverty; 54 % in rural areas and 63.0 % in urban areas (UNDP 2000). This coupled with the patriarchal nature of the Kenyan society inhibits women's attempts to escape poverty. Consequently poverty in Kenya predominantly wears a female face and as such, those in the rural areas face a dual form of marginalisation, i.e. being in a rural area and being female. As such, women in both districts are more affected by environmental degradation that results from wood fuel extraction.

Generally, women in Kenya have limited decision-making power in the household as it concerns choosing new fuels and appliances. The young girls engaging in firewood collection may also have their education affected, since they need to provide support to their mothers especially with increasing scarcity. This further perpetuates the feminization of poverty in Kenya as a whole. Women and girls are also more prone to injuries while collecting and carrying fuel. The local household environment is affected by indoor air pollution due to biomass burning which affects the quality of life in a significant way. Burning of biomass in inefficient cook stoves is one of the major causes of chest and lung related health problems among rural women and children. Biomass cooking produces soot and other substances linked to acute respiratory infections, chronic obstructive lung diseases, lung cancer and eye problems as well as low birth weight (UNFPA 2001). The effects of these pollutants are compounded by poor ventilation characteristic of most rural poor households. There are cases of failure to cook food or boil water adequately because of fuel shortage or inefficiency. In some incidences, low-energy consuming and fast cooking meals are preferred at the expense

of nutritious foods. This contributes to malnutrition, intestinal disorders and parasites. Poor health consequently restricts opportunities for economic development to overcome poverty.

In ASAL regions like Marsabit where there is forest encroachment, harvest of fuel wood is likely to cause desertification. Soil losses fertility and structure to the extent that its ability to support plant life is severely compromised. Deforestation can lead to downstream flooding, reduced water quality and sedimentation in the limited surface and ground water bodies. With increased desertification, salinization and acidification of soils may occur due to increased evapotranspiration on the bare soil surface. Consequently, agricultural productivity is compromised leading to food shortage, poor health and increased impoverishment. Loss of biodiversity reduces an ecosystem's ability to recover from natural or man-induced disruption.

Suitable sites and tree species should be identified to promote the crucial practice of planting trees, particularly in village woodlots on communal land, local schools, around small townships and other degraded settlement areas. *Cucurbits* can be effective in controlling soil erosion, as their large leaves reduce the impact of rain and the extensive roots hold the soil together. As noted in Marsabit, charcoal producers did not pay any money for its extraction and this has made the charcoal enterprise very lucrative and attractive. Hence, there should be a price tag, set by the Forest department in conjunction with village elders, to motivate the charcoal producers to economize on the use of wood. The ASALs of Marsabit district are situated in a geologically mineral rich area although little geological survey has been carried out. The existence of various minerals in the adjacent Turkana district raises the possibility of finding minerals in the area. As illustrated in Figure 1, there are a whole range of causes and effects due to wood fuel extraction. Therefore, the interventions introduced should be through participatory and holistic approaches that seek to integrate the local community, its indigenous knowledge and practices into environmental conservation activities in order to secure sustainability for such activities.

Biomass energy consumption, apart from local environmental effects, also has a serious impact on global climate change due to emissions of greenhouse gases. The process of degradation and depletion of forests – which results in loss of natural sinks that could absorb carbon emissions – and biomass burning, have been identified as significant contributing factors to the greenhouse effect. Green house gases such as benzene, hydrocarbons and carbon monoxide are emitted, though in small amounts, but cumulatively. Global warming is expected to increase the risk of vector borne disease, food and water shortage, population dislocation etc. Indoor pollution causes an estimated 2 billion excess deaths per year, or 5 % of the global burden of disease (World Bank 1993b).

SOLUTIONS SOUGHT AND RECOMMENDATIONS TO MITIGATE EFFECTS OF WOOD FUEL CONSUMPTION

The remedial interventions emphasize the provision of viable and affordable alternatives that seek effectively to address the legitimate needs of the local community, without causing further degradation of the fragile environment. There is an urgent need for tailor-made end-user training in the energy-saving technologies with a view to realizing wider dissemination and more efficient use of such technologies. Currently, improved stoves are widely used in the two regions with the view to conserve energy and the environment, and as an income-generating activity through the sale of stoves. Afforestation and re-afforestation programmes are also being undertaken. It is also felt that there is a need for imposition of an immediate ban on the harvest of particular indigenous species such as *Olea* spp. and *Teclea* spp. in

Marsabit forest, which are seriously endangered. Below are further recommendations to help alleviate the social-economic and ecological effects of fuel wood use:

- Subsidies for commercial fuels (e.g. electricity and liquefied petroleum gas) should be given by the government in urban areas to discourage reliance on charcoal from rural areas.
- Producers of charcoal should be helped to adopt the use of more efficient methods, such as the steel kilns through the government giving subsidies to producers through loans.
- Extension officers (local environmental and agricultural officers who help rural farmers) should be made available to the remote rural areas to advise farmers on efficient farming methods for sustainable agricultural production.
- Family planning campaigns should also be intensified in the two regions to help curb rapid population growth.
- Cultivation of *Curbataceae* plant species (*cucurbits*), whose roots can be used as fuel, should be introduced in the area.
- Cost-effective techniques of harnessing solar energy for cooking, heating and lighting should be encouraged in order to provide the local community with an affordable alternative/supplement to wood fuel.
- The government should also ensure stability of market prices of cash crops (especially cotton in Lower Embu), to encourage farmers to concentrate on cash crop farming and not charcoal production.
- Government provision of more incentives and amenities to the rural folk to curb rural-urban migration which has led to increased charcoal consumption by an ever increasing urban population.
- Extension officers should be more available in the rural areas to encourage productive, profitable and sustainable farming methods among rural farmers.
- Other economic potentials (especially in Marsabit), such as tourist attractions (wildlife), fishing, wind and solar energy should be fully exploited to economically empower the locals to reduce reliance on woodfuel use and sale. Salt tolerant crops can be grown in the area to provide food and trees to increase the district's productivity.

CONCLUSIONS

There are complex links between wood fuel extraction and various environmental processes. The complex problem of energy in the two districts calls for a combination of solutions, at all levels, as singular solutions, to diverse problems, risk missing their targets. They multiply costs by requiring adaptation to each specific problem. Experience has shown that those piecemeal interventions, such as isolated dissemination of technically improved cook stoves or isolated afforestation, while valuable in themselves are not adequate to address these problems. Biomass energy management is related to a whole range of other social, economic and environmental development, and consequently can only be addressed by a combination of demand management and supply enhancement using an integrated, intersectoral approach. Moreover, the present equation of energy and environment issues with global sustainable development brings a new perception to reflections on rural energy. It is above all based on the notion of diversification. In the Kenyan context, particularly in the agricultural sector, this is essential to ensure food security. Ironically, the Malthusian nightmare threatens to become reality in respect not to food, but to the fuel for its preparation. In the unlikely event that

present trends were allowed to go unchecked, shortages would affect millions of people by the turn of the century. We should not await a 'wood fuel pandemic' to first occur for us to consider mitigating it when the tell-tale signs are all so clear now. Local communities should be involved in a bottom-up approach where they actively participate in the programmes put in place. Women, especially in rural areas, should be empowered to participate and play a role in decision making in wood fuel issues as they have a more direct interaction with the environment and are the ones most affected by environmental degradation. Faced with this situation, it is imperative to seek, stimulate and accelerate the transition to viable energy systems. This transition requires political vision and long-term mobilization, and it includes a strong component of community development. Needless to say, the Kenyan Government should address this issue with profound urgency giving priority to the arid and semi-arid lands.

References

- Adomah-Darteh, R.O. (1995): *Wood for Fuel and Deforestation*. Unpublished manuscript. Department of Geography, NTNU, Trondheim, Norway.
- Angelique, H. (1984): Economy, Ecology and the Unequal Impact of Wood fuel Scarcity in Embu, Kenya. Barnes, C., Ensimerger, J. & O'Keefe, P. (eds.) *Wood, Energy and Households: Perspectives on Rural Kenya*. Beijer Institute, Stockholm, Sweden.
- Ardayfio, E. (1986): *The Fuel wood/Energy Crisis in Sub-Saharan Africa*. Web Journal, United Nations University Press. <http://www.unu.edu/unupress>.
- Foley, G. (1992): *The Energy Question*. 4th Edition, Clays Ltd, England.
- Kirubi, C., Wamicha, W.N. & Laichena, J.K. (2000): Effects of Wood fuel Consumption in the ASAL areas of Kenya: The case of Marsabit Forest. *African Journal of Ecology*, Vol. 38, 47–52.
- Leach, G. & Mearns, R. (1988): *Beyond the Woodfuel Crisis. People, Trees and Land in Africa*. Earthscan publications, London.
- Njoki, W. & Chandler, D.J. (2002): *Indigenous Gendered Spaces: An examination of Kenya*. Unpublished Web Journal. <http://www.jendajournal.com/jenda/vol2.1/chandler-wane.ht>.
- Riley, B. W. & Brokensha, D. (1988): *The Mbeere in Kenya, Volume I*. University Press of America, New York.
- Simmons, I.G. (1975): Conservation. Dawson, J.A. & Doornkamp, J.C. (eds.) *Evaluating the Human Environment: Essays in Applied Geography*. Edward Arnold, London.
- Timberlake, L. (1988): *Africa in Crisis*. Earthscan publications Ltd, London.
- UNDP (2000): *Overcoming human poverty*. UNDP Poverty Report 2000. <http://www.undp.org/povertyreport/ENGLISH/ARfront.pdf>.
- UNFPA (2001): *The State of World Population*. <http://www.unfpa.org/swp/2001>.
- World Bank (1993a): *Ecologically Sensitive Sites in Africa (East Africa)* Vol. 2. World Conservation Monitoring Centre for The World Bank, Washington DC.
- World Bank (1993b): *World development report 1993: investing in health*. Oxford University Press for the World Bank, New York.
- World Fact Book (2005): *Kenya*. <http://www.cia.gov/cia/publications/factbook/geos>.

Chandima Dilhani Daskon

HUMAN IMPACTS ON RAIN FORESTS IN SRI LANKA: THE CASE OF “SINHARAJA” FOREST RESERVE

Abstract

The interplay between human culture and nature has intensified greatly in recent time. From the beginning of human race, culture was a new kind of force in the biosphere leading eventually, through its effects on human behaviour, to big changes in the interrelationships both between human population and other living organisms and in their environment, and among human beings themselves. Forests are a unique pool of resources, which have disappeared rapidly at an irreversible rate. This is highly intensified by the resource extractions by the community who depends on the forests. Protection of forests is an integral part of Sri Lankan culture and is also reflected in the principles of its governance. Of many constraints to the protection of the forest those relating to the people and organisations in the immediate vicinity of the reserve are perhaps the most important. Protection of forest reserves is an urgent need both for the local community and for nations as a whole.

1 INTRODUCTION

Sri Lanka has been famous through centuries for an infinite variety of environmental features, including unique natural forests, manifestation of the ancient culture and unlimited natural resources that continue to be of high economic value even today. Since the advent of Buddhism to the country, Sri Lanka has had long history of conserving nature and wildlife nurtured by Buddhist Philosophy¹. Buddhism teaches universal respect for all forms of life and the importance of protecting nature in all of its manifestations. People in Sri Lanka have a strong connection to the environment, particularly to natural forests, and they have been utilizing them for various purposes.

We aware that, forests are a unique pool of resources, which provide services to nature in general and humans in particular, and also economically valued products such as industrial wood, wood-fuel and NWFPs². Naturally, forests support soil generation, soil and water conservation, purification of air and water, nutrient recycling and maintenance of biological diversity; socio-economically, they support employment, income, recreation and protection of natural and cultural heritage.

Human involvement with forests can be analyzed in different ways. In this paper attention is given to *Sinharaja*, which is located in the wet zone in Sri Lanka. The paper discusses the way of resource utilization of *Sinharaja* forest, leading to community interaction through resource utilization. Further, management and conservation of forest resources will be discussed highlighting constraints and challenges for sustainable future management of forest resources.

¹ It is in fact believed that King Devanampiyatissa, the first ruler to embrace Buddhism in the country, established the World's earliest wildlife sanctuary in 246 BC.

² According to the Forest Ordinance of Sri Lanka the following materials are declared as NWFPs:

- Leaves, flowers, fruits, seeds, juice, wood oil, natural varnish, resin, gum
- Plants that are not trees, including grass, creepers, reed moss and all parts or products of such plants

2 STUDY BACKGROUND AND PROBLEM STATEMENT

Rain forests are one of the unique resource pools, which consist of high species diversity both in flora and fauna. The major regions of rain forests are located on the tropical border. Every year millions of hectares of these forests disappear. As estimated between 1960 and 1990 more than 20% of the global forest cover was lost, and regionally 33% in Asia, 18% in Africa and Latin America had been destructed (IUCN 1993).

Sri Lanka is one of the South Asian countries with a luxuriant plant cover with a high number of endemic species. The lowland area has a vegetation of tropical rain forests where the crowns of dominant trees create a closed canopy at 25–30 m with emergents rising to about 45 m. Moreover, it has a rich underground cover. Sub-mountain forests, wet evergreen mountain forest, tropical semi-evergreen forest, dry mixed evergreen forests are some of the other dominant ecosystems of the country (Central Environment Authority 1988). This great habitat diversity is based mainly upon physiography, soil types and climatic variations in the country. According to the variation of the local climatic conditions, different types of forests can be identified within the country (Table 1).

Table 1. Forest Resources in Sri Lanka (Source: Ministry of Agriculture, Land and Forestry 1995, Forestry sector Master plan).

Forest type	Total area (ha)	Total land area (%)
Closed canopy		
Montane	3108	0.05
Sub-Montane	6861	1.04
Lowland Rain	141506	2.14
Moist Monsoon	243886	3.69
Dry Monsoon	1090981	16.49
Riverine	22435	0.34
Mangrove	8688	0.13
Sub total	1579220	23.88
Open canopy		
Sparse	464076	7.01
Total	2043293	30.89

The closed canopy forest cover has dwindled rapidly from about 84 % in 1881, to 44 % in 1956, subsequently to 27 % in 1983 (http://www.naturevoyagers.com/sinharaja_more.htm). At the end of 1999, the country's forest cover has dropped to almost 20 % from 70 % recorded in 1990 (FCD 1986). As the Forest Department shows for the year 1992 (see Table 1), Sri Lanka's total natural forest cover was around 2.0 million hectare (30.9% of the total land). Closed canopy natural forest cover was 1.5 million hectares or 23% of Sri Lanka's total land area. This suggests that the average rate of deforestation during the past few decades, both planned and unplanned, had been around 42,000 hectares per year. Per capita forestland declined from 0.32 hectare in 1956 to 0.09 hectares in 1992 (Ministry of Agriculture and Land and Forestry 1995).

The rapid reduction of the forest cover was mainly due to the large scale agricultural expansion and irrigation schemes. According to the FCD, shifting cultivation has also contributed to the depletion of forest cover. Agricultural production has increased mainly by converting natural forest to farmland. Nearly 809,000 hectares of natural forests have been lost to agricultural and residential use since 1948. However, in general this decline of forest

cover is primarily, due to rapid population growth and result of land shortages and poverty (Ministry of Environment and Natural Resources 2002). Table 2 illustrates the relationship between population growth and the depletion of natural forest cover in Sri Lanka.

Table 2. Population growth and depletion of natural forest cover in Sri Lanka (Source: Ministry of Agriculture, Land and Forestry 1995, Forestry sector Master Plan).

Year	Population density (persons/sq km)	Forest cover (Million ha)	Forest cover (% of land area)	Per capita forest area (ha/person)
1900	54	4.5	70	1.3
1956	131	2.9	44	0.3
1983	230	1.8	27	0.1
1992	269	1.6	24	0.1

However, economically, forests provide a good source of income. According to the latest estimations, timber and other forest resources generate an income of 70 million U.S. dollars a year, and over 98 % of rural energy needs and 78 % of those of the urban population are met from fuelwood (Peoples' Bank 2001).

3 RATIONALE AND SIGNIFICANCE OF THE STUDY

Sinharaja is one of the major forest reserves in the country, which contains great biological diversity. As many other forests in the country, this forest has also been subjected to heavy encroachment by the communities adjacent to the forest and some outside commercial groups. Thousands of hectares have been cleared for tea cultivation since British colonisation times (http://www.naturevoyagers.com/sinharaja_more.htm). After independence, a policy of nationalisation was applied and the Land Reform Commission took these lands in 1974. Tea cultivation was stopped but in 1999 the problem started again due to the release for organic tea cultivation of 62 hectares of dense forest adjoining Sinharaja (http://www.naturevoyagers.com/sinharaja_more.htm). The communities in the surrounding area are using the forest for various purposes such as food, medicines, building materials, and firewood and as spiritual elements that ensure long-term survival. Even though legal restrictions and forest regulations are already operated, some illegal land encroachments take place. Often due to conflicting interests of different groups, sustainable management of this forest has become more decisive. This tiny study intends to explore the existing practices within and surrounding the forest and its future management. With this overall objective this research paper sets out to meet the following objectives:

4 OBJECTIVES OF THE STUDY

- To examine the pattern of resource utilisation by the community
- To identify the impact of legal and illegal tree felling in forest on the community
- To assess the environmental consequences of resource utilisation of the forest
- To suggest suitable recommendation for the sustainable use of resources in the forest

5 METHODOLOGY

The type of methodology depends on the type of study that we are engaging in. It can be based entirely on primary sources with the data gathered from fieldwork or entirely on secondary data. Also, it can be either qualitative, quantitative or both. The selection of methods is influenced by the researchers' experiences, skills, time and even the availability of financial assets, etc. Due to the time constrain this paper has been organized completely as literature study based on a wide range of secondary sources. The data were collected basically from the publications of Environmental Authority, Department of Forest and Agriculture, environmental journals, environmental reports, research papers and articles, and internet sources. The reliability and the validity of data are limited due to the lack of primary information about the forest and the views from the community, and administrative personalities. However, the information provided is sufficient to figure out the existing situation in the study area.

6 THEORETICAL STRUCTURE OF THE STUDY

Geographical research aims at producing new facts and knowledge, or relating hitherto unrelated facts, with the ultimate aim of critical understanding, explanation and predictions on spatial differentiations (Holt-Jensen 2000). In this study, I employ two main theories namely, human-environmental relationship, and space and place concepts (theory of spatial analysis) in order to follow the theoretical perspective behind the phenomenon examined.

6.1 Human-environment relationships

The relationship between people and their environment is probably the most important theme in this study. It is believed that this study is related with geography, which studies among other topics human-nature relationships. This human-environment interaction debate is so fundamental that discussions of how nature affects man and of the human impact on the environment pervade many geographic discourses and research themes to the present. The concepts of man and nature may seem relatively recent in past interests; its roots in fact lie deep within human history (Diesendorf and Hamilton 1997). Nature is both universal and external. It is not so important to explore the elusive meaning of nature, but to examine how the society-nature relationships have been conceived and used in geographical research and geographical history. There are three main questions have been asked about the human and nature.

1. What are the conditions of nature when undisturbed by human influences?
2. What is the influence of nature on people?
3. What is the effect of humanity on nature and what is humanity's role within nature?

Different views have been formulated within the human-nature field in order to discuss the answer to these questions. In one aspect, nature is seen as a home for human beings. Human beings are the product of nature and the social, cultural and economic contexts are controlled by the natural forces (Haley 2002). As in the possibilism, the relationship between nature and society is as follows: the physical environment offers possibilities for human existences and adoptions; i.e. it provides the opportunity for a range of human responses, and human beings have a considerable discretion to choose between the opportunities (Johnston et al. 2000).

However, today we are extracting the resources from the nature, exceeding its natural carrying capacity. This approach provides the theoretical explanation which is the basis of my study.

