FOOD AND FUEL:
A HIDDEN DIMENSION IN HUMAN NUTRITION

a study on the relationship between nutrition security and fuelwood availability in Ntcheu District, Malawi

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STELLINGEN

1. Distance to collection place and frequency of collection are not reliable indicators of the level of fuelwood availability as often postulated in literature.
Dit proefschrift.

2. Availability of food, labour and time determine to a large extent the effect of decreasing fuelwood availability on nutrition.
Dit proefschrift.

3. Reduction in bean intake as a strategy to cope with decreasing fuelwood availability is a point of nutritional concern in view of the already high dependence on cereals and the marginal quality of the diet.
Dit proefschrift.

4. When studying stunted populations, nutritionists should be aware of Beaton's postulate: "Small people may cope with their environment and in that sense achieve at least the minimal health required for population survival and growth - but it has been at an important cost - a reduction in the potential for change."
Beaton GH. Small but healthy? Are we asking the right question? Eur J Clin Nutr 1989:43, 863-875

5. Trees are fundamental for sustainable development for a variety of reasons: for timber, fodder, fruit, fiber, soil conservation and improvement, shade and enjoyment, income generation and fuel. Tree growing programmes should pursue strategies which provide as large an aggregate as possible of multiple benefits.
naar: Dewees PA. The woodfuel crises reconsidered: observations on the dynamics of abundance and scarcity. World Dev 1989: 17, 1159-1172

6. Those concerned with multidisciplinar research, should think seriously about the observation of Audrey Richards. " To venture like this on the border-line between two different sciences, biological and social, is an ungrateful task. What pleases one set of specialists displeases the other."
Richards A. Land, labour and diet in Northern Rhodesia. An economic study of the Bemba tribe. Oxford: Oxford University Press, 1969 (2nd edition).

7. Tot nu toe is niet overtuigend aangetoond dat sociaal-economische karakteristieken van huishoudens de variatie in seizoensmatige gewichtsfluctuatie van vrouwen verklaren. Dit komt waarschijnlijk omdat onderzoek is uitgevoerd in populaties gekenmerkt door een marginale fluctuatie.

8. The call for simple and easy to measure indicators of nutrition insecurity for monitoring and evaluation purposes can lead to an oversimplification of the problem and, as a consequence, to incorrect policy decisions.

9. Kwalitatief voedingsonderzoek is essentieel voor de interpretatie van kwantitatieve onderzoeksgegevens en is met name van belang voor hypothese en theorie vorming ten aanzien van bestaande voedingsproblemen.

10. In ontwikkelingslanden waar sprake is van brandhoutschaarste, kunnen mensen in tijden van voedseltekorten niet eens meer op een houtje bijten.

11. In tegenstelling tot in Nederland, neemt in ontwikkelingslanden de professionele waarde van een vrouwelijke voedingskundige toe na het krijgen van een kind.

Stellingen behorende bij het proefschrift

'Food and fuel: a hidden dimension in human nutrition. A study on the relationship between nutrition security and fuelwood availability in Ntcheu District, Malawi'

van Inge D. Brouwer

Wageningen, 14 juni 1994.

Nkuni imodzi simanga mtolo

(one piece of fuelwood does not make a bundle)

Abstract

FOOD AND FUEL: A HIDDEN DIMENSION IN HUMAN NUTRITION
A study on the relationship between nutrition security and fuelwood availability in Ntcheu District, Malawi

Thesis by Inge D. Brouwer, Department of Human Nutrition, Wageningen Agricultural University, Wageningen, The Netherlands

This study describes and analyses the relationship between nutrition security and fuelwood availability in rural households in Ntcheu District, Malawi. It was carried out during 1990 to 1992 in four villages selected on the basis of distance to woodlands, situated in an area characterized by nutritional insecurity, an overwhelming dependance on cereals for energy intake and a moderate fuelwood scarcity. Already under conditions of moderate fuelwood scarcity households developed strategies as regards collection distance and collection frequency, which determined collection time, type of fuel used and amount of wood collected. Female labour availability appeared to be a strong determinant of the strategy used and especially households with a labour deficit economized on collection time, reduced the amount of fuelwood collected and switched to inferior fuels.

Nutrition security appeared to be affected by a decreasing fuelwood availability mainly through the strategies that evolved. The impact of increased collection time was seasonal and depended on the presence of other labour constraints. The labour input in agriculture was never reduced, but the time for resting and food processing and, during the rainy season, for food preparation and food purchase was decreased. The increase in wood collection at the expense of resting may imply an increase in energy requirements of women. A reduction in time spent on food-related activities may affect the household food availability. The use of inferior fuels prohibited women of doing other household chores during cooking as twigs need close attention to maintain the fire. Twigs could not serve as fuel for dishes needing a long cooking time so that, as a consequence, these will be dropped from the dietary pattern. A decrease in fuel use was associated with a reduced intake of cooked cereals and beans. This effect mainly showed during the post-harvest season, when fuelwood is a determinant of food intake. In the rainy season, this association was largely determined by the relatively low food availability. Especially the reduction of bean intake is a point of concern in view of the already overwhelming dependence on cereals and the relatively marginal quality of the food.

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Food and fuel: a hidden dimension in human nutrition

General introduction

Recent information on the world nutrition situation shows that, overall, between 1975 and 1990 the nutrition situation in developing countries has improved despite the rapidly growing population. The percentage of underweight children dropped from approximately 42 % in 1975 to 34 % in 1990 and the overall food available for human consumption increased from 2120 kcal/capita/day in 1970 to a global average of 2470 kcal/capita/day in 1990 (ACC/SCN 1992). This implies a considerable reduction in the number of malnourished people from nearly 1,000 million to approximately 780 million (FAO/WHO 1992a).

In contrast to all other regions, however, the nutritional trends in Sub-Saharan Africa show a less optimistic picture. The nutritional situation in Sub-Saharan countries hardly improved as is illustrated by the unchanged overall percentage of underweight children of around 30 % between 1980 and 1990. Only some African countries, especially those with community-level nutrition programmes, showed a trend in the opposite direction as they achieved nutritional improvement (ACC/SCN 1992).

In developing countries, protein-energy malnutrition, iron deficiency anaemia, vitamin A deficiency and iodine deficiency are the main forms of malnutrition. Malnutrition affects activity, growth, health, learning capacity, work performance and the overall quality of life. The occurrence of malnutrition in populations indicates that they are nutritionally insecure. In the early seventies, much attention was paid to inadequate food supplies and food production as major causes of malnutrition. From the eighties onwards, it was generally accepted that malnutrition was primarily a problem of poverty or, in other words, of failure to develop, not only economically but

also in terms of a sufficient health infrastructure and education system (FAO/WHO 1992b). Moreover, in recent years the existing problems have become superimposed by crises such as drought and civil wars, leading to massive population movements (ACC/SCN 1992).