6.2 Space and Place concepts (spatial analysis)

The concepts of 'space, place and time' are considered as key components of the geographical study (Holt-Jensen 2000). The production of geographical knowledge has always involved claims to know 'space' in particular ways (Holt-Jensen 2000). Human's actions cannot be isolated from the 'space' or 'place', and they occurred within 'time'. All the activities of the society are organized within this special context, and their intensity and the influences are varying spatially. Hence, the activities whether economic, social or environmental are changing from place to place, and space to space. Therefore, every human activity consists of a place, a space and a specific time. This gives the significance and rational thinking for any kind of study. In my study I look at the spatial changes of the use of resources in the Sinharaja forest. This conceptual framework provides a rational way of thinking of this study problem.

7 HUMAN INFLUENCES ON THE SINHARAJA FOREST

SINHARAJA, its name literally meaning lion (Sinha) king (raja), perhaps refers to the original 'king-sized or royal forest of the Sinhalese', a people of legendary 'lion-race' of Sri Lanka or to the home of a legendary loin of Sri Lanka (www.sinharaja.com).

The following sections include background information about the study area, socio-economic characteristics of the community, types of threats to the forest, the nature of resource consumption, and finally a discussion/analysis. The paper concludes with recommendations for a sustainable way of utilization of the forest resources.

7.1 Background information of the study area

Geographical Location

Sinharaja is situated in the southwest lowland wet zone of Sri Lanka within Sabaragamuwa and Southern provinces with approximately 6,091 hectares of forest reserve and 2,773 hectares of proposed reserve. The forest is bounded by the rivers named Napola Dola and Koskulana Ganga in the south, in the south-west by the Maha Dola and Gin Ganga, in the west by the Kalukadawa Ela and Kudawa Ganga, and in the east by an ancient foot path in the tea estate.

Climate

Based on meteorological records gathered in and around Sinharaja over the last 60 years, annual rainfall has ranged from 3,614 to 5,006 mm and temperatures from 19 to 34 °C. Most precipitation emanates from the south-west monsoon during May–July and north-east monsoon during November–January. Conditions are dry in February (http://www.sritravel.8m.net/sinharaja_biosphere_reserve.htm).

Vegetation

Two main types of forest can be found in the area. Remnants of *Dipterocarpus* forest occur in valleys and on their lower slopes, with here *D. zeylanicus* and here *D. hispidus* present in almost pure stands (http://www.sinharaja.4t.com/pages/types_of_vegetation.htm). Secondary forest and scrubs occur where the original forest cover has been removed by shifting cultivation. In other places of the forest it has been replaced by rubber and tea plantations (Rosayro 1954). Mesua-Doona (*Shorea*) forest, the climax vegetation in most of the reserve, covers the middle and upper slopes above 500 m. A range of species dominate the sub-canopy

and *Mesua nagassarium* usually predominates in the canopy layer (Gunathilake and Gunathilake 1980).

"UNESCO declared this magnificent landscape as Man and Biosphere Reserves in 1978. It became as a National Heritage Wilderness Area under the National Heritage Wilderness Act in 1988 and was named a World Heritage Site by UNESCO in 1989" (http://www.naturevoyagers.com/sinharaja_more.htm).

Ecological uniqueness of the forest

The flora and fauna of the forest reserve is unique compared to other forest reserves in the country. Almost all of Sri Lanka's endemic flora and fauna are confined to the rain forests in this area. Mainly moist climatic conditions and the long period of isolation of the wet forest-adopted species have promoted the evolution of endemism and specialisation (Pethiyagoda and Manamendra-Arachchi 1998; Philips 1980; Sri Lanka National Report 1991; Wikramanayake 1990). More than 60 % of the 306 species that are endemic to the country are found only in this forest area. Additionally, 98 % of 58 species in the family *Dipterocarpaceae* the dominant tree family in Asian rain forests are endemic to this area. An endemic ground orchid, commonly known as the king of the forest or "wanaraja" is found only in undisturbed portions of the forest reserve. The reserve is contiguous with several forest reserves, the largest forest block accounting for about 43 % of the remaining wet zone forests (Zoysa and Raheem 1987). The entire forest area contains a unique diversity. Table 3 shows different groups of species, number of species in each group and their endemism.

Table 3. Flora and Fauna (Source: Natural Resources, Energy and Science Authority of Sri Lanka 1991)

Group	Number of species	% Endemism*
<i>Flora</i>		
Algae	896	Na
Fungi	1920	Na
Lichens	110	35
Mosses	575	Na
Liverworts	190	Na
Ferns	314	18
Gymnosperms	1	00
Angiosperms	3100	27
<i>Fauna</i>		
Land snails	266	Na
Spiders	400	Na
Mosquitoes	131	13
Blister Beetles	15	20
Fish	59	27
Amphibians	37	51
Reptiles	139	50
Birds	237	08
Mammals	86	14

*Note: Na = data not available

Fauna

Birds are a highlight in Siharaja with 22 out of Sri Lanka's 26 endemic birds that have been recognised here. Even the less experienced persons could hope to see 10–15 endemics during their stay (Natural Resources, Energy and Science Authority of Sri Lanka 1991). However, it is not just birds that attract the visitors. The area contains a huge variety of trees and flowering plants as well as numerous colourful butterflies floating above the forest floor. Due to the dense forest animal life is more difficult to spot, although we would have a good chance of seeing giant squirrels, mongoose, purple-faced langur, wild boar and barking deer, rarer species including rusty-spotted cats, fishing cats, Indian civit cats and leopards (Natural Resources, Energy and Science Authority of Sri Lanka 1991). This forest provides a magnificent home for all the species in the area.

During the past two centuries, nearly all the natural forests in this eco-region have been cleared particularly for tea and rubber plantations, paddy cultivation, and human settlements. Only about 8 % of the lowland wet forests now remain as several small, isolated patches in a highly fragmented landscape (Gunathilake 1978).

Fragmentation is a prominent character of this area. The most visible form of habitat change is direct habitat removal due to clear-cut of the forest for agricultural purposes and human settlements. In the northern and eastern parts of the forest it consists of visible patches of clear cutting. Ecologically, fragmentation is described as a "way of losing diversity and uniqueness of the forest". Habitat fragmentation is generally considered to have two components (Carroll 1997)³:

1. Reduction of the total amount of a habitat type, or perhaps in all natural habitats in the landscape.
2. Apportionment of the remaining habitat in to smaller more isolated patches.

In the past, the Sinharaja was not subjected to heavy encroachments and it was protected largely because of its relative inaccessibility. Today, the problems have been aggravated due to increased clear cutting and human settlements. Consequently, the natural habitats are becoming too small. Some of the areas are isolated from the main forest area.

8 FINDINGS OF THE STUDY

8.1 Socio-economic background of the community

Today, more than 39 villages scatter along the borders of the reserves. Moreover, ancient hamlets are found along the southern boundary and the north-western side of the reserve. There are two main villages in the south-western part of the reserve, namely Warukandeniya and Kolonthotuwa, and about 52 families live in the north-western sector. At least 30 other settlements occur on the periphery of the reserve of which an unknown number has been established illegally on state land without approval from the relevant authorities. The total population exceeds 5000 people. Some land adjacent to the reserve is under private ownership, including small tea and rubber plantations. The extent to which local people are economically dependent on rain forest resources is variable but about 8% of households might be completely dependent on it (Bandararhilake 1995).

³ However, these two processes are not always coupled. In managed forest there are ways of fragmenting without removing the existing vegetation cover.

The area is little developed, and both social and economic backgrounds are lower than the national level (Gunathilake 1978). Most of the people living in the region are poor and often have large families. Their level of education is low, too. Income is a crucial issue and almost all villagers depend on using all available as a possible income source. The main source of livelihood of these people is the production of jaggery. Wewal (rattan) is another source of income which is used for manufacturing baskets, some furniture and handicrafts. Cardamom (*Elattarin ensal*) is one of the economic crops cultivated in the forest underground which contributes around 50% of the income of the community (Bandararhilake 1995). However, this is a very small-scale production.

In order to supply the productivity of their home gardens, villagers in Sinharaja also engage in the practice of chena (slash and burn) cultivation. They usually harvest their crops in December and clear the vegetation in February to early March with the help of fire. However, in general there is no secure income source for all villagers and often the available sources are not sustainable. One non-agricultural motivated activity which can be found in the Sinharaja is that of gemming. Though, gemming is forbidden in the reserve today it is carried out by organized gangs employed by gem-dealers. Low income and poverty are critical issues that this community has been suffering over a long time. Foods for their daily consumption are derived from the forest as, for example, plants, fruits and cultivated vegetables.

8.2 Types of threats to the forest

As noted previously, Sinharaja is also subjected to heavy encroachments by villagers and illegal merchants. Most of these activities are ecologically destructive and the situation has been aggravated over the last few decades. According to Gunathilake & Gunathilake (1990), clearing land for agricultural expansion, illegal logging and settlements by the villagers are the most serious threats to the survival of the endemic species. Identified activities in this forest can be summarized as follows.

- Collecting materials from the forest (NWFPs)
- Land encroachment for settlements and agriculture
- Legal and illegal tree felling
- Paddy and tea plantation
- New development projects in the adjoining area of the forest

8.3 Nature of resource consumption by the community

The village people use mainly NWFPs for their daily purposes. These are derived from a variety of sources: from plants (trees, shrubs, herbs, grasses, palms) many different parts (roots, stems, barks, leaves, flowers, seeds, fruits) provide different products simultaneously and/or at different times. Furthermore, NWFPs exhibit a considerable variation in their use. Some are consumed immediately after harvest (e.g. fruits, fodder, and wild meat), others after primary processing (e.g. edible nuts, bamboo and rattans products). Table 4 shows different species of the forest that are used as NWFPs.

Table 4. Non Wood Forest Products (NWFPs) (Source: Ministry of Agriculture, Land and Forestry 1995, Forestry sector Master Plan).

<i>Production item</i>	<i>Local name of the species</i>	<i>Scientific name of the species</i>
Gum, Resins and Oleoresins	Dawn	<i>Angeissus latifolia</i>
	Kaj u	<i>Anacardium occidentale</i>
	Gammalu	<i>Pterocapus marsupium</i>
	Kakuna	<i>Canarium zeylaicum</i>
Indigenous medicines	Etdemata	<i>Gmelina arborea</i>
	Kumbuk	<i>Temiminalia arjuna</i>
	Kohomba	<i>Azadirachta indica</i>
Wild fruits	Mora	<i>Nephelium</i>
	Palu	<i>Manilkara hexandra</i>
	Madan	<i>Syzygium cumini</i>
	Jack	<i>Atiocapus heterophyllus</i>
Handicrafts: Grass, bamboo	Thambotu wel	<i>Calamus zeylanicus</i>
	Sudu wewel	<i>Calamus ovoideus</i>
	Ma wewel	<i>Calamus thwaitesii</i>

Kitul (*Caryota urens*) is a multipurpose tree species found in the forest and in other wet and intermediate zones. This species provides a variety of popular products to the people. Some families completely depend on kitul productions. Kitul sap is the most popular product besides the jaggery, and it is the base for local beer (toddy) and treacle. Treacle and jaggery are sugary substances, which are used in preparing a variety of traditional sweets. Hence, they have a good market throughout the country. Other non-wood kitul products include the sago like pith, which forms a valuable food, and kitul fibber, which is obtain from the leaves. Both man and women participate in kitul tapping and processing. Normally, tapping of kitul trees within the reserve is controlled by the Forest Department and only a limited number of permits are issued to the villagers (Gunathilake and Gunathilake 1980). In similar vain significant quantities of firewood are used by the villagers for the production of jaggery. On the other hand, production of medicinal beverages is common in this area. One of the important species that is used for this purpose is weniwel (*Coscinium fenestratum*) which is intensively used by the villagers (Gunathilake and Gunathilake 1980).

Some families in the community are growing rice both for domestic consumption and the local market. But this is relatively small in scale. The periphery of the forest has been fragmented by paddy fields and some other crop fields. Such edge lands have been used for small scale farming including vegetables and cattle ranching. Some villagers have encroached the forest in order to expand their small farm plots. Forest underground is used for small-scale plantation of cardamom (*Elattarin ensal*) as a minor agricultural crop for export. It is becoming a good income source for the community. Cardamom production generates income for 50 families in Llukumbura village (Bandarathilake 1995).

Tea plantation has a historical legend in this forest. During the British colonial period tea plantations were introduced to this area. Thousands of hectares have been cleared for tea cultivation since this time. Thanks to interruptions of responsible authorities this has been controlled during the last few decades. However, it has been raised again as a new trend. Organic tea plantations have been introduced to this area as a new profit oriented practice. Now, the adjoining land to the forest is used for organic tea plantation and cultivators are encouraged by Non-Government Organizations and private dealers. It is believed that there will be a greater demand for the organic tea productions from the Northern regions of the

world. Sinharaja Plantation Organic (PVT) Ltd is set to clear 62 hectares of land in Sooriyakanda village, located close to the forest, to grow organic tea, flowers and vegetables for the international market (Central Environment Authority 2000).

The reserve remained untouched until 1968 when a government directive was issued to extract timber for the plywood sawmill and chip wood complex established at Kosgama. From 1971 until 1977, when logging was banned, largely due to public pressure and the Wildlife and Nature Protection Society playing a leading role (Hoffmann 1972, 1977), about 1,400 ha of forest in the western sector were selectively logged by the state sector (Gunathilake 1978; Forest Department 1986).

New project proposals have been released to get the assessment from the authority to build a hotel and a golf course near the Sinharaja forest. "*Sinharaja Resort Hotel and Golf Course*" with an 18-hole golf course was proposed by a group of companies and envisaged financing from Switzerland, United Kingdom and Japan. Environmentalists strongly objected to this project, stating that it proposed the destruction of forestland, and that it would adversely affect the water supply of the community downstream. Further, they also expressed the concern that courses use large quantity of pesticides, herbicides, chemical fertilizers and soil hardening agents. Although this proposed project has reached the Central Environment Authority (CEA) to get Environmental Impact Assessment (EIA) recommendations, it has failed at that stage.

9 ANALYSIS/DISCUSSION

The economic and social importance of Non Wood Food Products (NWFPs) for tropical areas is well known. Myers (1988) has calculated that communities in tropical forests produce a self-renewing crop of wildlife with a potential value slightly more than US\$ 200 per ha. In the Amazonia of Peru and Brazil, more than 1.8 million people derive a significant portion of their income from extractive forest elements. An estimated 80% of the plant species providing NWFPs are found only in the biological richness and ecological complexity of primary forest. In the Sri Lankan context it is adduced that forests are unique resource pools for the people who are living adjacent to the reserves.

As introduced earlier heavy encroachment of forest vegetation is the main cause of deforestation. Village people, timber merchants, gem mining groups and other illegal visitors involve with various activities. Though people utilize resources, land, for example, their legal ownership is still undefined. However, many of the practices are legally approved by the settlement agencies due to the absence of clear demarcation of the forest boundaries. According to MAB regulations, timber extraction is not permitted in Sinharaja within a distance of 1 mile from the boundary of the reserve. Though, it is not extensively cleared selective felling of the surrounding forests welcome the private contactors who open up routes to facilitate logging operations. Then the reserve becomes more accessible to illicit timber operations. Alleged malpractices by the State Timber Corporation are also a source of concern for the Forest Department. Private land owners along the periphery perhaps make illegitimate use of timber resources within the reserve. After having felled all the merchantable timber on their own land, they continue to request permits for timber (Hathurusinghe 1985). It is noticeable that planting Honduran mahogany (*Swietenia macrophylla*) along logging trails as enrichment species may lead to displacement of natural species (Zoysa and Raheem 1987).

However these activities bring negative impacts on local people and other forest-dependent peoples. It implies the loss of their possibilities of survival as independent cultures. The Sinharaja forest is a magnificent home to this community and provides them with food, medicines, firewood that ensure the long-term survival of the community. The clearing up the forest area means the loss of all these elements and consequently implies malnutrition, an

increase in illnesses, dependency, and acculturation, and in many cases more tendencies to move deeper in the forest. As reflected by the previous researches and discussions, community's objections are strong. They claim that losing their livelihoods and their way of income has created a difficult situation for them. As I mentioned earlier the loss of forest resources would be a great threat to the production of treacle and jiggery as a traditional source of income in the area. Most local and foreign groups are visiting the forest mainly only for buying fresh products of kitul.

Although, the links between the users and the owners are clear it is difficult to generalize or justify the situation due to multiple interests of communities and limited resources in the forest. Villagers may be aware of the damage and impact of extracting forest resources, but their poor economic opportunities mean they will continue to exploit such resources to survive. Encouragement to promote and protect their economic activities and to present opportunities for employment and the sustainable development of natural resources is urgently needed. These people live under the stress of poverty, and they depend on forest resources and simply incorporating national economic policies within this community is a practical strategy to reduce their vulnerability and secure their livelihoods. Figure 1 illustrates most of the problems that are related to the case of Sinharaja with respect to resource consumption and its social, economical and ecological perspectives.

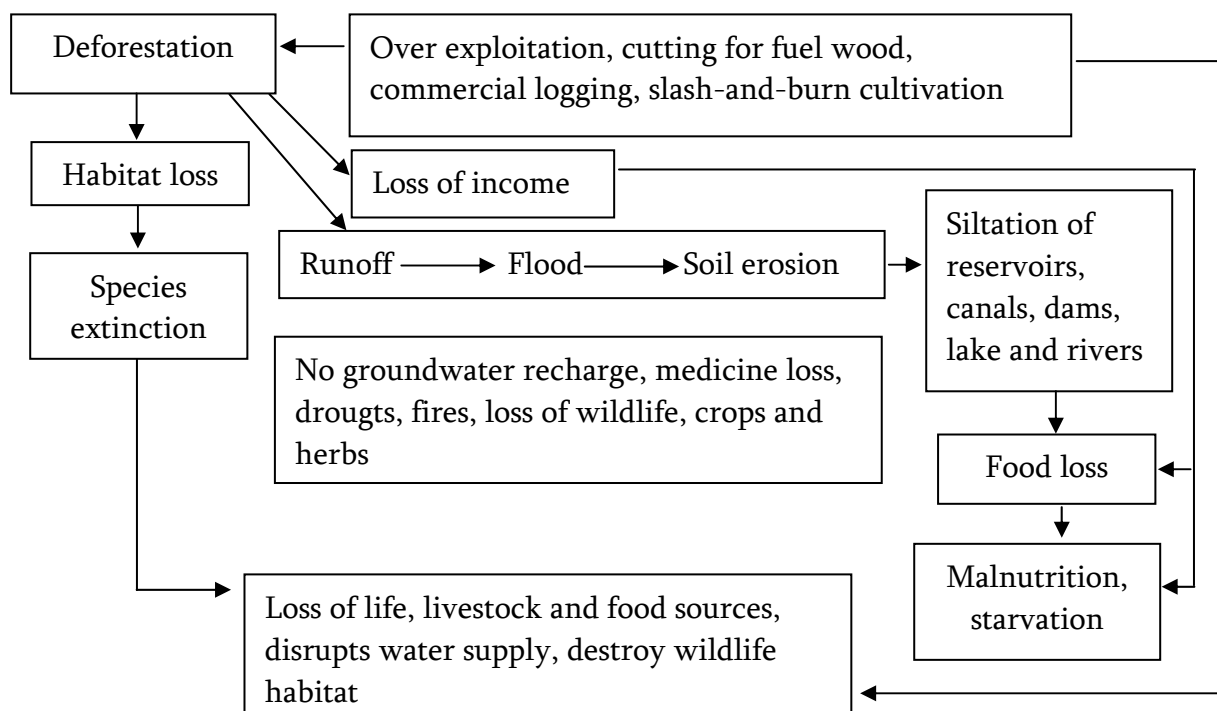


Figure 1. Interrelationships among forest resources and human interferences.

Tree felling creates an impact at the regional level as well. As forests assure the preservation of water, soils, plants and wildlife in general, their destruction causes serious impacts such as extensive flooding, aggravated droughts, soil erosion, resulting pollution of watercourses and the appearance of pests due to a break-up in the ecological balance. Soil erosion in the slope in the north-western part of the forest has been reported during last 10–20 years but this impact is not reported as being as severely as in other tropical areas. The scale of impact is comparatively smaller. However, the area has been exposed to severe soil erosion and consequently filling of the downstream area. Some parts of the region have been facing problems in the fields due to sedimentation (IUCN 1993).

9.1 Institutional concern for managing Sinharaja forest reserve

Sinharaja is administered by the Forest Department under the Ministry of Lands and Land Development (Ministry of Environment and Natural Resources 2002). Recognising the need for maximum possible protection, the area has recently been declared as a national heritage wilderness area under the National Heritage Wilderness Areas Act (<http://www.dwlc.lk/>). Any excision to such an area is permitted only with the concurrence of parliament and the president of the country. The site is also partially protected under the provisions of the Forest Ordinance (Ministry of Environment and Natural Resources 2002).

Since 1977, the Forest Department has given high priority to protect the reserve, and in 1978 planting of *Pinus cadbaea* started along the periphery to establish a living boundary. More recently, betel nut palm (*Areca catechu*) has also been used for this purpose (Zoysa and Raheem 1987). A conservation plan has been officially approved and its implementation has been carried out under a cooperative agreement between world conservation union (IUCN) and the Sri Lankan government, and with additional funding from the Norwegian government (Forest Department 1997). In order to ensure the strict protection of the reserve for scientific and aesthetic reasons, a scheme of zonation and management is proposed for areas outside the reserve. The creation and propagation of essential forest products, for sustained utilisation, in areas outside the reserve is intended to meet local needs and, thereby, eliminate former dependence on resources within the reserve. Alternative strategies are either to establish a 3.2 km-wide buffer zone around the reserve or to enlarge the area protected to about 47,380 ha, with the reserve forming a strictly protected core area and surrounding areas set aside as buffers for various uses. The only resource which may still be legally collected under permit is kitul (McDermott 1985). The preferred strategy has been to freeze resource use within the reserve at 1985 levels (when the conservation plan was prepared) and gradually eliminate future resource dependency on the reserve by relocating villages to areas outside the reserve (Ishwaran and Erdelen 1990).

Villagers unquestionably acknowledge the necessary rules and regulations in order to protect the forest as a biosphere reserve. Inadequacy of uniform land-use policy, multiplicity of government and involvement of semi government institutions have been the major administrative setbacks to the protection of the Sinharaja forest. Often the administrative decisions and regulations have become complex manoeuvres due to the wide coverage of forest over two provinces and three districts, and some other administrative areas (IUCN 1993). Hence, the clear demarcation of forest boundaries is apparently important to establish a strong land policy and administrative framework for reserve conservation.

The forestry sector master plan and the National Forestry policies in Sri Lanka have given an emphasis on the conservation of this nature reserve. The strategies recognise the immediate necessity of conserving the reserve. Important strategies are to

- Maintain ecological processes and life-sustaining systems
- Preserve genetic diversity, especially biodiversity and endemic biota; and
- Ensure the sustainable utilisation of species and ecosystems of immediate and potential importance to support the people (Ministry of Agriculture, Land and Forestry 1995).

10 SUSTAINABLE RESOURCE MANAGEMENT

According to the above discussion, it is adduced that the protection of this forest is an urgent need, both for the local community and for the nation as a whole. In order to achieve the aim of conservation of this site, the first thing is to identify in each case the direct and underlining causes that determine the factors, which were mentioned above. At the same time, it is

necessary to identify and assemble all those who have the interest in the conservation of the forest. Among the measures to be promoted, there is one that many governments could implement immediately: the recognition of the territorial rights of the local community. In most cases administrative personalities, refuse to accept the territorial rights of the community. Therefore, the problems of resource management are raised, due to the mismatch of community's and conservator's views. Providing people food, shelter and other sources of survival, encouraging them to manage the forest in a sustainable manner seems to be an appropriate route of conservation. Hence, the sustainable resource utilization, according to FAO, "*will ensure the values that are derived from their forest meet present-day need while at the same time ensuring their continued availability and contributions to long-term development needs*" (FAO 1993).

Although the concept of sustainability and resource utilization is much more popular among the developed nations, practically it creates difficulties to address clearly to the poor communities in developing regions (Wily 2002). The failure of sustainable resource utilisations in this region is due to the poor knowledge of the local community. At the same time they are not aware properly about the importance of having a balance of the natural ecosystem, for instance. The importance of addressing the relations between resource utilisation and natural balance will, therefore, help to seize the intensity of the threats. Both wood and non-wood forest resources, if properly managed will play a vital role in human welfare and their development in future. Integrated management for wood and NWFPs in natural forests is an important issue which was popularised during the 1980s. Controlled applications of harvesting, regulations, complemented by appropriate silvicultural and protective measures designed to maintain and improve the productivity of the forest are supported. Integrated Management projects should focus on

- The improvement of living conditions for the poor community
- Fulfilment of intentions of the biodiversity convention and supports for the rights of forest peoples.

Silviculture systems that enhance the growth of non-wood resources in forests such as wild fruits, edible nuts, mushrooms, gums and latex which can be harvested non-destructively have received little attention (Forest Department 1997). Another important aspect to be considered in this integrated management of resources is related to the knowledge both of wood-producing trees and the NWFP resources. The type of products by particular species can have major influences on its potential for sustainable exploitation and management.

11 CONCLUSION: RECOMMENDATIONS

According to the above discussion, one of the main reasons of destruction of this reserve is, overuse of both wood and non-wood forest resources by different stakeholders, and land clearing for cultivation and settlements. Administrative solutions for this were simply a declaration of a limited area for community access. According to them, people living in the forests are responsible for the resource destruction and, therefore, they should be removed from the forest in order to protect the existing area. People were, thus, expelled from their homelands under the pretence of protecting the Sinharaja reserve. Therefore, it is important to realise the essentiality of border concern of this forest reserve. State recognition of the forest people's rights would be the best conservation measure, given that the main interest of these peoples lies precisely in the conservation of the forest that assures their livelihood. In other cases, the measures to be promoted could be different and that is why it is so important to

identify specific causes and actors for each case. However, in all cases it is fundamental to organise and consolidate the increasing national and international awareness about the necessity to conserve this unique rain forest. This is one of the possible ways of conserving this unique resource pool. Based on this discussion the following recommendations could be made in order to assure the sustainable resource utilization and to preserve this magnificent forest reserve for the future generation.

- Development of appropriate policy, legislative and institutional framework with clear and functional definitions for involved groups
- It is needed to conduct demonstrations among the community based on a number of projects, which aim to conserve this reserve of outstanding importance for biological diversity.
- Setup a clear demarcation of the boundaries which are separated for each groups; this is essential to prevent illegal felling and encroachment.
- Adequate resources for forest protection and law enforcement. For this purpose training should be provided to the field staff to strengthen their law enforcement capabilities
- Primary level educational programmes for addressing the way of sustainable resource use in the forest
- Community and participatory forest management; people's participation in forest management should be promoted

References

- Bandarathilake, H.M, 1995. *The use of non-wood forest products by village communities in Sri Lanka: beyond timber – social, economic and cultural dimension of non-wood forest products in Asia and Pacific*. FAO, Bangkok.
- Carroll, R.C. 1997. *Patterns and Processes of Vertebrate Evolution*. Cambridge University Press, Cambridge.
- Central Environment Authority 1988. *National Conservation Strategy*. Central Environment Authority, Sri Lanka
- Central Environment Authority 2000. *National Conservation Strategy*. Central Environment Authority, Sri Lanka.
- Diesendorf, M. and Hamilton, C. 1997. *Human Ecology, Human Economy*. Allen & Unwin, St Leonards NSW.
- FAO 1993. <http://www.fao.org>.
- FCD (Forest Conservation Department) 1986. *Conservation plan for the Sinharaja Forest*. Forest Department, Colombo.
- Forest Department 1986. *Administration Report of conservator of forest, Sri Lanka 1970-85*. Forest Department, Colombo.
- Forest Department 1997. *Administration Report of conservator of forest, Sri Lanka 1980-97*. Forest Department, Colombo.
- Gunathilake, C.V.S. 1978. Sinharaja Today. *Sri Lanka Forester* 46: 275-284.
- Gunathilake, C.V.S. and Gunathilake I.A.U.N. 1980. The Floristic Composition of Sinharaja – a rain forest in Sri Lanka with special reference to endemics. *Sri Lanka Forester* 44: 386-396.
- Gunathilake, I.A.U.N. and Gunathilake, C.V.S. 1990. Distribution of floristic richness and its conservation in Sri Lanka. *Conservation Biology* 4:21-31.
- Haley, D. 2002. Community Forests in British Columbia: the past is prologue. *Forests, Trees and People. Newsletter*: 42.

- Hathurusinghe, D. 1985. *Constraints to the protection of the Sinharaja Forest*. Paper presented at the workshop for the preparation of a management plan for the conservation and protection of the Sinharaja Forest. Unpublished manuscript. Forest Department, Colombo.
- Hoffmann, T.W. 1972. *The Sinharaja Forest*. Wildlife and Nature Protection Society of Ceylon, Colombo.
- Hoffmann, T.W. 1977. Epitaph for a forest. Sinharaja - 1976. *Loris* 14: 31-32.
- Holt-Jensen, A. 2000. *Geography, History and Concepts*. SAG Publications, London.
- Ishwaran, N. and Erdelen, W. 1990. Conserving Sinharaja - an experiment in sustainable development in Sri Lanka. *Ambio* 19: 237-244.
- IUCN 1993. *Nature reserves of the Himalaya and Mountains of central Asia*. Prepared by the World Conservation Monitoring Centre. IUCN, Gland, Switzerland and Cambridge, UK.
- Johnston R.J., Gregory, D., Pratt, G. and Watts, M. 2000. *Dictionary of Human Geography*. Blackwell Publishers, Oxford.
- McDermott, M. 1985. *Socio-economics of the protection of the Sinharaja Forest: the village factor*. Paper presented at the workshop for the preparation of a management plan for the conservation and protection of the Sinharaja Forest. Unpublished manuscript. Forest Department, Colombo.
- Ministry of Agriculture, Land and Forestry 1995. *Forestry sector Master Plan*. Sri Lanka.
- Ministry of Environment and Natural Resources (MENR) 2002. *State of Environment in Sri Lanka: A National Report prepared for SAARC*. Ministry of Environment and Natural Resources, Colombo.
- Myers, N. 1988. Threatened biotas: "hotspots" in tropical forests. *Environmentalist* 8: 187-208.
- Natural Resources, Energy and Science Authority of Sri Lanka 1991. *Natural Resources of Sri Lanka: Conditions and Trends*. Natural Resources, Energy and Science Authority of Sri Lanka, Colombo, Sri Lanka.
- People's Bank 2001. *Economic Review, November/December 2001*. Research Department, Peoples Bank, Colombo.
- Pethiyagoda, R. and Manamendra-Arachchi, K. 1998. Evaluating Sri Lanka's amphibian diversity. *Occasional Papers of the Wildlife Heritage Trust* 2: 1-12.
- Phillips, W.W.A. 1980. *Manual of the mammals of Sri Lanka*. Wildlife and Nature Protection Society of Sri Lanka.
- Rosayro, R.A. de 1954. A reconnaissance of Sinharaja rain forest. *Ceylon Forester* N.S. 1(3): 68-74.
- Sri Lanka National Report 1991. *Sri Lanka national report to the United National Conference on environment and development*. Prepared under the auspices of the Ministry of Environment and Parliamentary Affairs. Govt. of Sri Lanka, Sri Lanka.
- Wikramanayake, E D. 1990. Ecomorphology and biogeography of a tropical stream fish assemblage: evolution of assemblage structure. *Ecology* 71(5): 1756-1764.
- Wily, L.A. 2002. The political economy of community forestry in Africa-getting the power relations right. *Forest, Trees and People. Newsletter*: 42.
- Zoysa, N. de and Raheem, R. 1987. *Sinharaja – a rainforest in Sri Lanka*. March for Conservation. Colombo.

Syed Mahmood Anwar

EFFECTS OF SHRIMP CULTURE ON ECOLOGY IN THE COASTAL AREAS OF BANGLADESH

Abstract

Shrimp is a major contributor to the national economy of Bangladesh since the mid-1980s. It gives millions of employment and earns more than USD 250 million annually. Thousand of acres of lands in the coastal region have been brought under shrimp cultivation, as the natural resources and environment are favorable for the cultivation of shrimp. Unplanned and haphazard expansion of shrimp culture has an impact on the coastal ecosystem. This paper has the aim to focus on how the shrimp culture in Bangladesh is affecting the soil, agriculture production, the mangroves and the coastal biodiversity. Shrimp production in Bangladesh is largely extensive and semi-intensive with low capital inputs. Shrimp fry is mostly collected from the wild stock, and in the process other marine species are caught and destroyed. Capturing of agricultural land and cattle grazing fields for the purpose of shrimp cultivation results in a significant decrease in crop production in the region, and in a decrease of 21% of the number of livestock in the last twenty years. Converting coastal wetlands into shrimp ponds reduces the natural breeding places for fish and other aquatic lives. The most important ecological impact might be the increase in salinity. Due to the increase in salinity due to improper management of shrimp cultivation, the whole biodiversity of the coastal region is now under threat. It is expected that some recommendations, which are put forth in this study, can be helpful for further researches for the development of sustainable shrimp culture.

1 INTRODUCTION

Cultivation of shrimps in a controlled and enclosed water body is described as Shrimp Culture or in general 'the cultivation of shrimp'. Both saline and fresh water can be used for the cultivation of shrimps. It is a form of aquaculture. Shrimps are swimming crustaceans that inhabit the warm marine waters of the tropics and subtropics. Smaller kinds of shrimps are known as prawns. There are several types of shrimps but in this study 'shrimp' will represent only *Penaeus monodon*. Production of farmed shrimp has grown at the phenomenal rate of 20 to 30 per cent per year in the last two decades. The leading shrimp producers are in the Asia-Pacific region while the major markets are in Japan, the USA and Europe (Primavera 1994).

Shrimp became a major export industry by the mid-1980s. Currently Bangladesh produces 2.5 per cent of the global production of shrimp. Today Bangladesh is the 7th largest exporter of shrimps to the markets in Japan and the USA. There are 600 thousand people employed in the shrimp sector, generating USD 301 million annually (GOB 2002). Shrimp culture plays a central role in the fisheries sub-sector in Bangladesh. Initially, shrimp farming was introduced in the coastal areas, particularly in Khulna and Cox's Bazar. 375000 acres of land in the coastal region have been brought under saline water shrimp cultivation. Greater Khulna district contributes about half of the total shrimp farming areas (The Independent 2002).

Shrimp farming has adverse effects both on the environment and society. The coastal communities of Bangladesh have been suffering from the worst excess of shrimp farming in that region. Few of the profits directly benefit them. The major socio-economic effects of shrimp

farming are – changes in agricultural patterns, changes in livelihood patterns, displacement of families and social structures, impact on social culture, increased social conflicts, increased migration, degradation of the health and education particularly of school children etc. (Wistrand 2002). In addition, coastal communities face the degradation of the environment. The environmental problems associated with shrimp farming have been widely reported throughout the 1990s. The extensive farming systems, requiring large land areas, have contributed most to the encroachment of agriculture land and mangrove clearance with increased intrusion of salinity, degradation of land and de-stabilization of coastal ecosystems. The south coastal regions of Bangladesh have been suffering from environmental degradation including: increased salinity of soil, canals and ponds within the dams, reduction in grazing land and a consequent reduction of livestock, destruction of mangrove forest, adverse effects on the potential crop-mix, cropping intensity, crop calendar and overall cropping pattern in the shrimp growing areas (Bhattacharya et al. 1999). The unregulated shrimp culture has an impact on bio-diversity, the mangrove forest, soil and marine species (Deb 1997).

The present situation of shrimp culture is that it is growing fast. This means that more coastal wetlands, crop fields and mangrove forests are transformed into shrimp ponds. The problem during the shrimp cultivating is that ecological aspects may not be considered.

1.1 Aim and objectives

The general aim of the study is to focus on the effects of shrimp culture on the coastal ecosystem. Different reports and other sources confirmed that the unplanned expansion of the shrimp culture has adverse impact in three major areas: reducing agriculture production, destroying coastal bio-diversity and particularly, capturing the valuable mangrove forest. Therefore, the specific objectives are to:

- a. Present the existing ecology of the coastal region
- b. Examine the effects of shrimp culture on the soil and food crop production.
- c. Analyze the effects of intensive practice of shrimp on the coastal bio-diversity.
- d. Analyze the effects on the mangrove forest.

1.2 Methodology

Study area selection:

The two main centers of shrimp production are located in Khulna/Satkhira/Bagerhat districts in the Southwest, and in Chittagong and Cox's bazaar districts in the Southeast. Almost all hatcheries are located in Cox's bazaar. Kabir (2002) highlights that about 80 per cent of the area of Khulna, Bagerhat and Satkhira are under shrimp culture in Bangladesh and noticed a threefold increase in the last decade. It now covers about 145 thousand hectares of land with over 9000 farms, 18 per cent of the total shrimp farms of the world.

In Bangladesh, shrimp cultivation has been spreading in the coastal regions. Fourteen southern administrative districts are sharing the whole shrimp cultivation. For this study the whole coastal region and its ecosystem are considered as the study area.

Data source and type:

This study is based on secondary sources of data. Reports, newspapers, other published documents and the internet or websites have been used as the sources.

Data analysis:

All the collected data has been manually interpreted in a descriptive way and with the help of available pictures. The discussion of the objectives has resulted in this report.

1.3 Scope and limitations

This study had a scope to focus on the effect of unplanned and haphazard shrimp cultivation in the coastal region. More specifically, the scope was to highlight the economic importance of the shrimp culture and the way how the coastal ecosystem i.e. the soil, species and mangroves are being affected. However, as the study area is not reachable within the short period primary observation survey was not possible. Apart from this, this study tried to present the current available facts.

2 COASTAL REGION AND ECOLOGICAL FEATURES (STUDY AREA)

The landscape of the coastal region is characterized by the Sundarban mangrove forest, sub-tropical food crop cultivation systems, grazing fields, wild marine and fresh water fishes and other aquatic lives, coastal flora and fauna.

2.1 General characteristics of the Coastal Region

The major portion of the land in this region is low lying, barely one metre above mean sea level, and below high tide level. As such, all the low lands are inundated during high tide. The only areas free from tidal inundation are artificially raised lands, such as homesteads, orchards, roads etc. The fresh water is brought down through the various branches of the Ganges delta, while the salinity is caused by tidal incursion.

The Sundarban mangrove forest discards about 3.5 million tons of detritus per year. This is carried to the farthest corners of the land by the tides. Through decomposition in the water, it is transformed into highly nutritious organic food for all types of aquatic life. When it deposited together with the silt on the land, it becomes the natural subsidence of the loose delta soil, which is common to all similar areas throughout the world.

2.2 Socio-economic characteristics

In comparison with other administrative divisions of the country (Dhaka, Rajshahi, Chittagong), the indicators for malnutrition, food insecurity, low birth weight and stunting are higher in the south-western coastal region. The major occupation in this area is shrimp cultivation and agriculture. Ali (2002) further notes that about four hundred thousands of people are presently engaged in fry collection, most of them from earlier agriculture labor before shrimp farming was introduced.

2.3 Previous development project (Alam 2002)

As a low lying tidal coastal region, the area was not favorable for producing food or other crop till the 1970s. In the 1960s, the theory of the Green Revolution was propounded. In the face of steadily increasing population and the shortage of sufficient food grains, the whole world was mobilized under the slogan "Grow More Food." This goal was sought to be achieved by the increase of land under cultivation, irrigation, and provision of better inputs such as high quality seeds, chemical fertilizers and pesticides. The Coastal Embankment Project was implemented in this region in the 1960s with the assistance of USAID. The declared aims of the project were to

protect the homes, crops of the homes and crops of the people from tidal incursions and tidal surges. In order to transform the tidal flood plains into perennial agricultural lands, 4000 km of high embankments were built to enclose the land in 92 polders, with 780 sluices to drain off the surplus rain water, during the period from 1960–1967. At first, during the 1970s, the result of the project was beneficial. The agricultural production in this region was enhanced considerably.