At first sight, forests and trees may seem to have little to do with nutrition security. In the last decade, however, their role has received more attention as a result of the increasing awareness that rural populations depend on trees and forests for survival (Wiersum 1988/89). Forests and trees support food and nutrition in two important ways (Murray 1991). Firstly, they play an important role in the management of the soil and water regimes which are the fundamental requirements of any food production system. Secondly, they supply (wild) foods which are particularly important as buffer during food shortfalls, and they provide fuelwood, income and employment (Campbell 1986; Chambers and Leach 1989; Falconer and Arnold 1991).

The general aim of the research described in this thesis is to study the relationship between fuelwood availability on the one hand, and nutrition security in rural populations on the other. Fuelwood provides a major source of energy in rural communities, especially for cooking and food processing (Eckholm *et al.* 1984; World Bank 1992). With fuelwood supplies diminishing in many rural areas, the possible impact of a shortage on food and nutrition security will become more and more evident.

This chapter explains the concepts of household food and nutrition security, fuelwood availability and shortage, and the conceptual framework used to study the relationship between these two. Further, an outline of the research project is given with special emphasis on the research objectives and the research area.

Household food and nutrition security

Determinants of nutrition security operate at different levels in a society. Several models illustrating the key determinants of nutrition security have been developed (Mason *et al.* 1984). The most recent one that has gained wide acceptance is developed by UNICEF (Maxwell and Frankenberger 1992). This model shows that the immediate determinants of nutrition security are adequate dietary intake and adequate health condition, and, most frequently, interaction between the two. These, in their turn, are determined by a combination of three factors: household food security, care of nutritionally vulnerable household members, and access to health services combined with a healthy

environment. Each of these three factors, food security, care and health, are essential but none is sufficient on its own for achieving nutrition security.

In its basic form **household food security** is defined as access at all times to the food necessary for a healthy life for all members of the household (FAO/WHO 1992c). Achieving household food security has three dimensions: adequacy, stability and sustainability (Frankenberger *et al.* 1993). Adequacy refers to foods which are adequate in quantity and quality, which are safe in terms of absence of toxic and harmful substances, and which are culturally acceptable. The supply of food should have a reasonable degree of stability both from one year to another and throughout the year. In other words: a household should be able to bounce back and regain an adequate food supply in case of a shortfall, often referred to as resilience. Finally, the supply of food should be sustainable, meaning that the long-term stability is ensured.

The International Fund for Agricultural Development (IFAD) has developed a model depicting conditions promoting household food security. This model distinguishes immediate, underlying and basic conditioning factors resulting in adequate, stable and sustainable food supplies at household level (Figure 1). Access to an adequate food base and effectiveness of food handling are considered as immediate conditioning factors. The term "*food base*" refers to all the foods available from different sources. "*Handling*" covers all processes necessary for increasing the life of food products and their safety such as storage, conservation and processing. The stable access to essential resources, the management of these resources and the patterns of social support are identified as "*underlying factors*". The food supply situation is regulated by the structures and mechanisms for control and management of resources referring to the rules and norms prevailing in a society, and by the way they are applied which govern a households decision making and action. Ultimately, the household food supply situation reflects the local agro-ecological conditions and the existing marketing systems. Together the latter determine the potential resource base and mould the particular food systems.

Care refers to the provision in the household of time, attention and support to meet the physical, mental and social needs of all household members (FAO/WHO 1992d). The attention is often focused on the growing child, but there are other vulnerable groups within households such as pregnant and nursing women, the elderly and the disabled. Specific care for children includes, among others, breast-feeding, providing shelter, clothing, feeding and bathing. One of the constraints on providing care is the often heavy workload of women, especially during the agriculturally active season, that puts an extra burden on them and reduces their ability to care for themselves and their families (FAO/WHO 1992d).

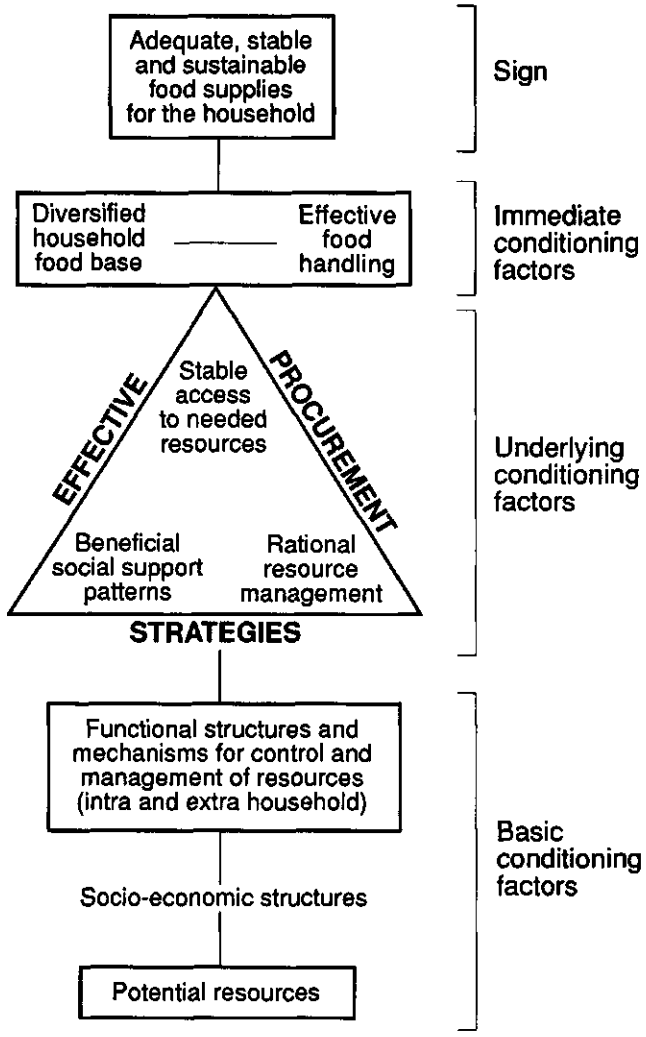

Figure 1
Factors conditioning household food security
(IFAD, Frankenberger et al., 1993)

Health services and a **healthy environment** contribute to nutrition security. Health services include prevention of infection and management of infectious diseases, health education, environmental health and food hygiene control, immunizations, curative care, growth monitoring and promotion, and primary health care. A healthy environment refers to safe water, proper human waste disposal and adequate housing (FAO/WHO 1992b).

The concept of nutrition security reflecting household food security, care and health, offers a useful framework. It improves the understanding of the opportunities, practices and constraints of households in attaining access to sufficient and adequate food, health and care in changing conditions. The framework can also be used as a guide to understand possible impacts of a decreasing fuelwood availability on household food and nutrition security.

Fuelwood availability and shortage

Traditionally, people in developing countries relied on fuelwood and charcoal for fuel. In most places trees used to be readily available and the end-use technologies, such as the three-stone-fire, were inexpensive (French 1986). Most of the fuelwood was collected outside forests; also other natural wood resources supplied fuelwood such as hedges, bushes, village or household wood lots and trees scattered in agricultural areas (Munslow *et al.* 1988). However, due to increasing land clearance for agriculture and to over-grazing of land by livestock, the fuelwood supplies rapidly become depleted (Dewees 1989). The decrease in fuelwood availability is a problem that is slowly growing, sometimes aggravated by a sudden increase in pressure on existing resources by population migrations due to, for example, wars.

Fuelwood shortage, in this thesis used as a synonym for fuelwood scarcity, is essentially recognized as a situation in which fuelwood needs exceed fuelwood supply. In 1981, the FAO presented a study that gave, both at regional and national level, an overview of the fuelwood situation in developing countries (FAO 1981; De Montalembert and Clement 1983). In it, two categories of fuelwood shortages were distinguished. First, acute fuelwood scarcity existed when people could not meet their minimum fuelwood needs, not even by overexploiting and overcutting the existing fuelwood resources. Second, in a situation of fuelwood deficit, people were still able to meet their minimum needs, but only by overcutting the existing resources, which would ultimately lead to situations of acute scarcity. The FAO estimated in 1981 that over 100 million people were already facing acute fuelwood scarcity, and that nearly

1.3 billion people were living in fuelwood-deficit areas. It is generally agreed that the data used in the FAO study were incomplete and did not take into account that people respond to fuelwood scarcities. Nevertheless, it can be concluded that the present demands for fuelwood cannot be met by existing tree resources. Therefore, fuelwood will become increasingly scarce and expensive for a huge number of people (Eckholm *et al.* 1984; Dewees 1989).

It is very difficult to determine whether there is a fuelwood shortage at household level. Firstly, the opinions in the literature on minimum energy needs vary greatly. It remains unclear whether or not the minimum needs should comprise factors such as the efficiency of the cooking method, the climate and the way of living. Secondly, the conversion factors from minimum needs to minimum amount of fuelwood needed are still inadequate. Thirdly, estimation of fuelwood available to the household occurs mostly through measurement of existing woody biomass (Bradley 1988; De Gier 1989). However, this woody biomass is usually not entirely available as fuelwood for all households. Availability is determined by factors such as competing demands for fuelwood (construction timber, fodder, wood for markets), physical and social access and cultural acceptability of wood species (Munslow *et al.* 1988; Soussan 1988; De Gier 1989). In view of these difficulties in determining the level of fuelwood shortage, some researchers suggest to employ indirect indicators of fuelwood shortages. So far, the most popular indicators have been the distance people need to travel to collect their fuelwood and the time they spent in fuelwood collection (Howes 1985; Soussan 1988).

Relation between fuelwood and nutrition

Rural households will develop strategies to cope with a decreasing fuelwood availability. The concept of coping was first discussed in socio-psychological studies by Folkman and Lazarus (1980; 1988). Although their studies refer to the industrialized world - the United States - and are carried out at the level of the individual, it nevertheless offers a useful framework. Coping behaviour can be regarded as any attempt, both cognitive and behavioural, made to manage a problematic situation, in this case fuelwood shortages. When confronted with fuelwood shortages, households will make an appraisal of the encounter. This appraisal is based on the answer to two questions: "What is at stake in this encounter" and "What can be done, what are the options for coping with it". The answer to these questions affects the way in which households will try to cope (see also Chapter 2).

The concept of household coping strategies in developing countries has, until now, mainly been used in research on food security and seasonal food shortages in which it focused on the behavioural efforts. According to Corbett (1988), the term "*strategy*" is used to describe what households do when faced with a decreasing fuelwood availability. The terms "*response*" or "*behavioural response*" are used for each of the specific actions undertaken within a strategy. Several responses may be undertaken in the household, at the same time or sequentially, as part of the same overall strategy. In their studies on seasonal food shortages Longhurst (1986), and Foeken and Hoorweg (1988) distinguish between responses to prevent seasonal food shortages and responses to meet actual shortages. Contrary to seasonal food shortages, which have a transitory character, fuelwood shortages are of a more chronic nature as the situation is usually worsening in time. Most responses aim at meeting actual stress, only some aim at prevention of worse effects in the future (for example the planting of trees).

As noted earlier, fuelwood provides the main energy source for food preparation in rural communities in most of the developing countries. While few studies have examined the links between nutrition and fuelwood, so that there is little evidence from which to draw conclusions, a few important relationships can be identified. Based on available data and information, three main strategies developed by households, and especially by the women within these households, can be distinguished:

- increase in time and energy spent on fuelwood collection;
- substitution of alternative fuels (either commercial or non-commercial fuels) for traditional fuelwood;
- economizing on the consumption of fuelwood and alternative fuels.

These strategies may have their effects on the nutritional situation of the households. Increased time needed for fuelwood collection may reduce time available for cooking, food production, income-generating activities or child care. A switch to inferior fuels such as crop residues and animal dung may affect health of those who spend much time near the cooking fire such as the women and children. The higher prices of commercial fuels may affect the money spent on purchasing foods or the quantity of processed foods consumed. A reduction in the amount of fuelwood used for food preparation may affect both the quantity and the quality of the foods consumed.

Returning to the theory of Folkman and Lazarus (1988), not all options for strategies will be at the household's disposal. First of all, coping depends on the availability and access to household resources (land, labour and cash) and on the way these are controlled and managed (Sen 1981; Frankenberger *et al.* 1993). Depending on the availability of cash, households may or may not substitute commercial fuels for

fuelwood. Labour availability determines whether households put more time in the collection of fuelwood availability.

Next, the relevance of an option will depend on experiences with the same or similar problems (Folkman and Lazarus 1980). If in previous situations a response has been effective, this response is favoured above other options with unknown effects. Also Campbell (1990) noted that the responses that are developed are not unique measures, but that they are already existing elements in a society which only become more important under difficult conditions.