2.4 Sundarbans Mangrove Forest and its flora and fauna

The mangrove forest, the Sundarbans in the southwest of Bangladesh, is unique because of its history, size, productivity and significance in balancing the local ecosystem. The moist tropical seral forest is the largest mangrove patch in the world. The second largest (in Malaysia) is only one-tenth of its size. The UNESCO has declared a patch in the Sundarbans mangrove forests as a world heritage site. This has resulted in significant donors' interest and investment in the area, and may lead to steps to protect and preserve this unique, dynamic but fragile and complex ecosystem. It covers an area of 5770 sq. km. of land and water with altitude ranges from sea level to three metres. (Khan and Mazumder 2002)

In addition to forest resources, the Sundarbans forest is extremely important for fish production, wildlife conservation, recreation, and serves as a protective barrier against coastal erosion, cyclones, storms and tidal surges. The mangrove forests and mudflats provide vital breeding and nursery areas for fin fish, crustaceans and molluscs.

This forest is below the mean high tide level and most part goes under water during the high tides. Every day the tidal water sweeps the whole forest twice. With hundreds of morasses, swamps (many of which have gradually filled up), estuaries, large and small rivers, canals and creeks, which are interlaced with each other, the Sundarbans is “dangerous-looking”.

It is a tangled region of estuaries, rivers and watercourses, enclosing a vast number of islands of various shapes and sizes. About one third of the total area of this forest is covered by river channels and tidal creeks, varying in width from just a few meters to 5 kilometers in some places. This dense and large forest also provides protection against coastal erosion and cyclones.

The dominant tree species are sundri (*Heritiera fomes*), from which the Sundarbans takes its name, gewa (*Excoecaria agallocha*) and hantal palm (*Phoenix paludosa*). Sundri and gewa cover most of the Sundarbans but *Oryza coarctata*, *Nypa fruticans* and *Imperata cylindrica* are prevalent on mud flats. Large stands of keora (*Sonneratia apetala*) are found on newly accreted mud banks and provide important wildlife habitat (Khan 1986).

Sundarbans is the home of many different species of birds, mammals, insects, reptiles and fishes. Over 120 species of fish and over 270 species of birds have been recorded in the Sundarbans. Seidensticker and Hai (1983) report a total of 334 plant species, representing 245 genera, present in the Bangladesh portion of the delta. The Gangetic river dolphin (*Platanista gangeticus*) is common in the rivers. No less than 50 species of reptiles and 8 species of amphibians are known to occur. The Sundarbans now supports the only population of the estuarine or salt-water crocodile (*Crocodylus parasus*) in Bangladesh. Its population is estimated to be less than two hundred individuals.

About 49 species of mammal are dominated in this forest. The Sundarbans of Bangladesh and India support one of the largest populations of tiger (*Panthera tigris*) with an estimated number 350 in Bangladesh (Hendrichs 1975). Gittin's estimate of 430-450 tigers may be overoptimistic (Blower 1985). The estimates of the number of spotted deer (*Cervus axis*) vary between 52,600 (Khan 1986) and 80,000 (Hendrichs 1975), and estimates of the number of wild boar (*Sus scrofa*) are 20,000 (Hendrichs 1975). Both species are the principal prey of the tiger, which also has a notorious reputation for man-eating. Of the three species of otter, smooth-coated otter (*Lutra*

perspicillata), estimated number of 20,000 (Hendrichs 1975), is domesticated by fishermen and used to drive fish into their nets (Seidensticker and Hai 1983). Other mammals include three species of wild cat *Felis bengalensis*, *F. chaus* and *F. viverrina*.

The varied and colourful bird-life that can be seen along its waterways is one of the Sundarbans' greatest attractions. A total of 315 species have been recorded (Hussain and Acharya 1994), including about 95 species of waterfowl (Scott 1989) and 38 species of raptors (Sarker 1985).

3.0 DESCRIPTION OF SHRIMP CULTIVATION

3.1 What is shrimp (black tiger shrimp)?

The common name for *Penaeus monodon* is black tiger shrimp, or giant tiger prawn. Its name refers to the colour of its shell, which has grey-black stripes. Black tiger shrimps grow very fast, and are cultivated extensively in Asia. They are available throughout the year in hatcheries in South-East Asia (including Thailand, Bangladesh, India, Southern China and Indonesia). In the wild they may be found throughout the Indo-Pacific region, from Southern Africa to Northern and Southern Australia.

3.2 Natures and procedure of shrimp cultivation

Shrimp production in Bangladesh is largely extensive and semi-intensive with low capital inputs, low yield per hectare.

Extensive farming:

Ali (2002) reports that till the early 1980s coastal shrimp farming was almost traditional and extensive in nature. Farmers used to cut a portion of the coastal embankments and allowed the water to enter into the farm during high tide. Tidal water naturally had enough shrimp larvae and the farmers trapped them.

Extensive farming was conducted in low-lying impoundments along bays and rivers. Impoundments range in size from a few hectares to over a hundred hectares. When local waters are known to have high densities of larval shrimp, the farmer opens the gates, impounds the wild larvae and then grows them to market size. Shrimp feed on naturally occurring organisms, which may be encouraged by organic or chemical fertilizer. Construction and operating costs are low and so are yields. Cast-nets and bamboo traps produce harvests of 50 to 250 kilograms (head-on) per hectare per year. Production costs range from \$1.00 to \$3.00 per kilogram of living shrimp. As the coastal region is low lying, this type of farming is developed not only along the riverside or bayside but also miles inside.

Semi-intensive farming:

During the early 1990s, some farmers started semi-intensive shrimp farming at a very small scale. Conducted above the high tide line, semi-intensive farming introduces carefully constructed ponds (2 to 30 hectares). Water is exchanged by pumping. Pumps exchange from 0 per cent to 25 per cent of the water a day. The farmer harvests by draining the pond through a net, or by using a harvest pump. Yields range from 500 to 5,000 kilograms (head-on) per hectare per year. Production costs range from \$2.00 to \$6.00 per kilogram of living shrimp. This type of farming is growing fast (Mitch 1998).

4 ECONOMIC IMPACT OF SHRIMP CULTURE

Bangladesh's coastal brackish water shrimp export sector has grown over the past thirty years in response to expanded global demand for high quality seafood and attempts by governments to diversify the economy (Pokrant et al. 2002). The frozen food export sector is the second largest export sector in Bangladesh's economy. The contribution of this sector to the GDP is about 4.7 per cent, and 9.38 per cent of the total export. About 10 million people are directly or indirectly dependent on this sector (Aftabuzzaman 1998). Pokrant et al. (2002) write that in 1999–2000 Bangladesh's seafood export earnings were US\$ 356 million from frozen shrimp alone, and accounting for 6.28 per cent of the total export earnings.

As most of the shrimp culture in such farms is done through an extensive method, the productivity average is only 120 kg/ha/year. Pokrant al. (2002) show that in 2000, Bangladesh stood fifth by volume (58183 MT) and eighth by value (approx. US\$ 200 million) of the total shrimp production in the world. Recent data shows that Bangladesh has earned US\$ 301 million by shrimp export (GOB 2002). The high export earnings have created substantial employment on shrimp farms as well as in trade and commerce, processing and marketing. Shrimp cultivation involves activities, such as beheading of shrimp, ice breaking in the ice factories and shrimp fry catching. These activities give jobs for the local people. Besides thousands of shrimp farms, there are 43 commercially run hatcheries, several ice plants and feed mills, and all these are employing thousands of male and female wage laborers.

5 IMPACT OF SHRIMP CULTURE ON SOIL AND AGRICULTURE

Islam (1999) studied the impacts of shrimp farming on soil and water quality in some selected areas, and the results of the study demonstrated some adverse impact of shrimp farming on soil properties by increasing soil salinity levels (up to 500 per cent) in non-saline area. The increased salinity hampered crop cultivation seriously.

Manju (1996) found income loss for the peasant households due to shrimp culture. Income losses occurred from a decline in rice productivity, loss of poultry and livestock and erosion of homestead vegetation and social forestry. He also stated that half of the jackfruit and mango trees were destroyed, and one-third of cattle heads disappeared in the shrimp polders during 1987–90. A scientific study sponsored by Nijera Kori (1996) found an increase in salinity and soil degradation and vegetation loss in the coastal regions. According to Hagler (1997), cultivation of shrimp needs storage of saline water for a long period of the year.

In places such as Bangladesh, Thailand and India, which grow shrimp mainly for export to richer countries, diseases and pollution limit a farm's life to 10 years. Shrimp farms located in the Sunderbans, Khulna, Bagerhat, Barisal and Bhola had to be given up after about 10 years. Vast areas of cultivable land in these districts where once paddy was grown were turned into shrimp farms by being filled with salt water (Khan 2002). It paid off instantly. But after about ten years of harvesting, these shrimp farms had to be given up because of virus infection. Pathogens settle in the muck of shrimp waste and unconsumed fodder, poisoning a pond and making it unsuitable for further use. The irony is that even when the water has been released, salt has spilled out in the surface land and vast areas have become unfit for any type of cultivation. As the shrimp growers cannot use a pond over and over again, they have to shift the cultivation to somewhere in the surrounding area. Thus, the shrimp culture is occupying the agriculture land fast.

Because of changes in cultural practices, saline water is retained for a long time, which leads to percolation of salts in the surrounding soil, resulting in changes in the soil chemistry. When

monsoon rainfall is early and heavy, the shrimp producers keep on adding extra salt to the water to ensure better growth of the shrimps. This extra salt gets stored in the field and adds to the level of soil salinity. This process hampers the microbiological system and decreases the soil fertility significantly.

The primary adverse effect of excessive salinity is to raise the salt concentration of the soil solution. As a result the flow of water into the plant by osmosis is reduced or reversed and the plant is starved of water even if the soil is moist.

Livestock:

A study, carried out by CARE International, in 1999 shows that the average number of cows per household decreases significantly. The figure was 2.3 in 1980 and 1.6 in 1999. In 1980, the data show that 81.7 per cent of the households have cows but in 1999 only 49.3 per cent. The average number of poultry per household was 3.8 in 1980 but in 1999 it had increased to 5.2 per household. The average number of goats per household was 3.3 in 1980 but in 1999 it had decreased to 1.3.

Livestock populations have decreased due to the loss of grazing resources. The rate of decreasing grazing land is 64 per cent during the last twenty years. The reason for the decrease in grazing land is shrimp culture expansion. Low lying land where people used to grow only one crop a year was previously used as common grazing land for much of the year. As a result, the number of cattle and goats has fallen. Whereas, the number of ducks has increased, because households prefer domesticate ducks as it is easy to get enough shrimp ponds for the rearing of ducks.

6 IMPACT OF SHRIMP CULTURE ON COASTAL BIO-DIVERSITY

Shrimp fry collection

In Bangladesh, hatchery production remains quite limited and fulfils around 17 per cent of the demand (40 million post larva (PL) per year). Moreover, farmers prefer wild PLs because of their hardy characteristics. In general, survival of wild PLs is higher than hatchery PLs as they hatch and grow up in natural conditions.

Nets with small or very fine meshes are used to capture shrimp fry from wild stock (Toufique 1998). Toufique (1998) also found that the polluted wastewater is generally pumped back into the surrounding environment in order to save costs.

The fishermen are especially interested to catch the shrimp post larva (PL) from the river. In the process also fry of different species as 'by-catch' is collect. The 'catch-ratio' showing the average number of species caught in 1998 was shrimp 176 and 235,956 fries of other species. In 1999, the average ratio was shrimp 100 and 202,838 fries of other species. In 2000, the ratio was shrimp 332 and other species 442,482. It has been calculated that during the collection of a single shrimp PL on average 1,341 fries of different species were caught in 1998, 2,038 fries in 1999, and 1,611 fries in 2000. 'By-catch' consisted of different species fry and post larvae. In the study, Toufique (1998) identified 'by-catches' as chela (*Salmostoma ssp.*), chava (*Pseudopocryptus lanceolatus*), kuchia (*Monopterus cuchia*), faishsa (*Barilius ssp.*), kakila, kakra (*Potamon ssp.*), Loita (*Harpodon nenereous*), horina (*Metapeneaus monoceros*), chacca (*Chaca chaca*), bele, dogra and other unidentified species. As a result, natural catch of fish has decreased by 90 per cent over the last 20 years. Moreover a declining catch of wild shrimp post larvae has been reported in Bangladesh (Islam 1999) where there is concern for over-fishing of post larvae.

Chemical use

Shrimp farmers apply different types of chemicals/medicine to save their ponds from oxygen deficiency and disease problems. The farmers are not aware about the effectiveness of these chemicals as well as the impact of the use of these chemicals on the pond environment.

The survey conducted by CARE showed that about 21 per cent of the farmers used potassium permanganate, 18 per cent used Aqua-nourish, 17 per cent used Capsule and 14 per cent Agro-fish. Almost all chemicals were used mainly for improving water quality and to prevent diseases. Sometimes overuse of the chemical might be the cause of killing of many living organisms.

Fishmeal from aqua lives

Shrimp farming relies heavily on compound aqua feeds made largely from fishmeal. Fishmeal mimic the composition of the natural food of carnivorous fish and crustaceans and are the simplest means of providing the nutritional requirements needed by shrimps on a daily basis.

Shrimp farmers have traditionally used the meat from the freshwater apple snail (*Pila globosa*) as a feed for the prawns. As shrimp farming became more popular the demand for snail meat grew and the harvest of snails intensified so much that the snails disappeared from many local wetlands. Collection areas extended to nearby districts. The estimated annual harvest of *P. globosa* from various beels (large water body with a shallow depth), canals, and rice fields in 1999 was 365,849 Metric Tons (CARE 1999).

CARE 1999 study also claims that *P. Globosa* plays an important role in the wetland ecosystem, occupying an intermediate role in the food chain, consuming phyto-plankton, algae, aquatic plants and insects. The eggs are a potential feed for fish, snakes, ducks, rats and birds. The recycling of alkaline elements found in the shell of the snail could also be important in maintaining water and soil chemistry. The long-term effects of this species' removal on the ecological balance of the wetlands are unknown.

Depletion of wetlands

The wetlands are the natural breeding grounds for native/wild fish and support a wide range of wetland flora and fauna. During the shrimp revolution, the low-lying land in the wetlands was seen as highly attractive as it was most easily converted into rainfed ponds that could retain water throughout the year. Most of the wetland area and many of the canals that are the "lifelines" through which fish migrate to and from Bangladesh's main river systems are now congested with shrimp ponds. The poor drainage and reduced flow has caused many canals to silt up completely. Destruction of their natural feeding and breeding grounds has led to sharp declines in native fish populations (Dutta 2001). Due to salinity many fresh water fish species like *Ruhi*, *Katla*, *Shole*, *Boal*, *Tengra*, *Koi*, *Shing* etc. are about to become extinct in the localities. Dutta (2001) feels that long term inundation has destroyed the traditional fish population of the coastal regions. Along with the likely decline in fish populations and diversity, many other species of flora and fauna have disappeared from these wetland areas.

Other

Islam (1999) found that water bodies are contaminated with high salinity (up to 22 ppt) that does not favor growth of many fresh water organisms. The higher concentration of salts in the soil due to the expansion of improper shrimp cultivation also adversely affects the *ammonifiers* and decreases the number of denitrifying microorganisms. However, nitrification varies with the nature of the salt and with the salinity level. Consequently, the nitrifying organisms are considered to be more sensitive to salts compared to the *ammonifiers*. The population of

Azotobacter differs in various salt concentrations. The number of fungi colonies decreased with increasing salinity of the soil. When the salinity increases, cellular dehydration commences ultimately causing the death of the organisms (Islam 1999).

Moreover, many shrimp farmers very often kill mammals and reptiles as the farmers consider them harmful for the shrimp, i.e. the animals could eat shrimps and share the foods of the shrimps. Many of those animals have been almost abolished from shrimp producing localities (Manju 1996).

7 IMPACT OF SHRIMP CULTURE ON MANGROVES

Reserve mangrove forest:

High percentages rates of destruction of mangroves and other types of wetlands have occurred in Indonesia, Vietnam, Bangladesh, India and Honduras in the Gulf of Fonseca (Rosamond et al. 2002). In order to maintain intensive yields from shrimp ponds the complete conversion of the surrounding land areas is required. Aquaculture production of shrimp has become the most relentless destroyer of large areas of pristine tropical wetlands. Mangrove forests are the most notable ecosystems that have fallen prey to shrimp pond construction, with massive destruction of mangrove forests in Latin America and Asia. A number of shrimp ponds have been developed along the periphery of Sundarbans mangrove reserve forest area.

The extreme fishing pressure has an effect on shrimp as well as other important riverine species that occur in the coastal areas. It is discussed in Section 6 how the collection of wild shrimp fry destroys marine species through by-catch. As a result, it destroys the environment of the coastal area or mangrove ecosystem.

Non-reserve mangroves:

The process of mangrove destruction in the south-western districts started two decades ago, and it harms the natural environment, ecosystems and social systems (Deb 1997 and Manju 1996).

Aftabuzzman (1998) emphasizes that mangroves play an important role in the ecology of the coastal zones and support the marine species that utilize the mangrove environment during part or their complete life cycle. Appropriate utilization of mangrove resources allows to maintain a high level of integrity in the mangrove area while capitalizing on the economic benefits of brackish water aquaculture. With the rapid expansion of shrimp farming, the mangrove ecosystem has been greatly affected (Manju 1996).

Mangrove trees are common all over the coastal areas of Bangladesh especially in the Sundarbans forest. The pond construction eradicates natural mangrove vegetation; the construction of canals and dikes alters irreversibly the hydrological characteristics of the coastal areas. After a pond cannot be used anymore, usually within three to six years, growers move along the coast, destroying mangroves and rice fields to make room for more ponds.

8 RECOMMENDATIONS

1. Procedures should be established for EIA (Environmental Impact Assessment) and monitoring to minimize the adverse ecological changes and related social and economic consequences resulting from water extraction, land use, discharge of effluents, use of drugs and chemicals and other activities.

2. Coastal zoning should include improved land use planning, to minimize conflicts over land tenure and to identify appropriate areas for shrimp cultivation and areas that need to be protected. Saline water shrimp cultivation may be restricted to areas where the soil salinity level is high. There is also need for an improved information system to manage and plan future growth.
3. There is a need to engage all the different stakeholders in regular a dialogue on issues affecting the industry to ensure the sustainability and social equity of the shrimp sector.
4. There is a need to improve the the linkages between farmers, extensionists and researchers to develop and select appropriate technology and make it more accessible to shrimp farmers.
5. There is a need for better cooperation and sharing and dissemination of information about disease prevention and control methods, improved disposal methods for diseased fry, guidelines on handling diseased fry, and training facilities for the farmers.
6. Present hatcheries can supply only 17 percent of the total demand of shrimp fry. So, there is the urgent need to increase the number of hatcheries or to increase the production of shrimp fry by the existing hatcheries. There is a need for an external regulator to prevent price fixing and assure the quality of hatchery fry to build confidence of farmers in hatchery fry.
7. There is a need to regulate fry catching. Fry catching should be banned in areas where there are adequate hatcheries and in certain ecologically sensitive areas such as the Sunderbans and migration routes. These need to be identified.
8. A seasonal ban should be applied during the main fish breeding season from August to January because there is no PL requirement during the rainy season and stocking PL during the winter months can result in high mortalities.
9. Shrimp fry catching by currently used fine meshed nets should be banned or at least regulated through a licensing system. Mesh sizes for other nets should also be regulated.
10. Research should be promoted to find possibilities for reclamation of salt affected soil for future use for agriculture purposes. Mulching improves the physical and microbiological properties of salt affected soils and promotes leaching of soluble salts. Research should be carried out to find appropriate solutions for post drainage management for the salt affected or waste water to be drained from a shrimp pond.
11. Some years ago, a trend has been started to culture saline water shrimp in fresh water ponds. This process is still in an experiment stage. This way of shrimp cultivation, if possible in sustainable manner, could reduce the adverse effect of existing shrimp cultivation. So, initiative should be taken to find a sustainable way of shrimp cultivation.