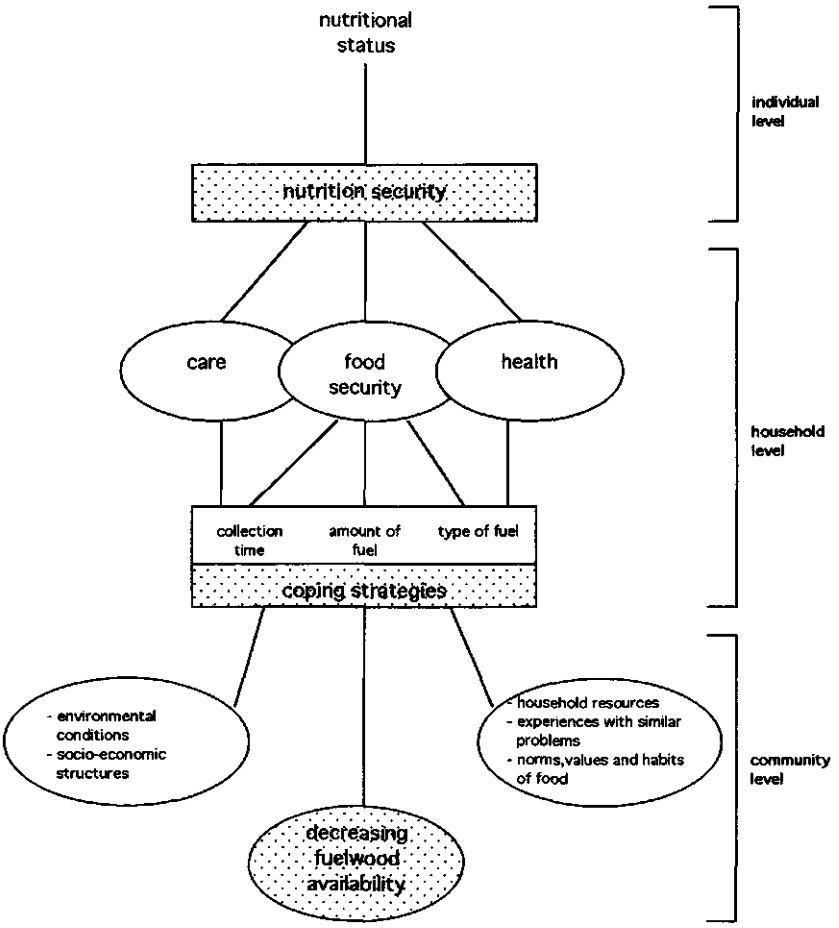

Figure 2

Relationship between fuelwood availability and nutrition security

Finally, the responses that are developed, are further determined by social and cultural norms, values and habits concerning food and life in general. Household resources, previous experiences and social and cultural norms and values regulate the choice for one or for a combination of the responses. Responses vary from one society to another according to their environmental, economic and social characteristics. Furthermore, responses will be adopted in sequence, beginning with those that involve relatively little discomfort (Campbell 1990).

The relationship between fuelwood availability and nutrition security is reproduced in Figure 2. It identifies the key determinants that operate at individual, household and community level. This model serves as a framework to analyse the possible impact of a decreasing fuelwood availability on nutrition security.

Malawi

Malawi is a small landlocked country in Southern Africa with an area of 120,000 km^2 of which 20 % is water (Figure 3). Based on the 1987 census, the population was estimated at 8 million, increasing at an annual rate of 3.7 %. The country is administratively divided into three regions: the hilly and relatively densely populated Southern Region (50 % of the population), the fertile and well-populated Central Region with the capital, Lilongwe, at its centre (39 % of the population), and the mountainous, relatively infertile, and sparsely populated Northern Region (11 % of the population). Approximately 90 % of the population live in rural areas with smallholder subsistence farming as main activity (Malawi Government 1987b). The dominant food crop is maize. Maize is grown by 80 % of the smallholders and occupies 58 % of the cultivated area (Malawi Government 1984). It serves as staple food but also forms an important source of cash income for smallholders. Millet, sorghum, rice and cassava are important secondary crops and replace maize as the staple food in some areas (Pelletier and Msukwa 1991). Groundnuts and/or pulses are grown by 34 % of the households and are used as cash crops and as ingredients of relish. Non-edible cash crops are grown by a small percentage of smallholders only, with 5 % growing cotton and 8 % growing tobacco in 1981 (Malawi Government 1984).

In general, the standard of living is deplorably low. Approximately 60 % of the population is illiterate (UNDP and World Bank 1992). The annual per capita income of $ 200 in 1990 is one of the lowest in Africa (World Bank 1992). The crude birth rate is 41.2 per 1000, the crude death rate 14.1 per thousand and infant mortality is estimated at 159 per thousand live births (Malawi Government 1987b). Life expectancy at birth is

about 48 years (UNDP and World Bank 1992). Prevalence of chronic malnutrition among children under five is high and in 1981/1982 56 % of the underfives were stunted (low height for age). The prevalence of wasted children (low weight for height) varied with the season and during the pre-harvest season 2.8 % of the underfives showed acute malnourishment (Malawi Government 1984).

As in most developing countries, fuelwood supplies over 90 % of the total energy consumption (Olthof and Stoffers 1984). The main consumers are rural households, using 60 % of the total energy consumption almost exclusively for cooking (ETC 1987a; Lindskog and Lundqvist 1989). Almost all fuelwood is collected by female family members from nearby communal lands or from their own farmland (French 1986). Commercial substitutes such as kerosene, charcoal and wood from plantations do exist but are beyond the scope of rural and poor urban households (French 1986). The fuelwood supply is considered to be critical in the densely populated areas in the Central and Southern Regions (ETC 1987a). In these areas the tree cover diminishes very rapidly at a rate of 3.5 % per year or even higher (Malawi Government 1987a). Further, in all border regions, especially around Mulanje and the Dedza-Ntcheu region, the influx of refugees from Mozambique constitutes an extra pressure on the existing woodlands (ETC 1987a).

The problem of fuelwood shortage has been recognized for at least the last fifteen years in Malawi. In 1976 a National Tree Planting Day was inaugurated by the President. On this day great efforts are made to distribute seedlings throughout the country. Posters and calendars are widely seen to advertise and remind people of the importance of tree planting. In 1980/1981 advantage was taken of the National Survey of Agriculture and a section on fuelwood use was incorporated. The main findings were that, although fuelwood was becoming increasingly scarce, the pattern of energy use remained largely unaffected. People spent more time and travelled further to collect fuelwood. However, they did not yet reduce the number of meals prepared, the brewing of beer (which is very fuel-consuming) or the heating of water for bathing. Only a small number of rural households started to buy part of their fuelwood or made use of inferior cooking fuels such as mango cuttings, crop residues or bark. Trees were not planted for fuelwood, but rather for use as building poles and fruit. The household labour division was recognized as one of the problems in tree planting. Men traditionally plant trees especially for building purposes. They were unlikely to have a similar interest in planting trees for fuelwood, which is considered a women's problem (Malawi Government 1987).

The research project

Although the relationships between food and fuel mentioned here seem to be intuitively logical and many references are made in the current literature, in most cases these citations are based on limited observations or ideas rather than on substantial research. Furthermore, it is not clear that a declining fuelwood availability is the cause of household food and nutrition insecurity, as it is only one of the many determinants. Also other circumstances such as food shortages, increased workloads, commercialization and urbanization could have comparable effects. This justifies further research, not only to settle an academic question, but also to help define directions for future action both in terms of increasing the fuelwood supply and improving nutrition security (FAO 1990/1991).

The present thesis describes the results of a research carried out between October 1990 and May 1992 in Malawi. The study is a joint venture between the Department of Human Nutrition, Wageningen Agricultural University, and the African Studies Centre, Leiden, The Netherlands. In Malawi, the study was affiliated to the Centre for Social Research, Zomba. Official approval of the study was given by the National Research Council of the Government of Malawi in July 1990.

The research focuses on the relationship between fuelwood availability and nutrition in rural areas. It looks into the responses of rural households to cope with a decreasing fuelwood availability. The relationship of these responses with the elements of nutrition security (food security, care and health) are studied by determining time allocation of women and dietary pattern, food preparation and food consumption.

Research objectives

The main aim of this research was to describe and analyse possible relationships between decreasing fuelwood availability on the one hand and household food and nutrition security on the other. In order to achieve this aim, the following research questions were formulated:

- Which strategies are used by rural households to cope with a decreasing fuelwood availability? (Chapter 4)
- What are the preferences of women for different qualities of fuelwood and does the use of inferior fuelwoods affect dietary pattern and food preparation? (Chapter 5)
- Does increased time spent on fuelwood collection affect the women's time allocation on other (food-related) activities and household labour division? (Chapter 6)
- What are the consequences of a low level of household fuelwood use for household food preparation and food intake? (Chapter 7)

Research area and population

Research was carried out in Ntcheu District, located in the Central Region of Malawi near the Mozambican border in the West (see Figure 3). The research area was selected for the following reasons:

- the existence of areas with a fuelwood deficit and areas with an adequate fuelwood supply in the district (Monitoring and Evaluation Unit, Energy Studies Unit 1990; personal communication), offering the possibility of comparison.
- relatively low prevalence of malnutrition among children under five (Malawi Government 1989) and relatively high maize production (Ministry of Agriculture 1990; personal communication). The effect of food shortages which may obscure the relationship between fuelwood availability and nutrition, may therefore be expected to be weak in this region.

Ntcheu District is situated along the main traffic road (M1), leading from the upper north of the country to the south. It is characterized by a relatively high population density (105 inhabitants per km^2) with an annual population growth of 4.6% (Malawi Government 1987b). The vegetation consists largely of woodland savanna with an annual precipitation of 900 mm concentrated in the rainy season (November-April). Daily temperatures vary between 18 ^oC (July) to 36 ^oC (October). The study population belongs to the ethnic group of the Ngoni, and follow a matrilineal system of inheritance and practice matrilocal marriage. Approximately 30 % of the households reported to be headed by a female, mainly due to migration of the husband, divorce or widowhood. Polygamy is not common. Households usually occupy several dwellings, concentrated in villages with their fields partly surrounding these villages and partly located at further distances due to land scarcity. Households in the research area show the features and characteristics of peasant farming families (Ellis 1993). The predominant activity is farming with a subsistence character. The cultivated farm size is on average 2.8 acre (1.1 ha). Most of the field work is done by hand using the traditional hoe. A large proportion of the farm output is directly consumed rather than sold in the market. The most widely cultivated food crop is maize, often intercropped with finger millet, pulses, groundnuts and vegetables. Surplus production of hybrid maize and, to a lesser extent, of groundnuts, fruits and sugar cane are sold. Households have access to land through a complex of traditional rights, and as such land forms a long-term security for the household. There is a strong reliance on family labour, although some households use hired labour in peak periods during harvesting whereas others sell their labour on an ad hoc basis. Some household members participate in non-farm activities and earn an income from manufacturing foods,

beverages and crafts and selling these, from repairing and construction work or from employment by companies or Government. Features of reciprocity and sharing goods and services are still identifiable, although these have lost much of their value in the last decades.

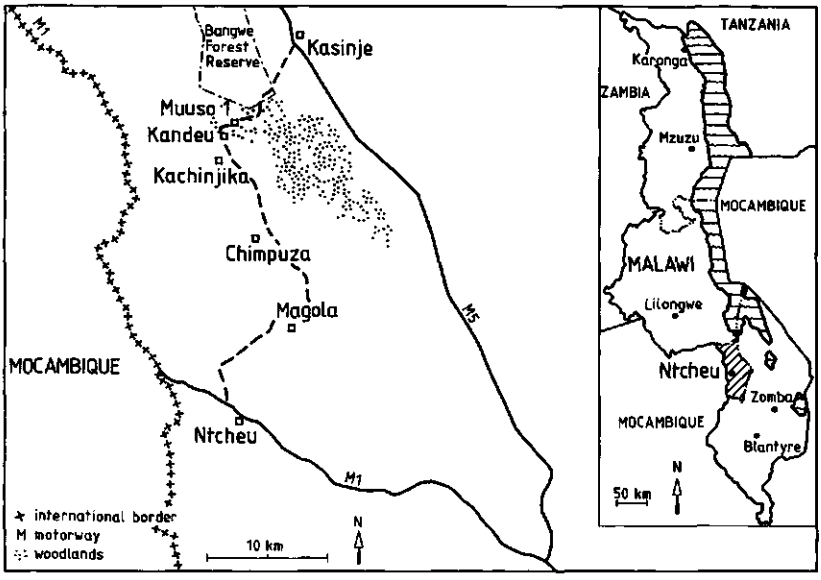

Figure 3
Map of the research area in Ntcheu District. Inset: Malawi

The household as study unit

The unit of study is the household. A household is defined as a self-sustaining unit, consisting of two or more persons who are usually related by kinship or marriage. The members of the household, whether or not (temporary) physically dispersed, contribute to its subsistence and maintenance and share in the food that is produced on a

household basis (Aarnink and Kingma 1991; Kayongo-Male and Onyango 1991). It is a socially recognized unit headed by one person, either a man or a woman, who represents the household in the village and who controls its economic and social management (Aarnink and Kingma 1991). The household is not a homogeneous and static unit. Within households individuals have different positions based on gender and age and have different rights, responsibilities and (sometimes conflicting) decision-making (Elson 1990). During the life cycle, a household may change from nuclear (including at its simplest level husband, wife and their off-spring) to extended households comprising more generations or a combination of siblings with their respective descendants (Aarnink and Kingma 1991; Kayongo-Male and Onyango 1991). In this research special emphasis is given to women, as they are responsible for fuelwood collection and food preparation, and their young children.