9 CONCLUSION

Shrimp cultivation has ecological impacts in terms of salinity increase, destroying marine species and loss of biodiversity. Despite of the negative impact on ecology, the economic importance of shrimp cannot be overlooked for a developing country like Bangladesh. Proper management and planning can give a sustainable growth and benefit of shrimp cultivation. Pollution, destruction of sensitive coastal habitats, threats to aquatic biodiversity and significant socio-economic costs must be balanced against the direct economic benefits or earnings from the shrimp cultivation.

References

- Aftabuzzaman, 1998. **Sustainable Environment Friendly Aqua-Culture**. Centre for Policy Dialogue Report No. 18, Centre for Policy Dialogue, Dhaka, Bangladesh.
- Alam, A. 2002. **Review of Large Projects in the Southwest Coastal Region of Bangladesh**. BCAS, Dhaka.
- Ali, Md. Liaquat 2002. **Policy Framework for Fisheries Sector Development in Bangladesh**. (unpublished monograph), BCAS, Dhaka.
- Bhattacharya D., Rahman M., and Khatun F.A., 1999. **Environmental Impact of Trade Liberalization and Policies for the Sustainable Management of Natural Resources: A Case Study on Bangladesh's Shrimp Farming Industry**. Centre for Policy Dialogue (CPD), Dhaka, Bangladesh.
- Blower, J. 1985. **Sundarbans Forest Inventory Project, Bangladesh. Wildlife Conservation in the Sundarbans**. Project Report 151. Overseas Development Administration, Land Resources Development Centre, Surbiton, UK.
- CARE 1999. **Environmental Impacts of Gher Farming**. http://www.careinternational.org.uk/resource_centre/agriculture/golda/back/env.htm.
- Deb, A.K. 1997. **False Blue Revolution: Environmental and Socio-Economic Impact of Shrimp Culture in the Coastal Areas of Bangladesh**. Community Development Centre (CDC), Canada.
- Dutta, A. 2001. Who Benefits and at What Costs? Expanded Shrimp Culture in Bangladesh, in **Grassroots Voice. A Journal of Indigenous Knowledge and Development** 3 (4).
- GOB 2002. **Shrimp Aquaculture in Bangladesh: a vision for the future**. Dhaka, Bangladesh.
- Hagler, M. 1997. **Shrimp: the devastating delicacy, a greenpeace report**. (http://www.dec.ctu.edu.vn/cdrom/cd6/projects/shrimp_greenpeace/shrmp01.html).
- Hendrichs, H. 1975. The status of the tiger *Panthera tigris* (Linne, 1758) in the Sundarbans mangrove forest (Bay of Bengal). *Säugetierkundliche Mitteilungen* 23: 161–199.
- Hussain, K. Z. and Acharya, G. (eds.) 1994. **Mangroves of the Sundarbans. Volume two: Bangladesh**. IUCN, Bangkok, Thailand.
- The Independent 2002. **Shrimp Farming: Ecological Impact has to be assessed**, newspaper article, Dhaka, Bangladesh.
- Islam, A. 1999. **Effects of Shrimp Farming on the Physico-Chemical and Biological Qualities of Water**. Bangladesh Agriculture University, Mymensingh, Bangladesh.
- Kabir, M.E. 2002. **Ecological Impact has to be Assessed**, The Independent, Dhaka, Bangladesh.
- Khan, A. 2002. **Blue Revolution Blues**, BCAS, Dhaka.
- Khan, M.A.R. 1986. Wildlife in Bangladesh mangrove ecosystem. *Journal of the Bombay Natural History Society* 83: 32–48.
- Khan, M.H. and Mazumdar, A.H. 2002. **Conserve Forest or It Only be Mentioned in the Text Books**, BCAS, Dhaka.
- Manju, T. 1996. **Political Economy of Shrimp Culture in Bangladesh**. Poverty Research Report 13, Grameen Trust, Bangla.
- Mitch, H. 1998, **Shrimp Farming**. Honduras.
- Nijera Kori 1996. **The Impact of Shrimp Cultivation on Soils and Environment in Paikgacha Region, Khulna (Limited to Polders 20, 21, 22, 23 and 24)**. Khuina, Bangladesh.
- Pokrant B., Reeves P. and Rahman A.A. 2002. **The Organization and Development of Coastal Brackish-Water Export-Oriented Shrimp Production in Bangladesh: A Critical**

- Review of the Literature**, Presented at the ISA XV World Congress of Sociology in Brisbane, Session 7, Australia, (Unpublished).
- Primavera, J. H. 1994. **Shrimp Farming in the Asia-Pacific: environmental and trade issue and regional cooperation**. Tigbauan, Philippines.
- Rosamond, L. Naylor, Goldberg, R., Primavera, J., Kautsky, N., Beveridge, M., Clay, J., Folke, C., Lubchenco, J., Mooney, H., and Troell, M. 2002. **Effects of Aquaculture on World Fish Supplies**. (<http://cisac.stanford.edu/publications/12219/>).
- Sarker, S.U. 1985. **Density, Productivity and Biomass of Raptorial Birds of the Sundarbans, Bangladesh**. Proceedings of SAARC Seminar on Biomass Production, 15 April 1985, Dhaka, pp. 84–92.
- Scott, D.A. (ed.) 1989. **A Directory of Asian wetlands**. IUCN, Gland, Switzerland and Cambridge, UK.
- Seidensticker, J. and Hai, M.A. 1983. **The Sundarbans Wildlife Management Plan: Conservation in the Bangladesh Coastal Zone**. IUCN, Gland, Switzerland.
- Toufique K.A. 1998. **Technological Capability in the Shrimp Processing Sector in Bangladesh**. Bangladesh Institute of Development Studies (BIDS), Dhaka.
- Wistrand, Å. 2002. **Environmental and Social Cost of Shrimp Aquaculture**. Online Document. <http://www.uvm.edu>.

Thokozani Olex Kanyerere

EFFECTS OF PLANTATION AGRICULTURE ON THE ENVIRONMENT: THE CASE OF TOBACCO PLANTATIONS IN MALAWI, SOUTHERN AFRICA

Abstract

Malawi is primarily agro-based country and the agriculture is and will continue to be the backbone of the economy, since the country is not well endowed with mineral resources. The country is mainly dependent on tobacco farming which accounts for about 70% of the export earnings. The tobacco sector highly depends on the use of natural resources such as land, forests and other resources, like chemical fertilizers and pesticides. Such reliance has its own consequences for both the environment and people's livelihoods. It is important to note that tobacco production and consumption entail enormous environmental and social costs which tend to be ignored in favour of the economic benefits accrued from such production processes. The main objective of this paper is to discuss and analyze the causes, effects and implications of the tobacco production process in the plantations on the environment/ecosystems in Malawi. Both quantitative and qualitative data were collected from secondary sources. The collected data were analyzed and discussed/interpreted. Results show that tobacco production occupies relatively large land sizes which are either unused or underutilized, relative plain/flat and fertile lands which deny the majority people to have access to such lands. The production uses chemical fertilizers and pesticides which have potential effects of making the soils acidic, killing microorganisms, hence, losing biological diversity. The demand of the production for forest resources such as wood fuel is high and is increasing which is a great threat to the many actors who rely of forest resource for the livelihoods. In general, the findings indicate that the tobacco production process pose a great threat to the sustainability of the natural resources, sustainable livelihoods of the people, biodiversity loss and even the future of the same production is at risk. In short the environmental and socioeconomic sustenance are at risk with the activities done in tobacco production. It can be said that the very economic problems which the country tries to solve now through the current system of tobacco production, are being created in the near future. Therefore, the paper suggests implementing and monitoring appropriate legislation and intervention practices to protect the environment and promote sustainable operation of the tobacco industry.

1 INTRODUCTION

1.1 Background information

Malawi is primarily agro-based country and agriculture contributes about 35–40 % of the Gross Domestic Product (GDP). About 90 % of the foreign exchange earnings come from the agriculture sector, and 85 % of the workforce is employed in the same sector. Agriculture continues to provide 60–70% of the inputs to the manufacturing sector and dominates the commercial and distribution industry. Agriculture is and will continue to be the backbone of Malawi's economy, since the country is not well endowed with mineral resources (Hoffmann 2002).

Since 1964 when the country got independence from British Colonial Rule, Malawi's agricultural sector has been developed along a dualistic structure, comprising the smallholder subsistence and commercial plantation sub-sectors of which tobacco plantation counts the largest followed by tea and sugar (Malawi Government 1999). Malawi is mainly dependent on tobacco farming and this tobacco sector accounts for about 70 % of Malawi's export earnings. Between 1991 and 1998, tobacco earned Malawi a minimum of US\$ 200 million per annum. In some good years tobacco earnings are almost US\$ 400 million per annum (Kwengwere 1999).

The country has a total area of 11.8 million hectares of which 9.4 million hectares is land, the rest is water. Of the 9.4 million hectares of land, 5.6 million is arable while infrastructure, forests, mountains and parks occupy the rest. The rate of urbanization was about 13 % in 1992, which was the lowest in the Southern Africa Development Community (SADC) region compared to 22 %, 30 % and 27 % for Tanzania, Mozambique and Botswana, respectively. The mean land holding for agriculture is below 1 hectare for a family of five in the rural areas (Malawi Government 2001a).

This background information about tobacco farming in Malawi shows that human-environment interactions are unavoidable in the pursuit to gain the economic benefits of such a farming system both at national and individual levels. The description above shows the importance of tobacco plantation to Malawi. The tobacco sector highly depends on the use of natural resources such as land, forests, water and other resources like chemical fertilizers and pesticides to mention but just a few. Such interactions have their own consequences on both the environment and the people as it will be shown later in this paper. In this paper wherever the word environment is mentioned, it refers to the physical and biological factors that surround human beings. Human Ecology refers to the study of the detrimental effects of the modern civilization on the environment with a view toward prevention or reversal through conservation (American Heritage 2000). In this paper modern civilization refers to tobacco plantation agriculture. Biodiversity refers to the number and variety of organisms found within a specified geographic region.

1.2 Problem statement

Malawi is endowed with a variety of natural resources within its aquatic and terrestrial ecosystem. These include land, water, forests, fish, and wildlife. The basis for sustainable socioeconomic development in Malawi rests on these natural resources. Because of the combined effects of the population growth, poor land management practices on tobacco plantations and poverty, these resources are being depleted at faster rate than they can replenish themselves. The outcome of this human-nature interaction is a problem for both ecosystems and human beings' provisions of their livelihoods. It is important to note that tobacco production and consumption entail enormous environmental and social costs which tend to be ignored in favour of the economic benefits accrued from the tobacco production process. Lack of serious efforts to assess and expose the adverse effects of tobacco productions on the environment and ecosystem means perpetual socioeconomic hardships for the poor who are in majority. This is a problem because it is the poor who experience such adverse effects more on their surroundings as their production resources become unproductive due to the activities of tobacco plantations. At the same time, the minority well-to-do group continues to enjoy economic gains of the tobacco production system as the environment continues to degrade.

1.3 Main objective of the study

The main objective of this paper is to discuss and analyze the causes, effects and implications of tobacco plantations on the environment/ecosystems in Malawi. In line with the main aim, specifically in this study I will:

1. Analyze causes and implications of land sizes occupied by tobacco plantations on the environment
2. Investigate the causes of chemical fertilizers and pesticides used in the tobacco plantations and evaluate the effects of such use on the environment
3. Investigate the importance of forest resources use in tobacco plantations and analyze the implications of increasing demand for such resources on the environment.

1.4 Research questions in this study

What is the extent of damage brought about by the tobacco production on the ecosystems/environment? What are the causes for such damage? What are the effects of such damage on the environment? What are the implications both for the environment and the socioeconomic development of the people and the country as the whole?

2 METHODOLOGY

2.1 Description of the study area – Location of Malawi, physical and demographic characteristics

Malawi is located in the Southeastern Africa. It is between latitude 9°45' south of Equator, and between longitudes 32° and 36° east of the Greenwich Meridian. It is bordered by Tanzania to the north, Zambia to the west and Mozambique to the south and east. Malawi has highlands, plain areas and lowlands. It has lakes, rivers, high plateaus and rugged relief features with a distinct climate. The country experiences good rainfall during the rainy season from November to April with an annual mean of 1.037 mm. The mean monthly temperatures ranges are as follow: from 10–16° C in highland areas, 16–26° C on the plateau and 20–29° Celsius along the lakeshore. Rainfall ranges from 800 mm to over 2,500 mm per annum in low and highlands respectively. The climate allows growth of tropical and subtropical crops such as tobacco (Malawi Government 2001a).

The 1998 Population and Housing Census estimated Malawi's population at 9.8 million. Of these, 4.8 million were males (49 %) and 5.0 million were females (51 %). About 86 % of the population lives in rural areas and most of these depend on subsistence agriculture for their livelihood. About 69.5 % and 46.5 % of the rural and urban populations, respectively, are economically active, of which 83 % is engaged in agriculture, animal husbandry, forestry and fisheries sectors. About 50 % of the population is under the age of 15 years. The population distribution is rather skewed; about 50 % lives in the Southern Region and 10 % in the Northern Region (Malawi Government 2001a).

2.2 Data sources, data type and data analysis used in this paper

This being a desk research work, I entirely relied on secondary sources for the data that I have used in this paper. Secondary data and statistics were collected from the published, unpublished sources and articles on the internet. These sources have enabled me to come up with results that I

have presented in this paper on the causes of human-nature interactions in the tobacco plantations and the effects of such interactions on the environment/ecosystems. Both qualitative and quantitative data were collected and used in this paper. Such data have been acknowledged. The two data types were used as complementary to each other to give robust to the results found. The statements, statistics and the figures obtained for the secondary sources were first presented and then interpreted and discussed under the results and discussion section of this paper.

2.3 Limitations/weaknesses of the study

The study entirely used secondary statistics/data. Such statistics have two weaknesses in general. The first problem with such statistics is that users of secondary data do not have as thorough understanding of the background as the original investigator and, therefore, users of the secondary statistics may not be aware of the conditions under which the data were collected and the limitations encountered during such processes. Secondly, such statistics may have special features concerning the earlier statistics or the population studied which are not known to the compiler of such data (Harper 1991). These features plus more could result in misleading conclusions made in this paper. Lack of maps to show the exact land sizes of tobacco plantations in Malawi is another limitation in this paper. Such maps would have been helpful to exactly analyze the area covered by tobacco plantations in different tobacco growing districts in relation to the area left for subsistence farming in those areas.

3 RESULTS/FINDINGS: CHARACTERISTICS OF TOBACCO PRODUCTION IN MALAWI

3.1 Tobacco plantations in Malawi

Since tobacco is the major cash earner in Malawi for both government and the local people, it is grown by many smallholder farmers as well as commercial farmers in their small and big estates respectively. Tobacco grows well in plain areas where the soils are brownish to reddish and provide iron minerals needed for tobacco growth. The main areas for tobacco growing in Malawi are Rumphu, Mzimba, Kasungu, Lilongwe, Mchinji, Mangochi and Zomba districts. Most of these districts where tobacco is grown are in the western part of the country. Press Agriculture such as Flue-Cured Tobacco Authority and Agricultural Development and Marketing Corporation (ADMARC) are the major commercial tobacco growers in Malawi. There are also major and smaller tobacco estates owned by individuals in the mentioned districts (Malawi Government 1999).

3.2 Tobacco growing practices in Malawi

Tobacco seeds are bought from the Agriculture Research and Extension Trust (ARET) and sown in seedbeds at the nurseries of farmers' plantations. The nurseries are supposed to be allocated near water sources such as river banks for watering the seedlings. This is done between August and November. When the seedlings are old enough, farmers transplant them in their fields. This is usually when rain starts in late November or early December. Weeding is done twice before harvest but it can be thrice on other farms depending on the weeds on those farms. Weeding is done either by using pesticides or uprooting weeds manually with hoes/spades. Chemical fertilizers are applied twice before harvests; basal dressing for fast growth and top dressing for high yield. The harvest starts in late March normally to early May. Thereafter, activities as curing

and packing tobacco in bales ready to be transported to the markets (auction floors) for sale are going on (Maeresa 2003).

3.3 Resources used in tobacco plantations and curing methods practiced in Malawi

Tobacco needs different resources to be grown productively. First, it needs money to buy different types of inputs for its production such as seeds, chemicals and money to pay for the labour force and associated expenses. Secondly, grass and trees are needed for various activities in the tobacco production processes. Some uses include the following: mulching at the nurseries, constructing fences around the nurseries, constructing barns/sheds for curing tobacco, trees to be used as wood fuel for curing tobacco and minor related usage. Thirdly, people are highly needed in the entire process. The production is labour intensive in general. Fourthly, relatively flat land is needed which is cleared of trees. This clearance is good for a proper photosynthesis process on the tobacco leaves. Fifthly, chemicals are highly needed for high production to be achieved. Chemical fertilizers are applied in the tobacco crop estates for high yield. Pesticides are applied in the tobacco nurseries to kill the pests. For example, *Methyl bromide* is used. This is a chemical substance which is heavily used in Malawi to kill pests in the soil at the tobacco nurseries. There are two types of curing methods practiced in Malawi. These are air-cured and flue-cured methods. In both methods trees are used for curing tobacco but flue-cured method uses more trees than air-cured method. The potential effects of such methods are discussed in Section 4 (Mweninguwe 2002).

4 FINDINGS AND DISCUSSION

4.1 Causes and implications of land sizes occupied by tobacco plantations on the environment

Beckford (1972) observes that plantations in general are capitalist enterprises which are driven by capitalist accumulation under specific land, labour and capital markets forces. Tobacco plantations fall in this category. It is aimed to accrue high economic benefits from the markets. With this aim in mind, the plantations occupy large areas, employ a large but low skilled labourforce and strive to produce a large amount of tobacco (Johnston *et al.* 2000).

Table 1. Land Size versus Land Use Distribution in Malawi (Source: Malawi Government (1999:13).

Land Percentages	Actual Land size	Land Use
31% of 9.4 million hectares	2.914 million hectares	Suitable for rain-fed agriculture
32% of 9.4 million hectares	3.008 million hectares	Marginal land
37% of 9.4 million hectares	3.478 million hectares	Unsuitable land for rain-fed agric

Malawi has a total area of 11.8 million hectares of which 9.4 million hectares is land and the rest is covered with water, the main one being Lake Malawi. Of the total land area approximately 31 % is suitable for rain-fed agriculture, 32 % is marginal land and 37 % is unsuitable land for agricultural activities (see Table 1). It was found out that the plantation sector takes up to 13 % of the total arable land area in Malawi (Malawi Government 2001a:19) which is about 0.379 million hectares leaving 2.535 million hectares of land for the 9.8 million people to grow their food crops (see Table 1). Of the total land occupied by the plantations, about 55–76 % of it is either

unutilized or underutilized (Malawi Government 2001a). Ironically the rural population accounts for 84 % of Malawi's total population. This majority of people make their living out of subsistence farming relying on natural resources such as land. The tobacco plantations are owned by the few well-to-do Malawians of both Malawi and foreign origins, for example Europeans (Malawi Government 2001b:17). The implication here is that the land sizes for the growing population continues to shrink as tobacco continues to have large land sizes.

When the tobacco sector takes up such an amount of arable land, it means that the majority of the poor people are forced to cultivate on the marginal land which is not recommended for agriculture activities, but people seem to have no alternative option. With the continuous cultivation in such areas, they degrade the land. When it rains, there is heavy soil erosion which results into sedimentation and siltation of the lowlands and water bodies such as rivers. This does not only bury and damage the biodiversity in the lowlands but also aquatic lives in rivers are negatively affected in the process. The overuse of the small land sizes by many people for subsistence farming does not only result into land fragmentation but also reduces the crop production. The result is both food insecurity at the households of many families and negative environmental effects on their natural resource base for livelihoods (Malawi Government 1999).