Brief outline of study design

The research locations are four villages situated along the (sandy) Ntcheu-Kasinje road (see Figure 3). Selection was based on distance from woodlands, being less than 1.5 km (Muuso), 2.5-3 km (Kachinjika), 4-6 km (Chimpuza) and more than 6 km (Magola) from woodlands. Following a village census, 200 households were randomly selected (50 in each village) meeting the criteria concerning permanence of residence, origin and size of household.

A baseline study was carried out in October-November 1990 in order to collect background data on household demography, farm characteristics and off-farm employment. Household coping strategies were studied in a fuel supply and fuel use study carried out in three seasons: the dry season (Oct.-Nov. 1990), the rainy season (Jan.-Mar. 1991) and the post-harvest season (Jun.-Aug. 1991). The impact of three strategies (switch to alternative fuels, increase in collection time and reduction of fuel use) were studied in three separate studies:

- a qualitative study on women's wood preferences in relation to diet composition and food preparation including cooking experiments;
- a women's time allocation study;
- a household food consumption study.

In view of the seasonality in food availability and labour demands, the latter two studies were carried out in two seasons: in the rainy season (Jan.-Mar. 1991), a period of relatively low food availability and hard agricultural fieldwork, and in the post-harvest season (Jun.-Aug. 1991), a period of sufficient food availability and moderate fieldwork. Anthropometric data were collected on a two-monthly basis, starting during the baseline study with the last data collection round in September 1991.

Besides collection of quantitative data by means of structured questionnaires, it was considered important to collect additional information in a more qualitative way to achieve a better understanding of the quantitative data. Therefore, a food ethnography among the Ngoni in January-April 1992 and a three-generation study on fuelwood shortages in January-April 1992 were carried out.

Outline of thesis

Chapter 2 provides an overview of the literature on the relationships between fuelwood availability and nutrition in rural households in developing countries. As this thesis concerns a research into fuelwood and nutrition, it is of importance to know the nutritional situation in the research area. Therefore, **Chapter 3** describes the nutritional situation of the population in the research area by means of anthropometric indicators of women and children aged 6 months to 11 years. **Chapter 4** pays attention to the lowest part of the model presented in Figure 2 of this chapter. Strategies used by rural households to cope with a decreasing fuelwood availability are described. In the next three chapters these strategies are studied further with special emphasis on their relationship with nutrition security. **Chapter 5** focuses on the responses related to the use of inferior fuels. In this chapter the wood preferences of women and the relationship with food preparation and diet composition are described. **Chapter 6** looks at the responses concerning time allocation and describes the relationship between time spent on fuelwood collection and time allocation on other (food-related) activities. **Chapter 7** investigates a third response: the reduction in fuelwood use. In this chapter the relationship between fuel consumption and food intake is explored. Finally, the findings of the various studies and their implications are discussed in **Chapter 8**. The **Appendices 1** and **2** summarize the food ethnographic study and the three-generation study.

2

Nutritional impacts of an increasing fuelwood shortage in rural households in developing countries[1]

A literature overview

Inge D. Brouwer, Leo M. Nederveen, Adel P. den Hartog, Anita H.C. Vlasveld

Abstract - *Developing countries face the problem of an increasing fuelwood shortage. For rural households, fuelwood is the main source of energy. As energy is essential to make food suitable for human consumption by means of cooking, the present fuelwood crisis could jeopardize the nutritional situation of rural households. This article reviews and analyses available data and information on the relationship between the availability of fuelwood and the nutritional situation of rural households. Based on analysis of empirical studies, three main strategies developed by rural households, especially by the women within these households, to cope with a shortage of fuelwood can be distinguished: (i) increase in time and energy spent on fuelwood collection, (ii) substitution of alternative fuels for fuelwood and (iii) economizing on the consumption of fuelwood and alternative fuels. These coping strategies affect food supply, food preservation, preparation and distribution, income generating activities and food consumption, all of which result in a decrease in quality and quantity of food consumed and in a deterioration of physical condition, especially of women and their young children. Available data on fuelwood availability and nutrition are rather diffuse and incomplete. The presence of several confounding variables in the studies analysed make it difficult to establish the nutritional impact of a growing shortage of fuelwood. Nevertheless, it is concluded that a shortage of fuelwood plays at least an important role in changes in nutritional situation of rural households. If current trends continue, this role will become more important and evident. The impact of a growing fuelwood shortage should be a point of concern for rural development.*

[1]Progress in Food and Nutrition Science 1989; 13: 349-361

Introduction

Developing countries face the problem of securing an adequate food supply for their rapidly increasing populations. In general, nutritional inadequacy arises from lack of access to resources. The inability to produce enough food and the small purchase power of the population are considered to be two of the major bottlenecks in meeting nutritional requirements.

Fuel is one of these resources. An adequate fuel supply is increasingly becoming a problem to rural households. Fuel is a basic need for man's nourishment. Fuel is essential to make food suitable for human consumption. By means of cooking, palatability and digestibility of food is improved, toxic elements and bacterial intoxication disappears and preservation is possible (Leopold and Ardey 1972; Goudsblom 1985; Pimentel and Pimentel 1985). Both quantity and quality of fuel may influence the nutritional situation of a household.

For rural households in developing countries, fuelwood is the main source of energy. More than 80 % of their energy supply is from vegetable or animal origin, especially fuelwood (Anderson and Fishwick 1984; Barnes *et al.* 1984; Eckholm *et al.* 1984; Cecelski 1987b). Of this energy, 80 % is used for cooking (Cecelski *et al.* 1979), though in cold areas, space heating also accounts for a large part of the energy consumption. Therefore, one might expect that the present fuelwood crisis in developing countries jeopardizes the nutritional situation of rural households.

Several studies have been carried out on the causes and nature of the fuelwood crisis and the resulting fuelwood shortage[1] in rural households. Deforestation is considered to be the main cause of this fuelwood crisis. Dependent on the ecological and political measures and on cultural factors, different causes of this deforestation can be distinguished, the most important being the extension of the agricultural area, over-grazing and the commercial demand for wood (Chavangi *et al.* 1985). This takes place within a context of population growth, market integration and stagnation of agricultural production. As well as causing a fuelwood shortage, deforestation also causes a decrease in soil fertility and therefore a decrease in food production (Cecelski 1987a).

According to an FAO study in 1980 , more than 100 million people live in areas with acute fuelwood scarcity and 1.3 thousand million in areas with fuelwood deficits (FAO 1981)[2]. The most affected areas are (De Montalembert and Clement 1983; Eckholm *et al.* 1984):

- Arid and semi-arid regions south of the Sahara
- Eastern and south-eastern parts of Africa
- Himalaya region in Asia

- Densely populated regions of Central America and the Caribbean.

In some regions deforestation is happening very rapidly. According to an FAO/UNEP-study, Africa looses 1.3 million hectares of forest annually (Timberlake 1985). Foley (1986) expects that fuelwood stocks will be exhausted long before the oil fields, on which the industrialized world relies, are depleted. FAO (1981) predicts that in the year 2000 the total population living in areas with an acute fuelwood scarcity and deficits will have doubled.

In developing countries fuelwood energy is essential for man's nutrition. Shortage of fuelwood can have negative effects on the nutritional situation of rural households. With regard to FAO's prediction of an increasing fuelwood shortage, possible negative consequences on the nutritional situation of rural households will become more evident in the future.

Up to now, the effects of growing shortage of fuelwood on food and nutrition have hardly been taken into account. Available data and information are hidden in studies and reports on women's work and energy use in rural households.

The aim of this paper is to review and analyse available data and information on the relation between fuelwood availability and the nutritional situation of rural households in developing countries. The paper is based on an unpublished manuscript (Nederveen and Vlasveld 1987).

Coping with a growing fuelwood shortage

To discover whether a lack of fuelwood affects the nutritional situation of a household, one needs to know what is meant by a nutritional situation and from which theoretical framework a deeper understanding of the mechanism of adjustment of elements of the nutritional situation can be obtained.

The nutritional situation of a household comprises food supply, food preservation and storage, food preparation and distribution and the consumption of food (Figure 1), resulting in a nutritional and health status of household members. The way in which households choose, use, prepare and consume the available food in reaction to the social, economic, cultural and ecological pressure is referred to as food habits and is determined by norms and values about food prevailing in a society. Every change in a society of a socio-economic, cultural or ecological nature implies changes in the nutritional situation as, for example, the introduction of cash crops or the

urbanization. Moreover, a reduction in the fuelwood availability might constitute a change in the nutritional situation.

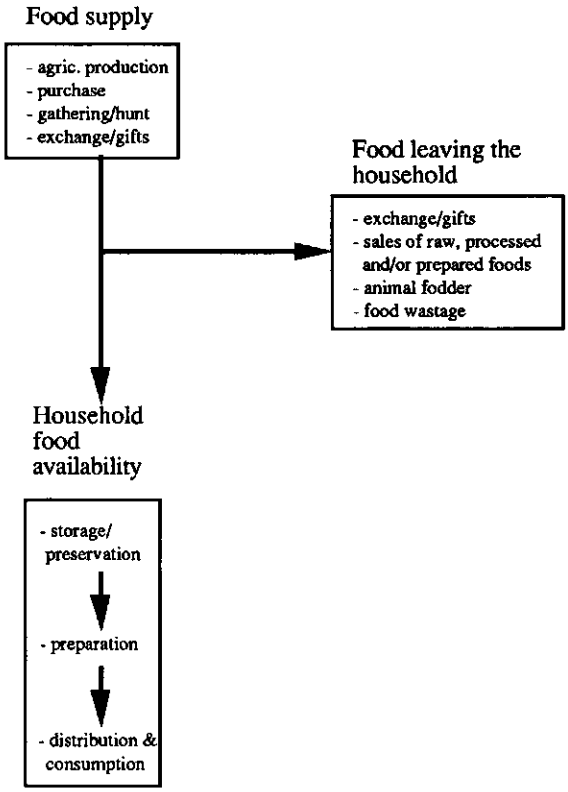

Figure 1
Nutritional situation: food flow at household level

Women play a crucial role in the nutritional situation of a household (FAO 1979) as well as in the procurement of fuelwood. Fuelwood shortage means an additional burden for women. In the first instance they will be the ones who have to decide how to cope with the problematic situation of such a shortage.

How do women cope with an emergency or stress situation? A useful theoretic framework is found in socio-psychological studies by Folkman and Lazarus (1980;

1988). Coping behaviour is any effort (cognitive and behavioural) made to manage a problematic situation (Folkman and Lazarus 1988), in this case a shortage of fuelwood. The critical determinant from which coping behaviour develops is the appraisal of the fuelwood problem. This appraisal is based on the answers to two questions: (i) What is at stake in this encounter (primary appraisal), and (ii) What can be done and what options for coping are available (secondary appraisal).

In the primary appraisal, the consequences of the fuelwood problem are evaluated. Since energy is essential for man's nutrition, the survival of the household will be considered as at stake. The primary appraisal is followed by a secondary one. Here different coping strategies at the disposal of a household are evaluated on their expected effectiveness.

The central role of coping strategies evolved in the relation between fuelwood availability and the nutritional situation, and the factors determining the coping strategies evolved are shown in Figure 2.

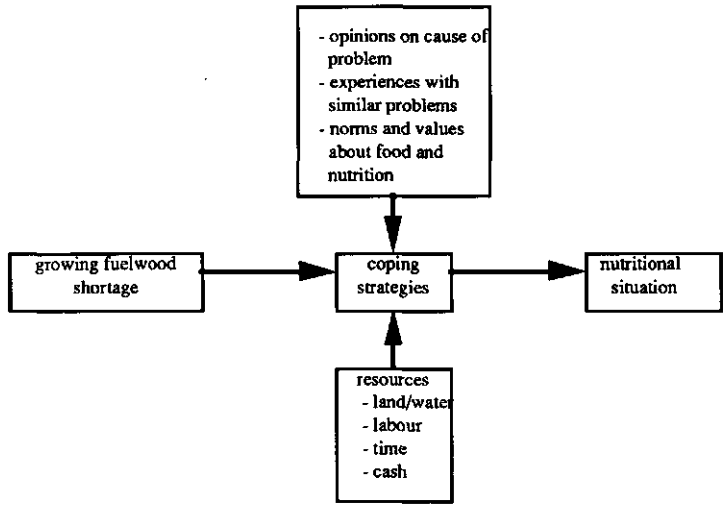

Figure 2

Factors determining the strategies evolved to cope with a growing fuelwood shortage

The options relevant to a household depend on what is considered the cause of the problem. Coping strategies are directed to altering or managing the cause of the problem, referring to what households, or in fact the women within the households, actually do in a problematic situation. Further, options for coping are determined by available household resources. In most cases, because of lack of access to resources such as land, labour and cash, it is beyond the reach of the households to alter the cause of the problem. However, since energy shortages are life-threatening, acceptance of the situation is not probable. In other words, something has to be done in order to survive. Households then adopt probably less effective coping strategies.