With the rapid increase in population and the large amount of land sold to the tobacco plantation sector, land holding size per farm family is dwindling continuously. The Malawi Government (1999:13) reports that the average area cultivated by the individual households in the smallholder sector is less than 0.5 hectares of land. Because of this pressure, fallow periods for restoring soil fertility have been reduced greatly in the smallholder farming systems and cultivation is expanding to marginal and less fertile areas. This is leading to severe deforestation, soil erosion and general degradation of the natural resource base. This problem is most serious in the southern Malawi as compared to central and northern Malawi. This is because 50 % of the population in Malawi lives in the southern region and 40 % in the central, and the rest in the north.

In smallholder farms, tobacco farming is given the best land which is relatively fertile and which is along the water sources. The surrounding areas are cleared of trees either for tobacco processing or for other uses but the ground remains almost bare. During the transplanting period the ground is bare and even few weeks after tobacco has been transplanted, the tobacco leaves are still scattered exposing the ground to heavy rains. The surrounding areas such as hills and the tobacco gardens themselves are in potential danger to accelerating soil erosions rates during first rains which are normally heavy within the tropics. Such erosions have negative effects down streams on the aquatic lives and others water users and also the activities along riverbanks (Mweninguwe 2002).

What is more alarming is that various studies show that in most of the tobacco plantations 55–76 % of land is either unused or underused, but the majority of people in the smallholder sector cannot have access to such land for food production. This is because such land is under leasehold or freehold tenure system and belongs to some few well-to-do people who bought it (Malawi Government 1999:19). The implication of increasing human population, the shrinking land sizes for the smallholder farmers and land ownership system, all combined show how human-nature interactions in tobacco plantation agriculture cause adverse effects on the environment.

4.2 Chemical fertilizers and pesticides use in tobacco plantations and potential implications

Malawi Government (1999:25) reports that pests and diseases in general reduce the crop yield and, therefore, need to be controlled if high productivity is to be achieved. Because of this notion, tobacco plantations have experienced frequent and heavy applications of both pesticides to protect crops from being attacked by pests and diseases on one hand, and chemical fertilizers to

boost the yield of tobacco on the other. The yearly applications of such chemicals kill the microorganisms in the soils which fertilize the soil biologically. Again when it rains chemicals are washed down streams and pollute the water for both aquatic lives and the other organisms that may want to use water, such as human beings and livestock. The killing of microorganisms in the soils and killing of the aquatic lives contribute to biodiversity loss in the ecosystems.

One of the chemicals which have been thought to pose great danger to the environment is *Methyl bromide*. *Methyl bromide* is a chemical substance that is used by most tobacco farmers in Malawi to kill the pests in the soil at tobacco nurseries. The chemical boosts the tobacco yields, hence, its wide usage in the country. However, the gas it produces when fumigated in the soil contributes to ozone depletion. Ozone is a layer of gasses which protects the earth against sun from reaching the earth with strongest rays. The scientists link ozone depletion and subsequent high levels of ultra-violet-B radiation to occurrences of skin cancer, eye cataracts and immune system degradation (Mweninguwe 2002). Though not quantified, the scientists strongly believe that *Methyl bromide* pose a big threat to the environment because it disturbs the ecological system. Chemicals with seemingly detrimental effects on the environments need to be discouraged at the earliest notice. However, many farmers seem to have no cheaper and reliable alternative options to *Methyl bromide* at the moment (Mweninguwe 2002).

In this way the human activities on the tobacco plantations do not consider the implications of their actions on the environment. The paramount cause of their action seems to be entirely economic gains. This is at the expense of the environment which provides natural resource base for sustainable agricultural activities. Kwengwere (1999) agrees that the economic profits to countries that grow tobacco are paramount despite the knowledge that the crop is a major health concern for both smokers and non-smokers and the environment in general.

4.3 Forest resource use in tobacco plantations and their implications on the environment

Malawi Government (2001a:52-53) states that agro industrial production of most export crops such as tobacco relies almost exclusively on forest resources from indigenous woodlands for the various processes that take place during tobacco production. These activities include constructions of nursery seedbeds, nursery fences, barns/sheds, drying ranks and curing processes on the plantations. With too many tobacco farms in the country, the quantity of used forest resource aggregate is estimated to be too high for the country natural replenishment level. Malawi Government (1997) observes that many tobacco estate owners do not plant trees on their plantations to be used during the tobacco process, although, this is a legal requirement according to the Forestry Act cited in Malawi Government (1997). Surprisingly, the industry uses big poles for curing and construction of the barns/sheds. The result of ignoring this act has been the growing deficit of wood fuel for tobacco curing. This wood fuel shortage has further forced many tobacco farmers to travel long distances to purchase their wood fuel requirements from Chikangawa which is the largest pine plantation in Mzimba district (Malawi Government 2001a:52). Malawi Government (2001c:32-33) confirms that demand for wood fuel exceeds the available sustainable supply. The deficit is estimated to be at 6.1 million cubic meters for 2000/01 and is projected to 10 million cubic meters by the year 2010. Tobacco industry remains the largest in the country which needs more wood fuel.

The observation that Malawi Government makes that tobacco estate owners are not planting their own trees for tobacco processes and that in return they use almost exclusively indigenous trees for such processes is serious enough and warrant a close analysis of the implication of that situation on the environment. First, it means that large areas in these plantations are bare grounds as we have already seen that 55 % to 76 % of the plantations are either underutilized or not used

at all (Malawi Government 2001a:19). Using indigenous trees nearby for tobacco processes is another serious fate on the ecosystem. Many different plant and animal species are lost in this process. Secondly, during rainy seasons it means that there are heavy soil erosions which not only wash down the fertile soils in the uplands but also destroy the ecosystem down slopes and the landscape in the lowlands. Thirdly, deforestation of indigenous woodlands reduces the carbon sink and affects the rainfall patterns on long term basis. Fourthly, many of these upland forests are sources of rivers, hence, such practices reduce water tables and render the rivers dry or make the perennial rivers to be seasonal rivers. This trend has adverse effects on the many lives that depend on water in the dry seasons. If this situation is not checked promptly and appropriately, the future of the tobacco growing industry may be in jeopardy as the present source of wood fuel supply may not be in a position to sustain the industry on a long-term basis (Malawi Government 1999 and Hoffmann 2002).

It is an open secret in the tobacco section that flue-cured tobacco needs and uses much wood fuel for curing and it has the greatest danger in depleting forest resources such as trees. Surprisingly, the current policy in the tobacco industry is encouraging farmers to grow this type of tobacco. For example, the spokesperson for the Commercial Bank of Malawi said that flue cured tobacco will increase because growers of this type had access to cheap capital, which attracts both new and old growers who had switched to growing other types. The industry expects an increase in volumes of flue cured tobacco in the light of anticipated shortages on the Zimbabwean industry, whose production is expected to hit all-time low levels because of Harare's controversial land resettlement program that has crippled the once vibrant industry and affected the entire economy. This situation is expected to raise Malawi's position to the world market as an alternative source of tobacco. However, this will come with a high price to commercial growers as curing has high a demand on firewood, which will be a challenge because of the intensive fight, environmental activists are waging against wanton cutting down of trees (Maeresa 2003).

Chapalapata (2003) reports that there is intensive campaign in Malawi recently, trying to encourage tobacco farmers to switch on to flue-cured tobacco type despite the environmental threats the crop poses. "We have to increase production of flue tobacco because Zimbabwe can no longer do it. We should expect good prices on flue tobacco because there is low demand for burley tobacco on the world market," said the president of Tobacco Association of Malawi (TAMA) cited in Chapalapata (2003). "I must ask you TAMA president together with the ministry of agriculture to advise our farmers correctly so that they go into flue tobacco to make money for themselves and for this country," said the State President cited in Chapalapata (2003). It is more than obvious in these citations that the major concern is economic gains and not the effects of tobacco plantations on the ecosystems.

In this section it has been argued that the demand for wood fuel for tobacco processes will lead to loss of biodiversity in forests and water, loss of water sources and related lives that need such water, frequent droughts and floods, heavy soil erosion, sedimentation and siltation which have negative effects on both uplands and lowlands. In Malawi, the majority of the rural households live below the poverty threshold of US\$ 1 per day (Bohringer 2001). Therefore, such negative effects on the environment will perpetuate people's poverty situation to that level where it will be too difficult to provide sustainable solutions to human suffering. Some academicians have argued that soil erosions and sedimentations bring about different landscapes which are beautiful to look at. However, here we are talking about the effects of droughts and floods on the lives of people and on the environment. It is the environment which supplies a natural resource base for their livelihoods.

5 FLOW DIAGRAM, RECOMMENDATIONS, AND CONCLUSION

5.1 Causes and effects of human-nature interactions and implications on the environment

This model (Figure 1) presents the potential implications on the environment due to human-nature interactions. It outlines inputs needed in the tobacco production process and the outcome of using such inputs.

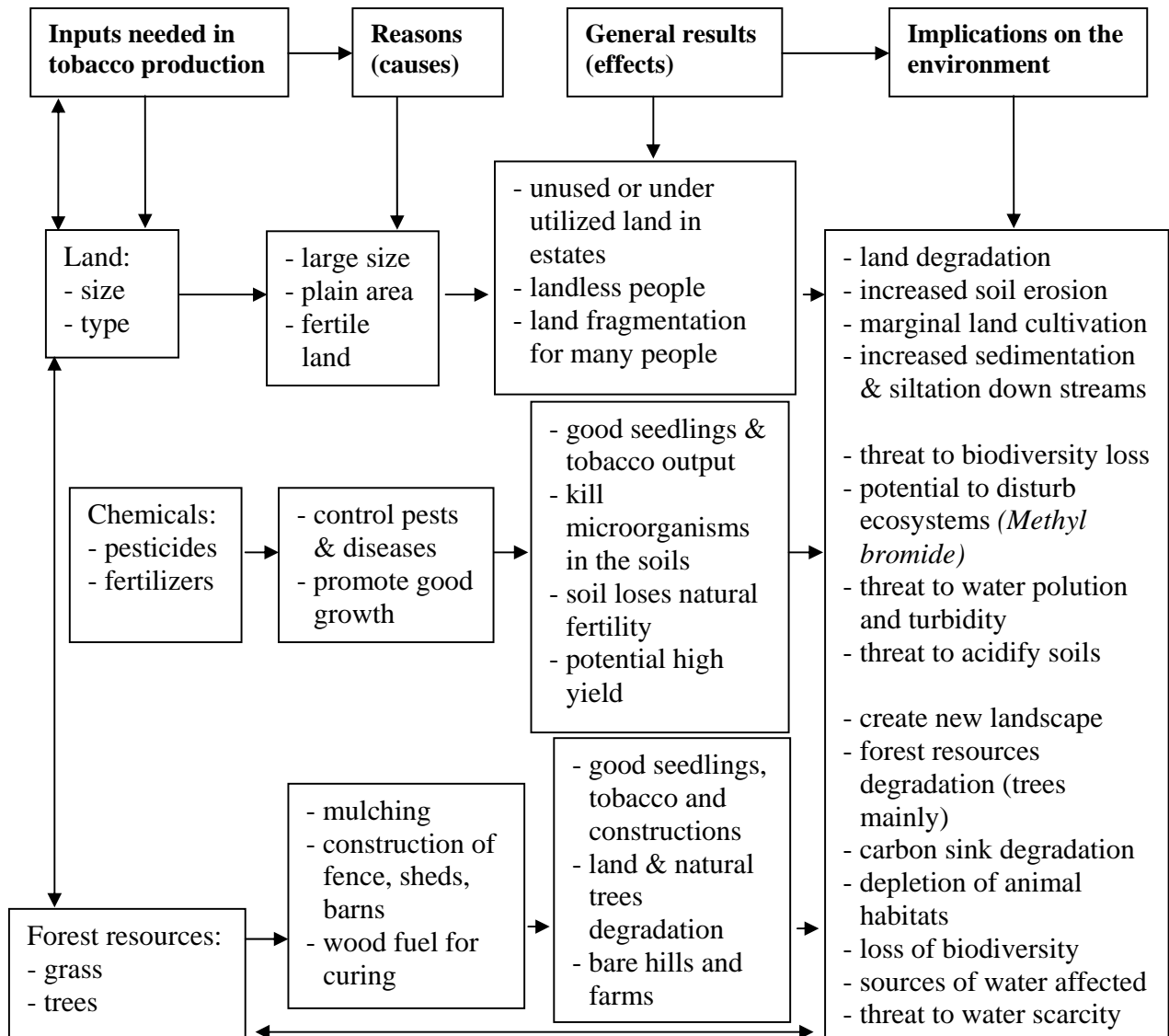


Figure 1. The flow diagram of how human-nature interaction affects the environment in summary.

The model has shown potential effects of the tobacco production process on the environment. It also shows how the tobacco production process threatens the sustainability of the environment. From the potential implications and inputs used in this process, both producers and

environmentalists are made to think on alternatives to this production process in order to sustain the environment for the benefit of various stakeholders who rely on it.

5.2 Recommendations

- Use of chemicals in tobacco plantations should be reduced especially those which pose threat to the environment as it disturbs the ecological system such as *Methyl bromide*.
- Strict policies should be implemented and closely monitored to ensure owners of tobacco plantations plant their own trees and grass for the usage in the tobacco production process.
- Local communities should be properly educated on the benefits and costs of tobacco growing in their small gardens in relation to their sustainable livelihoods.
- Effects of tobacco estates on the natural resource base need to be quantified to show a clear picture of the trend in resources depletion. A multidisciplinary approach is needed in carrying out such studies so that a holistic understanding of the problem is developed and perceived by all the people. This will facilitate implementations and monitoring of appropriate interventions. This implies that communities in such areas need be consulted in decision making on the issues that affect their surrounding areas. The overall aim is to implement interventions that solve the problem on a long-term basis for the majority of the population.

5.3 Conclusion

In summary it can be said that the loss of biodiversity and other threats to the environment can be seen as stemming from an increased reliance on natural resources to meet macroeconomic goals and foreign capital needs on one hand and a failure to acknowledge and address long-term environmental costs associated with economic growth objectives on the other. The adoption of environmentally destructive practices in the tobacco plantations as discussed in the discussion section lead to the conversion of ecosystems due to unsustainable levels of consumption. The current encouragement that Malawi launched to increase the flue tobacco production because of the Zimbabwe crisis in the land resettlement program, poses the greatest challenge ever to sustainable use of the natural resources if appropriate interventions will not be implemented. This paper is important because it discusses human-nature interactions and potential implications on the environment. The discussion in this paper shows that a sustainable socioeconomic development of Malawi depends on the sustainable use of the natural resources available. Unsustainable tobacco production systems being practiced threaten the existence of the present and future natural resources.

The main objective of the paper was to discuss the causes, effects and potential implications of human-nature interactions on the environment. It was found out that generally the natural resources which include biological and physical resources continued to be exploited. It was also found that the major motive for such unsustainable use of natural resources is to meet economic needs and livelihoods. The paper revealed that if tobacco estate producers continue to use the fertile lands extensively, the majority of smallholder farmers who form the majority poor category, will be forced to cultivate on marginal lands and continue to be marginalized and landless. In addition to that, the paper reveals that natural disasters, mostly droughts and floods and erratic rains and soil erosions periodically amplify the already severe structural socioeconomic challenges Malawi is facing. The result is an increase in peoples' economic poverty regardless of the economic benefits from the tobacco sector. However, the paper has not presented quantified data on neither how much economic poverty has been due to the tobacco

sector nor how much natural resources have been lost due to the tobacco industry. Finally, the results show that despite the current pursuit to meet economic benefits from tobacco production, there is a potential threat to the existing natural resource base. These results indicate that the current strategies being used are unsustainable and inappropriate for the sustainable production of tobacco and pose serious threats to the environment in Malawi and the livelihoods of the people. In short, it can be said that the very economic problems which the country tries to solve now through the current system of tobacco production, are being created in the near future. Therefore, the paper suggests implementing and monitoring appropriate legislation and intervention practices to protect the environment and promote sustainable operation of the tobacco industry. For example, changes in the land tenure system especially the idle land within plantations can enable the majority of people to have access to land for subsistence farming (Cunneyworth 2001).

References

- American Heritage (2000) *Dictionary of English language*. Fourth Edition, Houghton Mifflin Company, USA, <http://www.dictionary.reference.com>.
- Beckford, G. (1972) *Persistent Poverty: Underdevelopment in Plantation Economies of the Third World*. Oxford University Press, London. Cited in Johnston *et al.* (2000) *The Dictionary of Human Geography*, Fourth Edition, Blackwell Publishers Ltd, UK.
- Bohringer, A. (2001). *Facilitating Change of Agricultural Technologies as a Pathway from Poverty – The Case of Agroforestry and Food Security among Smallholder Farmers in Malawi*. A paper presented at the conference held at Chancellor College in Zomba, University of Malawi from March 28-29, 2001.
- Chapalapata, M. (2003) *Tobacco Association of Malawi warns against burley tobacco: The Nation Newspaper*, 22 January 2003. Blantyre, Malawi. <http://www.nationmalawi.com>.
- Cunneyworth, P. (2001) *Managing Agriculture Resources for Biodiversity Conservation: Case Study of Ethiopia, Kenya, South Africa and Zimbabwe*. Email: pamelac@elci.org.
- Harper, W.M. (1991) *Frameworks Statistics*. Sixth edition, Pearson Education Limited, England, UK.
- Hoffmann, V. (2002) *Farmer-To-Farmer Extension: Opportunities and Constraints of reaching Poor farmers in Southern Malawi*. Universität Hohenheim, Institut für Sozialwissenschaften des Agrarbereichs, Hohenheim, Germany.
- Johnston, R.J., Gregory, D., Pratt, G. and Watts, M. (2000) *The Dictionary of Human Geography*. Fourth Edition, Blackwell Publishers Ltd., UK.
- Kwengwere, R. (1999) *Tobacco Industry in Malawi*. Paper Prepared for the Regional Meeting on Setting Tobacco Control research Priorities for East, Central and Southern Africa; Juliusdale, Zimbabwe 11–13 January 1999. Lilongwe: Malawi Investment Promotion Agency, Malawi.
- Maeresa, A. (2003) *MK17 Billion from Tobacco This Year 2003: The Nation Newspaper*, 19 March 2003. Blantyre, Malawi.
- Malawi Government (2001a) *Malawi Energy Policy White Paper*. Ministry of Natural Resources and Environmental Affairs, Department of Energy Affairs, Lilongwe, Malawi.
- Malawi Government (2001b) *Machinga District Socio-Economic Profile*. Machinga District Assembly, Malawi.
- Malawi Government (2001c) *Economic Report 2001*. National Economic Council of Malawi, Government Print, Zomba, Malawi.

Malawi Government (1999) *Review Of Malawi Agricultural Policies And Strategies*. Part 1, Main Report draft, Ministry of Agriculture and Irrigation, September 1999, Lilongwe, Malawi.

Malawi Government (1997) *Forestry Policy 1997*. Ministry of Forestry, Fisheries and Environmental Affairs, Department of Environmental Affairs, Lilongwe, Malawi.

Mweninguwe R. (2002) *Campaign against Bromide Hots Up: The Nation Newspaper*, 31 October 2002. Blantyre, Malawi. <http://www.nationmalawi.com>.

Jon Birger Johnsen

THE CONSEQUENCES OF NATURE TOURISM. MOUNTAIN TOURISM IN JOTUNHEIMEN NATIONAL PARK AND UTLADALEN SPECIAL LANDSCAPE AREA AS A CASE STUDY

Abstract

The government of Norway preserves nature areas as, for example, national parks, as a part of the international effort to secure intact nature areas and to preserve biological diversity. On the other hand, a central criterion for national parks in Norway is to provide recreational opportunities for visitors, and parks play a significant role as recreation areas in Norway. All tourism in national parks and other nature areas will have consequences for the natural environment and may affect it negatively. In this study I have investigated the negative impacts of tourism on nature areas in general, and especially on Jotunheimen National Park and Utladalen Special Landscape Area. By using relevant foreign and domestic studies the general negative consequences of tourism for the vegetation, soil and the fauna in nature areas have been explained. With the help of these studies, several reports, management plans and personal contacts with persons dealing with related issues, I have investigated the extent of tourism and the related actual and potential negative impacts on the wild life in Jotunheimen National Park and Utladalen Special Landscape Area. In general, the study shows that the main negative effect on the vegetation and soil is wear, while the main negative effects on the fauna are long term disturbances and the addition of allochthonous resources. In Jotunheimen, the extent of tourism is substantial. It is concentrated in Easter and summer, and within the marked tracks. The present level of tourists and their concentrated use of the area seem not to devastate the flora and soil in the area other than the intensively used marked tracks and camping areas. The main negative effects on the fauna are related to disturbance of the population of wild reindeer located in the west of the preserved area, and the addition of allochthonous resources. To reduce these problems it is important to inform the users and make them aware of how they can minimize their negative effect on the nature.

1 INTRODUCTION

Since the beginning of our time we have altered our natural surroundings in a variety of ways to sustain our needs. Our superior intelligence compared to other species has made us capable of influencing the earth in a much severer way than any other known organism has done before. We have altered every natural ecosystem, made species go prematurely extinct, caused widespread erosion of top soil and also eroded the genetic diversity. As a consequence, biodiversity is itself at stake and rapidly declining (Meffe et al. 1997). The ultimate threat to biodiversity is, therefore, the expanding human population. By far the largest single threat to biodiversity worldwide is habitat destruction, fragmentation and alteration. This leads to loss of habitats, and species dependent upon these habitats can no longer “make a living”; they fail to reproduce, die, or, if mobile enough, move elsewhere (Myers 1997).

In 1948, The World Conservation Union (IUCN) was founded. The mission of the IUCN is “*to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable*” (<http://www.iucn.org/about/index.htm> 07.04.04). The IUCN has developed a global standard for seven protection area categories based on ecological criteria and different management strategies (Tab. 1). In almost every country we find more or less

harmonized adaptations of this system of conservation categories. Each country's definition reflects its local environmental, application and political circumstances. A national park in Norway might therefore not be equal compared to a national park in, for example, Africa (Aas et al. 2003).

Table 1. The IUCN's definition of conservation categories (<http://www.iucn.org/themes/forests/6/notitle.html> 07.04.04).

Category of conservation	Definition
I a	Strict nature reserve/wilderness protection area: managed mainly for science or wilderness protection.
I b	Wilderness area: protected area managed mainly for wilderness protection.
II	National park: protected area managed mainly for ecosystem protection and recreation.
III	Natural monument: protected area managed mainly for conservation of specific natural features.
IV	Habitat/Species Management Area: protected area managed mainly for conservation through management intervention.
V	Protected Landscape/Seascape: protected area managed mainly for landscape/seascape conservation or recreation.
VI	Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural resources.

The government of Norway preserves nature areas as, for example, national parks, as a part of the international effort to secure intact nature areas and to preserve biological diversity (DN 2001). However, intact nature is not equal to an area unused by humans. The landscape, which we may perceive to be natural today probably has a history of human influence, that dates back a long time (Turner et al. 2001).

Norway has based its definitions of protected areas on the IUCN's central definition. According to the Directorate for Nature Management (DN), which is the central organization for nature management in Norway, a national park is a large nature area relatively unused by humans and mainly owned by the government. The park secures intact nature, and conserves the natural values for our descendants. Inside the park the entire natural environment and the landscape with its plants, wildlife, natural- and cultural monuments are protected against disturbance, development, pollution and other interventions (DN 2002). Here, disturbance is meant to consider human activities, which influence both the fauna and flora. However, a central criterion for national parks in Norway is to provide a foundation for recreational and visitor opportunities (DN 2002). The parks play a significant role as recreational areas in Norway (Kaltenborn 1994).

All tourism in national parks and other nature areas will have consequences for the natural environment. Our presence will affect our surroundings more or less according to our behaviour (Aas et al. 2003). In the last couple of decades the use of nature areas for recreation has grown intense (Dervo et al. 2002). Human intrusion, the mere presence of people in the environment, has become a dominant form of disturbance in many landscapes (Riffel et al. 1996). It is, therefore, important to investigate the negative effects of tourism on nature. In this study the definition of tourism is all open-air activity where nature-experience is the main goal. This means people who visit nature for recreational purposes like hiking, skiing,

climbing etc. This also includes hunting and fishing, but I have chosen not to consider the effects of hunting and fishing on the populations of game species and fish.

The first aim of this paper is to explain the potential negative effects of tourism on nature, and which categories human disturbances are divided into. This section will only give a general introduction to the subject, however, the most important negative effects of tourism on the nature will be illuminated. The second aim is to map the main actual and potential negative effects caused by tourism in Jotunheimen National Park and Utladalen Special Landscape Area. First of all the extent of tourism will be mapped in order to find out whether tourism is of consequence for the nature area, and if it is increasing or decreasing. Further on, the negative consequences on the nature that can be related to tourism will be investigated. This will consider both the proved unwanted influences and potentially negative effects. Several relevant studies on this topic will be related and discussed. Finally, I will point out possible management attempts that will be of importance in order to reduce the negative effects of tourism. Preventive efforts in the management can, thereby, reduce these negative effects and Jotunheimen will bear up with recreational activities in the future.

2 STUDY AREA

Jotunheimen National Park and Utladalen Special Landscape Area are located at the county border between Oppland and Sogn og Fjordane in the south western part of Norway. The area of the national park is ca. 1145 km² while the area of the special landscape area is ca. 314 km². Jotunheimen National Park and Utladalen Special Landscape Area were enacted by royal decree on December 5th, 1980. The aim of the protection was to conserve the most typical and spectacular mountain formations in Norway with a distinct character of both eastern and western mountain nature. Great mountain mass and summits characterize the landscape, and we find the highest peaks of Norway in the area with Galdhøpiggen (2469 m a.s.l.) as the highest (Bø 1998).

Inside this area we find vigorous lower-lying valleys, peculiar watercourses, several glaciers and some of the highest mountains of Northern-Europe. There are scientific preservation interests in geology, limnology, botany and zoology. In the western parts of the park and in the special landscape there is a population of wild reindeer (*Rangifer tarandus tarandus*) of approximately 400 individuals (Bø 1998, Fortun & Moen 2001). This will have a special focus in my study because it is a so-called umbrella-species. This means that the reindeer demands large areas for survival. Thus, the conservation of this species will automatically preserve a variety of other species (Simberloff 1998). Among other large mammals, there are elk (*Alces alces*), deer (*Cervus elaphus*) and roe deer (*Capreolus capreolus*). The arctic fox (*Alopex lagopus*) exists in the park but is rare. Until 1950, there was a population of wolverine (*Gulo gulo*) but because of extensive hunting this population disappeared. In the recent years the amount of trace- and eye-observations of wolverine has increased (Bø 1998). The bird populations in Jotunheimen aren't peculiar according to other high mountain areas in Norway. However, it is an important area for golden eagle (*Aquila chrysaetos*) and gerfalcon (*Falco rusticolus*).

The area bears witness of a rich land use history from the time when hunters followed the reindeer and the retreat of the glaziers from the ice age up till modern history. There are several cultural monuments like old stone huts, foundations of other buildings and relics from early reindeer trapping activities (Kaltenborn 1994, Bø 1998). In the eastern parts of the area there are semi-domesticated reindeers, and cattle and sheep graze in parts of the area. In the Utladalen valley there are several closed farms, mountain dairy farms and cotter's farms. The earlier human use of the special landscape area has formed it into a characteristic cultivated

landscape. In the Utladalen valley we find Vettisfossen, which is the third highest waterfall in Norway with its 275 m free fall, and Norway's largest non-regulated waterfall (Bø 1998). Jotunheimen has a long history of recreational use. Since the 1850s it has been one of the most popular areas for hiking in Norway and has been accordingly heavily utilized (Kaltenborn 1994, Bø 1998, http://www3.dirnat.no/nasjonalparker/psmaler/park_info.asp?thisId=948294605_08.03.04.). Both in the surrounding buffer zones and inside the preserved area we find several tourist resorts. For tourism these function as main access points into the preserved area. In the west, we find the main entrance located in Utladalen with the tourist cabins Avdalen, Vetti and Skogadalsbøen. In the north the main access points are Turtagrø, Sognefjellshytta, Leirvassbu, Juvasshytta, Spiterstulen and Glitterheim. Located in the east and south we find Gjendesheim and Eidsbugarden respectively. From these points an extensive network of trails spread out into the terrain (Kaltenborn 1994, Bø 1998). In all there are approximately 280 km of marked tourist tracks inside the preserved areas (Bø 1998). The Norwegian Tourist Association (DNT) mainly operates these trails and tourist cabins.

3 METHODS

In the attempt to map the unwanted effects of tourism on nature areas, search for relevant literature and studies has mostly been executed on the internet. The main search engine has been the electronically resources at the University Library in Trondheim (<http://www.ub.ntnu.no/>). Here all students at NTNU have the opportunity to use several updated search engines to find scientific literature relevant to their work. With the aid of the search engine at the University Library, I searched for relevant literature and periodicals in the library-base of BIBSYS, the ISI Web of Science and Blackwell Synergy. These search engines cover both domestic and foreign studies. Some of the literature that has been included is of foreign origin and, therefore, not directly related to Norwegian mountain areas. However, I assume that the negative effects of tourism in general speaking will have similar effects on nature areas all over the world despite differences in flora and fauna. Another problem related to literature, was to find relevant studies on the negative effects of tourism. This has forced me to look at studies concerning negative effects of permanent human interventions like power lines and roads. Tourism is chiefly not a permanent intervention, however, as I will try to explain, it might become one when it is concentrated both in time and space.

In the attempt to map tourism, actual and potential negative effects concerning tourism in Jotunheimen several other procedures supplied the use of the University Library. Several persons dealing with these topics in Jotunheimen because of their professions have been contacted both by e-mail and phone. They have supplied information about relevant studies, reports, and collected data on tourism, flora and fauna and own opinions concerning the effects of tourism. Some of these persons are mentioned in the section with personal communications. Some of the gathered literature has been sent to me from the persons I have contacted. I haven't managed to find relevant reference to several reports made by local governmental organizations. In these cases, I have referred to them as personal communication. Much of my work in order to investigate the actual and potential negative effects of tourism in Jotunheimen has for the most been based on the management plan for this area (Bø 1998). It was made in 1998 and, therefore, the effects of tourism might have changed in the later years. Therefore, this study might not be up to date concerning these effects.

4 RESULTS AND DISCUSSION

4.1 Consequences of tourism in nature areas

There are several potential negative effects of tourism in nature areas. In general, human activity leads to wear and tear on vegetation, soil and geological formations (Vistad et al. 1996). The activities leave restricted and visible marks in the terrain like camping sites, camp fires, tracks, areas where wood has been cut etc. According to Aas et al. (2003), it is natural to distinguish between the influences on the plant life and the soil, and the fauna.

Trampling damages the existing plants, and may lead to alteration in the plant species composition, and with high levels of trampling to a complete destruction of the plant cover. Simultaneously, trampling leads to a compression of the soil. This will negatively affect the level of moisture and temperature in the soil. The amount of organic substances will decrease and, therefore, the soil will contain fewer nutritive substances. As a consequence, the abundance and diversity of the organisms in the soil will decrease (Vistad et al. 1996).

Kuss et al. (1990) discovered that the effect of human activities is an interaction between the three factors; plant species, environmental conditions and level of stress. The authors mention five main principles according to how plants and soil react on trampling and other influences:

1. The influence on plants and soil in an ecosystem may happen directly or indirectly; the altered environment that evolves because of the influence will consist of plant species that are adapted to the particular influence.
2. The degree of influence or wear can be both dependent and independent of the intensity of use.
3. Different plant species and types of soil vary in their sensitivity and resistance towards an influence.
4. The plants' and soils' responses to a particular influence are dependent on factors in the surrounding environment, and also genetic or species typical circumstances.
5. The type and extent of the influence varies according to the intensity of the (open air)-activity.

The effects on the plant life and soil are more obvious for the naked eye, and in comparison to the effects on the fauna more restricted. The effects on the fauna are more complex, and consider various effects of disturbance/influence caused by the mere presence of humans. Moberg (1985) defined disturbance to force animals from utilizing apparently available resources, which may trigger flight behaviour and stress. Kuss et al. (1990) have divided the human influence on animal species into direct and indirect influences. Direct influences are principally all situations, which lead to disturbance or other direct contact between humans and the fauna. Confrontations are related to activities like hunting, fishing etc. but also to the mere presence of humans in an area (Vistad et al. 1996, Aas et al. 2003).

Indirect influences are caused by human behaviour, which first of all leads to negative consequences for the habitat. Indirect influences are due to the addition of allochthonous resources, dumping of refuse like glass, cans, packaging, food etc., and also represent a threat for animals (Vistad et al. 1996, McCann et al. 1998, Huxel et al. 2002, Aas et al. 2003). Property left by hunters and fishers as, for example, lead pellets may poison water birds. Left over of fishing lines and fishing hooks may further harm or kill birds and other animals (Vistad et al. 1996, Kuss et al. 1990). Dumping of refuse can also pollute drinking water, which further can influence species that are dependent on this water (Vistad et al. 1996). Activities like fishing can introduce new unwanted organisms into lakes, which may harm the fish, and alter the ecosystem in these lakes (Vistad et al. 1996). Both direct and indirect

influences can lead to changes in psyche, physiology, behaviour, reproduction, in the population level of the species and the balance between different species (Kuss et al. 1990). In a similar way, Vistnes and Nellemann (2000) have divided studies on effects of human disturbance on the fauna into local, regional and cumulative effect studies. The local effects are caused by direct confrontations between humans and the nature. This is a short-term effect, and causes individual responses. For wild animals this can be illustrated by their escape behaviour when interfered by humans. This behaviour is a natural anti predator behaviour, and has been developed through a long time span as a result of the coexistence between humans and wild animals (Alcock 1997). The regional effects are more difficult to measure than the short-term effects, and might be more or less invisible for the human eye. The effect will be shown as a long-term gradual change of the species' use of the habitat. This is a typical response when species react negatively on the presence of human. Cumulative effects are a measure of the total effect of the human disturbance. This effect will be shown through changes in survival and reproduction, and changes in the population size. This total effect is based on the fact that human disturbance may lead to loss of essential habitats, increased use of energy, reduced foraging time and breeding care, abandonment of offspring and lack of reproduction (Vistnes & Nellemann 2000, Aas et al. 2003).

4.2 Actual and potential negative effects caused by tourism in Jotunheimen National Park and Utladalen Special Landscape Area

The tourists in Jotunheimen can be divided in mainly three different user groups. The first group consists of tourists who spend only a day in the area. The second group is tourists that hike in the park with a tent. The number of persons in these two groups is not exactly known. The third group consists of tourists who walk from cabin to cabin. This has been the dominant use of the park, but the amount of one-day visitors increased in the middle of the 1990s. The tourist traffic in Jotunheimen is greatest in the summer season and the most popular activities are hiking, mountain climbing and glacial wandering. The skiing trips reach a peak in the Easter holidays (Bø 1998).

The two most popular tourist tracks in Jotunheimen are definitely Galdhøpiggen and Besseggen. It is estimated that 25 000 persons visit Galdhøpiggen each year, and this traffic has been stable for several years. Moreover, it is also estimated that 30 000 tourists use the Besseggen-track each year. This number has also remained stable for several years (L. Bakkom, personal communication 2004). According to the management plan for Jotunheimen, it is estimated an amount of 40 000–50 000 visitors yearly only on this track (Bø 1998). The number of accommodations at the main tourist resorts in Jotunheimen has increased from 27220 in 1970 to 39518 in 2001 (Fig. 1). This is an increase of more than 45 % (S.A. Larssen, personal communication 2004).

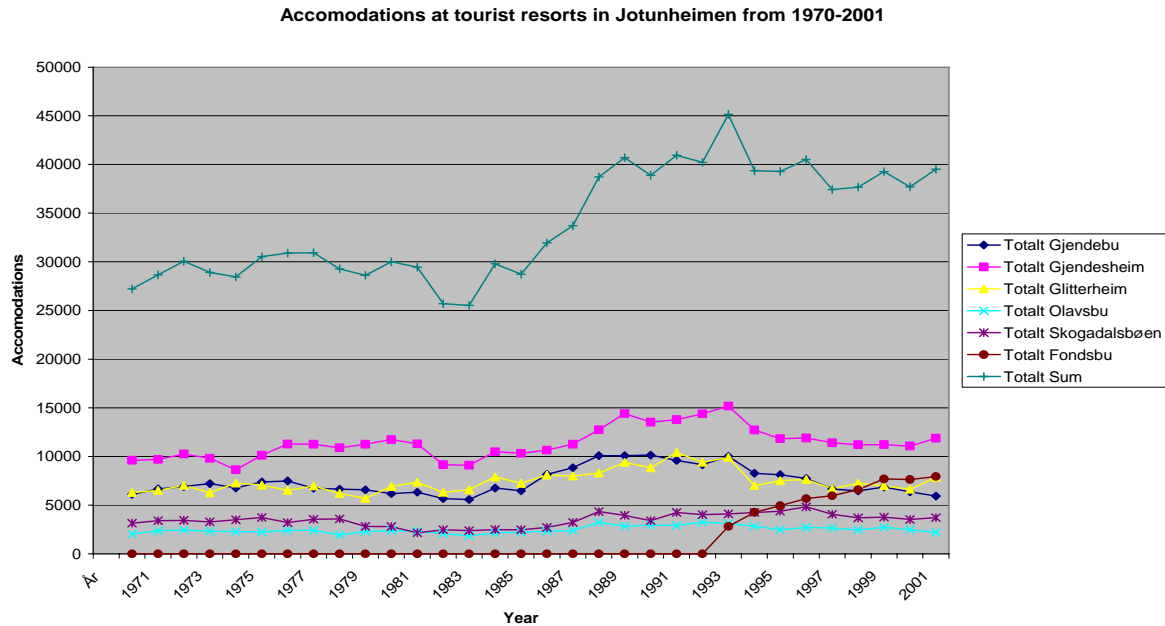


Figure 1. The total accommodations at six tourist resorts in Jotunheimen from 1970–2001. (S.A. Larssen, personal communication 2004).

In 1992, it was conducted a study on the tourism in the area where the tourists were asked to fill in questionnaires located at the eight major entry and exit points surrounding the park, throughout the summer season from 1st of July to 10th of September 1992. An estimated number of 9500 tourists registered at the access points (Kaltenborn et al. 1994). According to a similar registration in 2002 there were registered a total of 11020 visitors. If we assume that these numbers reflects the total amount of tourism in Jotunheimen, this is an increase of 16 % in the number of visitors (M. Vorkinn, personal communication 2002).

In 2002, there were 28 operators that had permission to carry out commercial mountain guiding. The total amount of “days of use” related to commercial activity inside the park were approximately 20 000. A study in 2003 concluded that the total amount of “days of use” inside the park could be 200 000. This brings Jotunheimen National Park on the third place among the tenth most visited attraction in the county of Oppland (M. Vorkinn, personal communication 2004).

Based on this data, it appears that the extent of use by tourists in the area is significant. It is also reasonable to believe that there has been an extensive increase of visitors in Jotunheimen in the last decades (S.A. Larssen, personal communication 2004, M. Vorkinn personal communication 2002, Bø 1998, Vorkinn & Kleiven 1997).

The large and increasing tourist activity involves that all parts of the park receive substantial use throughout the year. Yet, the use follows a distinct pattern, with a concentration of traffic along the marked tracks (Kaltenborn et al. 1994, Bø 1998). The tourist traffic is also concentrated in time. The tourist density is highest in Easter and in the period from approximately 15th of July until approximately 15th of September (Bø 1998). The negative effects of tourism on the wildlife, therefore, are considered to be greatest near to the tracks in Easter, summer and autumn.

It is very difficult to avoid wear on both the vegetation and soil when large user groups follow the same tracks. This is evident in several of the marked tracks and the camping sites in the park. According to the management plan we find the greatest wear on the vegetation and soil in the tracks of Besseggen (Memurubu – Gjendesheim) and Olavsbu – Grisletjern (Gjendebu). The Besseggen-track is the most popular track and suffers from great wear. In some valleys

(Leirungsdalen and Skagastølsdalen) there has been registered increased wear of the vegetation because of increased traffic and tenting (Bø 1998).

An important finding is that the relation between use and the effect of wear isn't linear, but curvilinear. This implicates that the relative strongest environmental alteration will occur at low-level use, while it will flatten out with increased use (Vistad et al. 1996, Hammit and Cole 1998, Aas et al. 2003). The concentration of traffic in the marked trails in Jotunheimen might, therefore, be better considering the problem of wear on the vegetation and soil. If there were no marked tracks, it is possible that this would negatively affect larger areas than at present because people tried to "find their own way" through the landscape. Cole and Krumpal (1992) have made several principles for low-impact wilderness recreation. Some of these rules are based on this finding and suggest concentrating use and influences in popular areas, dispersing use and influences in intact areas, and avoiding use of areas where it is registered slight and incipient influence. For Jotunheimen this means concentrating the use in already existing tracks and avoiding new tracks to be formed, especially in intact areas. To deal with the already existing problem in the exposed tracks implies an environmentally sound preparation of the tracks in order to avoid further wear on vegetation and soil. This is done in exposed trails by the DNT today (T. Evensen, personal communication 2004).

According to several studies of local effects on the short-term level, the main conclusion is that the effects of tourism on the fauna are very limited (Vistnes & Nellemann 2000, Vistnes & Nellemann 2001, Aas et al. 2003). However, these studies focus only on individual responses like flight behaviour of animals and birds when they are confronted with humans. This behaviour will stop when the animals have escaped from the source of disturbance. However, the total effect does not stop here. Studies on this level might, therefore, hide half the truth, but this will be illustrated in the following. A literature study made by the Norwegian Institute for Nature Research (NINA) concluded that the fauna's reaction on human presence on the local level differed between species, where predators and birds were likely to react more severe compared with ungulates (Aas et al. 2003). This implies that the management plan for Jotunheimen especially should consider preservation of wolverine, which is the only large predator in this area, but also bird species like the golden eagle and the goshawk. Studies have also indicated that both ungulates and birds get more stressed when tourists are in company with dogs (Aas et al. 2003, Macarthur et al. 1982, Hockin et al. 1992, Martinetto & Cugnasse, 2001). This indicates that man's best friend should stay at home in sensitive periods for the fauna, like the breeding time. In any case, dogs should be kept on leash in order to reduce this negative effect.

On both the regional and the cumulative level most of the studies indicate negative effects for the fauna like changes in the use of the habitat and reduced survival and reproduction as a consequence of the human presence (Vistnes & Nellemann 2000, Vistnes & Nellemann 2001, UNEP 2001, Aas et al. 2003). It is, therefore, these long term and cumulative effects of tourism we should have in mind when we consider the fauna. However, generalist species like the red fox and crows are more tolerant against human disturbance, and is likely to increase in numbers in areas with human activity (UNEP 2001, Aas et al. 2003, Swihart 2003). This has most likely to do with the addition of allochthonous resources as a consequence of tourism (Aas et al. 2003). Such an addition of resources might be classified as an indirect influence of human behaviour that first leads to increased populations of generalist predator species. Further, it will lead to increased predation on the prey species and in the end to reduced prey populations (Vistad et al. 1996).

Contamination of nature areas and the addition of allochthonous substances will increase with higher levels of tourism and will, therefore, be more severe in often used areas. Studies have shown that great addition of allochthonous substances affects the ecosystem stability and may lead to alterations in the composition of species (Huxel et al. 2002, Aas et al. 2003).

Norwegian high mountains, with Jotunheimen as no exception, are low productive areas and, therefore, probably more vulnerable for addition of food resources compared with more productive coniferous forest (Aas et al. 2003). Increased access of allochthonous substances can be a reason for the prosperity of generalist species like the red fox (*Vulpes vulpes*), crow- and gull-species while small rodents-specialists like the snow owl (*Nyctea scandiaca*), rough-legged buzzard (*Buteo lagopus*) and in some areas the snow weasel (*Mustela nivalis*) have decreased in numbers (Farner 1994, Henttonen and Wallgren 2000, Kjellen & Roos 2000, Aas et al. 2003). In the end this may lead to changes of the entire ecosystem in the mountains, and alteration of the preserved area (Aas et al. 2003).

Human waste is a problem in many places in Jotunheimen. This problem is most evident in the eight major access points and the most attractive parts of the park. Galdhøpiggen, Besseggen and the most attractive fishing lakes suffer from this problem (Bø 1998). An unwanted effect caused by mountain climbing is the remains of pitons and other accessories at the most attractive routes (Bø 1998). It is possible that the large addition of allochthonous material has increased the population of generalist predators in this area, but there have not been any studies on this in Jotunheimen. However, if this effect is present it would likely have a negative effect on the populations of small rodents and avian species due to the increase of generalist predators as described above. The occurrence of not-decomposable material represents also a threat for the fauna. In some of the tenting areas and the most popular tracks it has been necessary to carry out yearly sanitation actions to handle this problem (Bø 1998). In order to reduce this problem, placing out garbage cans in the worst affected area has been tried. Unfortunately, this has not solved the problem, but rather increased it because it led to congestion of garbage. However, it should not be necessary to carry out such sanitation actions in nature areas. It is a general rule that everyone brings his/her garbage when he/she leaves, and throws it in garbage cans, which are located in every access and exit point surrounding the park. Increased focus on information about the effects of this problem might decrease it.

Tourism can be classified as reversible activity because recreational activities don't sequester areas in the same way as physical interventions do. An interesting finding opposite to this is that often used tracks like the DNT's tracks can potentially be compared with the disturbance effects of permanent interventions like roads etc. in periods with intensive use (Aas et al. 2003). Several studies indicate that permanent interventions lead to avoidance of large areas especially by the wild reindeer (Nellemann et al. 1999, Nellemann et al. 2001, Vistnes & Nellemann 2001). This might be the case for the most exposed trails in Jotunheimen, especially considering the wild reindeer in the west but also other animals with large home ranges like wolverine etc. The negative effect on the fauna is not explicitly studied in this area. However, rangers in West-Jotunheimen wild-reindeer area, regard the DNT's tracks to represent one of the main threats to this reindeer population. According to these rangers, six specific tracks located in the west and northwest represent the greatest disturbance by tourists of the important summer grazing land. These tracks are as follows: Sognefjellet – Vetle Utladalen – Skogadalsbøen, Leirvassbu – Skogadalsbøen, Leirvassbu – Olavsbu, Olavsbu – Skogadalsbøen, Skogadalsbøen – Keisaren – Fanaråken/Turtagrø. Disturbances also include activities like organized mountain guiding between Skogadalsbøen and Gjertvasstindan as a similar serious threat for the reindeer (Fortun & Moen 2001).

The network of marked trails in Jotunheimen supplies the area with tourists during the whole summer season through what traditionally have been core areas for the reindeer. This activity is increasing and difficult to combine with the consideration of the wild reindeer (Fortun & Moen 2001). In Jotunheimen the reindeer is located only in the west of the preserved area and mostly in the summer when the availability of grazing pastures is good. (E. Fortun, personal

communication 2004). However, the amount of tourists reaches a peak in the summer and accordingly the chance of disturbing the wild reindeer will be greatest in this season.

A study of the disturbance effect of winter tourism on crucial winter grazing pastures of wild reindeer in Hardangervidda indicated that ski trails influenced an area of 1765 meter in each direction and accordingly 30 % of the total area of Hardangervidda (Hagen 2002). If this effect were generalized to the 280 km of marked trails in Jotunheimen, approximately 68 % of the total area would be influenced by the trails. However, this estimate is very uncertain and most likely not relevant for Jotunheimen. The topography of Hardangervidda is a lot plainer than the hilly landscape in Jotunheimen, which will greatly reduce the effect of the influence. An important knowledge of this study is that tourist trails located in open areas disturb reindeers in a greater extend, than trails more "hidden" in the landscape.

Considering the wild reindeer population it might be necessary to avoid human activity in areas where the reindeers are located in Easter and summer. Human disturbance on crucial winter grazing pastures has also a severe negative effect on the reindeer survival (Nellemann et al. 2001). These possible negative effects in the preserved area of Jotunheimen are limited because the reindeer doesn't stay in this area most of the winter season. However the effects of disturbance on the long term and cumulative level indicate that the overall human use of areas with reindeer should be limited.

The Law of Nature Preservation gives the management the opportunity to forbid traffic throughout the whole year or in periods, if it seems to be necessary for protecting the plant- or animal- life, or geological occurrences (<http://www.lovdato.no/cgi-wift/wiftldles?doc=/usr/www/lovdato/all/nl-19700619-063.html&dep=alle&titt=lov+om+naturvern& 15.03.04>). This might be a solution for the management in vulnerable periods like the breeding time for the fauna, especially for the wild reindeer population, but also for the flora and soil. However, the legal right of access to private land makes it difficult to forbid somebody to stay in outlying fields whether it is preserved or not. Preserving a nature area as a national park gives the management the opportunity to forbid traffic in certain areas, but this is seldom done. The best way of reducing the negative effects of tourism in Jotunheimen is through information and an awareness drive, concerning how certain behaviour may decrease the unwanted influence on the wild life. In this way, tourists will be more aware of their possible negative effects on the nature, and hopefully do their best to reduce the environmental influence of their own activity. Forbidding traffic in areas with high level of conflicts might be used in the national park, but only as a last solution.

5 CONCLUSION

The vast number of tourists that visits Jotunheimen each year affects the nature and causes several negative influences on nature areas. For the vegetation and soil this means wear caused by direct influences like trampling and other activities. The influences are, therefore, mainly restricted to the most intensively used areas. The marked trails in Jotunheimen concentrate the negative effects on the vegetation and soil caused by tourist traffic, and, further, shields the surrounding terrain from similar damage. Environmentally sound adaptation of the most exposed trails will reduce the unwanted influences that are caused by a high level use.

Altogether, it doesn't seem like the high level of tourism ruin the vegetation and soil in Jotunheimen. However, it is important to be aware of the fact that increased traffic outside the tracks will lead to an unwanted expansion. The tourism has an increasing tendency and if this leads to an increase of the share of people that travels outside the marked tracks, the current influence will aggravate. An important mission for the administrative authority, DNT and the

local commercial companies involved in tourism is, therefore, to maintain a focus on this subject through their work and activities, and request tourists to follow the marked tracks inside the preserved area.

Tourism in Jotunheimen has the greatest influence on the fauna and, hence, the wild reindeer population. A concentration of tourists in marked tracks will be better considering the overall effects on the vegetation and soil, however, will be worse considering the wild reindeer if these tracks present a severe influence in the reindeer's range zone. A challenge for sustainable management of the reindeer population is to decrease the level of tourism and organized activity in the western parts of the national park, where the reindeers have summer grazing pastures. Norway has a special responsibility to manage viable populations of this species, and a sustainable management of the wild reindeer will automatically preserve a variety of other species in Jotunheimen. For the management of the fauna, it is also important to focus on the long term and the cumulative consequences of tourism, and not let the studies of the minor local effects become a resting pillow. Moreover, it is important that the management deals with the problem of refuse dumping. As explained this may influence the ecosystem stability, alter the composition of species and in the end change the entire ecosystem in the preserved area.

Focus on reaching the users of Jotunheimen through information and awareness drive might be the best solution in order to deal with the negative impacts of tourism. If all preventive efforts fail, there is a possibility to forbid traffic in exposed areas of the national park but not the special landscape area.

References

- Aas, Ø. Vistad, O.I. Dervo, B. Eide, N.E. Kaltenborn, B.P. Haaland, H. Andersen, O. Svarstad, H. Skår M. and Nellemann, C. 2003: Bruk og forvaltning av nasjonalparker i fjellet. – Internasjonale erfaringer med forvaltning av menneskelig virksomhet i nasjonalparker. – Kartlegging av næringsaktivitet i Dovrefjell-Sunndalsfjella, Femundsmarka og Reisa nasjonalparker. – Litteraturstudie av økologiske, kulturfaglige og sosiale effekter av turisme i verneområder. – *NINA Fagrapport 72*: 83pp. Trondheim.
- Alcock, J. 1997: *Animal Behaviour: An Evolutionary Approach*. 6th ed. Sinauer Associates, Inc. Massachusetts.
- Bø, E. (ed.) 1998: *Forvaltningsplan for Jotunheimen nasjonalpark og Utladalen landskapsvernområde*. Fylkesmannen i Sogn og Fjordane, Rapport nr. 4 1998. 98 pp. Leikanger (Fylkesmannen i Sogn og Fjordane) & Lillehammer (Fylkesmannen i Oppland).
- Cole, D.N. and Krumpel, E.E. 1992: Seven Principles of Low-Impact Wilderness Recreation. *Western Wildland* 18/1.
- Dervo, K.B. Aas, Ø. Kaltenborn, B.P. and Andersen, O. 2002: Utmarksturisme i fjellregionen i Sørøst-Norge. – Vekst og vyer eller nedgang og resignasjon? – *NINA Fagrapport 73*: 31 pp. Lillehammer.
- Direktoratet for naturforvaltning 2002: Nasjonalparker og andre verneområder. *Faktaark 1: 2002*. Trondheim.
- Direktoratet for naturforvaltning 2001: Områdevern og forvaltning. *DN-Håndbok nr 17 - 2001*. Trondheim.
- Farner, M. 1994: *Snøugle Nyctea scandiaca og smånagerdynamikk på Hardangervidda: en syklisitets- og populasjonshistorisk analyse*. Master thesis in Biology. The University in Oslo.

- Fortun, E. and Moen, V. 2001: *Driftsplan for Vest Jotunheimen Villreinsområde 2001-2005* Årdal.
- Hagen, A. 2002: *Disturbance of Wild Reindeer (Rangifer tarandus tarandus) – The effect of winter tourism*. Candidatus Scientiarum Thesis. Department of Biology, Norwegian University of Science and Technology (NTNU), Trondheim.
- Hammit, W.E. and Cole, D.N. 1998: *Wildland Recreation. Ecology and Management*. 2nd ed. John Wiley and Sons, New York.
- Henttonen, H. and Wallgren H. 2001: Rodent dynamics and communities in the birch forest zone of northern Fennoscandia. In: Wielgolaski, F.E. (ed.) 2001: *Nordic mountain birch ecosystems*. Parthenon Publishing Group, pp. 261-278.
- Hockin, D. Ounsted, M. Gorman, M. Hill, D. Keller, V. and Barker M.A. 1992: Examination of the Effects of Disturbance on Birds with Reference to Its Importance in Ecological Assessments. *Journal of Environmental Management* 36(4): 253-286.
- Huxel, G.R. McCann, K. and Polis G.A. 2002: Effects of partitioning allochthonous and autochthonous resources on food web stability. *Ecological Research* 17(4): 419-432.
- Kaltenborn, B.P. 1994: Recreational use of Jotunheimen National Park: some implications for management and planning. *Norsk Geografisk Tidsskrift* (48):137-149.
- Kjellen, N. and Roos, G. 2000: Population trends in Swedish raptors demonstrated by migration counts at Falsterbo, Sweden 1942-97. *Bird study* 47:195-211.
- Kuss, F.R. Graefe, A.R. and Vaske, J.J. 1990: *Visitor Impact Management. A Review of Research*. National Parks and Conservation Association, Washington D.C.
- MacArthur, R.A. Geist, V. and Johnston R.H. 1982: Cardiac and behavioural responses of mountain sheep to human disturbance. *Journal of Wildlife Management* 46(2): 351-358.
- Martinetto, K. and Cugnasse, J. M. 2001: Reaction distance in Mediterranean Mouflon (*Ovis gmelini musimon* x *Ovis* sp.) in the presence of hikers with a dog on the Caroux plateau (Herauld, France). *Revue D Ecologie-La Terre Et La Vie* 56(3):231-242.
- McCann, K. Hastings, A. and Huxel, G.R. 1998: Weak trophic interactions and the balance of nature. *Nature* 395(6704): 794-798.
- Meffe, G.K. and Carroll, C.R. 1997: What is Conservation Biology? In: Meffe, G.K. and Carroll, C.R. 1997: *Principles of Conservation Biology*. 2nd ed. pp. 1-7. Sinauer Associates, Inc. Publisher, Massachusetts.
- Myers, N. 1997: Global Biodiversity II: Losses and Threats. In: Meffe, G.K. & Carroll, C.R. 1997: *Principles of Conservation Biology*. 2nd ed. pp. 148-149. Sinauer Associates, Inc. Publisher, Massachusetts.
- Nellemann, C. Jordhøy, P. Støen, O.G. and Strand, O. 1999: Cumulative Impacts of Tourist Resorts on Wild Reindeer (*Rangifer tarandus tarandus*) during Winter. *Arctic* 53(1): 9-17.
- Nellemann, C. Vistnes, I. Jordhøy, P. and Strand, O. 2001: Winter distribution of wild reindeer in relation to power lines, roads and resorts. *Biological Conservation* 101(2001): 351-360.
- Moberg, G.P. 1985: *Animal Stress*. American Physiological Society, 111 pp.
- Riffel S.K. Gutzwiller, K.J. & Anderson, and S.H. 1996: Does repeated human intrusion cause cumulative decline in avian richness and abundance? *Ecological Applications* 6(2): 492-505.
- Simberloff, D. 1998: Flagship, umbrella, and keystones: is single-species management passé in the landscape era? *Biological Conservation* 83(3): 247-257.
- Swihart, R.K. Gehring, T.M. Kolozsvary, M.B. and Nupp, T.E. 2003: Responses of "resistant" vertebrates to habitat loss and fragmentation: the importance of niche breadth and range boundaries. *Diversity and Distributions* 9(1): 1-18.

- Turner, M.G. Gardner, R.H. and O'Neill, R.V. 2001: *Landscape ecology in theory and practice: pattern and process*. 86-90 pp. Springer-Verlag, New York.
- UNEP - United Nations Environmental Programme. 2001. Nellemann, C. Kullerud, L. Vistnes, I. Forbes, B.C. Foresman, T. Husby, E. Kofinas, G.P. Kaltenborn, B.P. Rouaud, J. Magomedova, M. Bobiwash, R. Lambrechts, C. Schei, P.J. Tveitdal, S. Grøn, O. and Larsen, T.S. 2001: *GLOBIO – Global methodology for mapping humans impact on the biosphere. The Arctic 2050 scenario and global application*. UNDEP/DEWA/TR.01-3.
- Vistad, O.I. Kaltenborn, B.P and Aas, Ø. 1996: Miljøkonsekvenser av friluftsliv. *ØF-Rapport* 02/1996: 50pp. Østlandsforskning, Lillehammer.
- Vistnes, I. and Nellemann, C. 2000: Når mennesker forstyrrer dyr - En systematisering av forstyrrelseseffekter. *Reindriftnytt* 02.03.2000, 28-32.
- Vistnes, I. and Nellemann C. 2001: Avoidance of cabins, roads, and power lines by reindeer during calving. *Journal of Wildlife Management* 65(4): 915-925.
- Vorkinn, M. Aas, Ø. Kleiven, J. 1997: Friluftslivsutøvelse blant den voksne befolkningen - utviklingstrekk og status i 1996. *ØF-Rapport* nr 07/1997: 113pp. Østlandsforskning, Lillehammer.

Personal communication

- Einar Fortun, 2004. Ranger in West Jotunheimen Wild-reindeer Area.
- Lars Bakkom, 2004. Lom Tourist-office.
- Marit Vorkinn, 2004. Employee in Oppland fylkeskommune
- Sverre A. Larssen, 2004. Manager The Norwegian Tourist Association (DNT) Oslo og Omegn.
- Torfinn Evensen, 2004. Employee in The Norwegian Tourist Association (DNT) Oslo og Omegn.

Internet references

- <http://www.iucn.org/about/index.htm> 07.03.04.
- <http://www.iucn.org/themes/forests/6/notitle.html> 07.03.04.
- <http://www.ub.ntnu.no/> Januar – March 2004.
- http://www.lovdatab.no/cgi-wift/wiftldles?doc=/usr/www/lovdata/all/nl-19700619_063.html&dep=alle&titt=lov+om+naturvern& 15.03.04.