Here it is useful to refer to Longhurst's approach (Longhurst 1986). He distinguishes measures to prevent a stressful situation and direct measures to meet actual stress. In the case of shortage of fuelwood, the cultivation of trees can be seen as a preventive measure for altering the cause of the problem, the lack of trees on the farm. However, a household with no land, labour or cash, has to adopt more acute measures such as building up a stockpile, or in more extreme situations, the adaptation of food preparation. This paper focuses mainly on these acute strategies.

Strategies which develop, are further determined by norms and values of food and nutrition in a society and of life in general. In the adjustment of the nutritional situation as a coping strategy, people try to maintain the core of their food habits. Decreasing or omitting important and appreciated foods and meals are avoided for as long as possible. If people are forced to do so, this is experienced as a hardship.

The evaluation of the effectiveness of a strategy is also determined by experiences with the same or similar problems. If in previous situations an option has been effective, this option is favoured above other options with unknown effects.

Coping is a dynamic process. To evaluate the effectiveness of the coping strategies evolved, people re-appraise their situation and possibly change their strategies.

Fuelwood availability, women and nutrition

Based on analysis of empirical studies, the following acute coping strategies can be distinguished:

- Increase in time and energy spent on fuelwood collection;
- Substitution of alternative fuels for fuelwood;
- Economizing on the consumption of fuelwood and alternative fuels.

The first two options are attempts to maintain the total fuel supply constant and the third is an attempt to economize on the total fuel consumption.

These coping strategies have their impacts on the nutritional situation of households. Table 1 shows the elements of the nutritional situation of households mentioned in Figure 1, negatively affected by the different strategies.
It is important to realize that there is no question of a choice of options. Women have to carry through a change in order to ensure the survival of the household. Actually, features of more options at the same time will be identifiable. The next sections give examples of the different options as found in the literature.

Table 1

Elements of the nutritional situation negatively affected by different strategies evolved to cope with a shortage of fuelwood

Strategies	Food supply				Household food handling		Income generation
	prod.	purch.	hunt/ gath.	gift/ exch.	preserv/ storage	prepa- ration	
Increase time/energy spent on fuelwood collection	X				X	X	X
Substitution of fuelwood							
non-commercial	X						
commercial		X					
Reduction fuelwood consumption					X	X	X

Increase in time and energy spent on fuelwood collection

The fuelwood supply of a rural household is determined by climate and distance and the accessibility of agricultural lands and forests. Traditionally, fuelwood collection is closely related to the 'shifting-cultivation' system (Bonkoungou and Catinot 1986). Women collect fuelwood from the cleared and fallowed land, supplementing it with wood from forest land.

In regions with a decreasing fuelwood availability women have to make extra trips to collect sufficient fuelwood (Cecelski 1987a). The time women have to spend on

In regions with a decreasing fuelwood availability women have to make extra trips to collect sufficient fuelwood (Cecelski 1987a). The time women have to spend on this activity can be nearly 35 hours a week according to studies conducted in the Sahel (Hoskins 1980) and Gujarat in India (Schenk-Sandbergen 1985).

To economize on the time taken, women try to carry as much wood as possible in one load. The weight of one load of fuelwood varies from 15 to 45 kilograms (Ki-Zerbo 1981; Cecelski 1987b). A study in India has shown that collection of fuelwood, fetching water and agricultural work are the most energy-consuming activities of rural women (Batliwala 1982). If more time has to be spent on fuelwood collection, at the cost of less human energy consuming activities, then the energy requirements of women will increase (Maloiy *et al.* 1986).

An increase in time spent on collecting fuelwood might imply a shift in labour division within households. Children, especially girls, may help their mothers more often with fuelwood collection and sometimes even men may help (Howes 1985). Sometimes children are kept home from school to collect wood (FAO 1983; Eckholm *et al.* 1984). Some children who help their mothers are very young. In the Umbara Mountains in Tanzania, girls of five years old help to collect fuelwood (Fleuret and Fleuret 1978).

An increase in time and energy spent on fuelwood collection is at the cost of other activities. On the basis of several ILO-studies on women's work, Cecelski (1987a) concluded that women gave priority to activities concerned with food production and with income generation. Often women have to spend even more time than before on food production, because a fuelwood shortage is often connected with decreasing soil fertility. In spite of this priority given to activities connected with food production, there are examples of a decrease in time spent on these activities. In Senegal, a great deal of land has been brought into cultivation as a result of the introduction of peanuts as cash crops. Women now have to walk longer distances to find enough fuelwood and so have less time for domestic tasks and for maintaining homegardens. As a result, vegetable consumption decreases (Hoskins 1980).

The decision on whether or not to economize on income-generating activities depends on their profitability. If these activities are profitable, women may spend less time on food preparation, domestic tasks, personal and child care (Kumar and Hotchkiss 1988). Young children especially suffer if their mothers have less time to prepare weaning foods and less time for paying special attention to them. In general, an increase in work load can result in an increase in stress feelings among women. This

may result, for example, in a decrease in breast milk production by lactating women (Bader 1981; Kusin 1986).

Substitution of fuelwood by alternative fuels

Another way of augmenting the fuel supply is by substitution of fuelwood by other non-commercial fuels and/or commercial fuels.

Substitution by non-commercial fuels

Non-comercial fuels are defined as fuels which are freely available and do not have to be paid for. They constitute an important part of the fuel supply of rural households. The use of non-comercial fuels is strongly correlated to ecological conditions and varies per season.

In semi-forest villages in India, almost only fuelwood is used. Animal dung and agricultural residues are more important in agricultural villages (Dasgupta and Maita 1986). According to Eckholm *et al.* (1984) dung is the most important fuel in India, Pakistan and Bangladesh. In the Sahel-region, especially in the dry season, a great part of the fuel needs is covered by millet stems (Ki-Zerbo 1981).

As the availability of fuelwood decreases, the use of animal dung, agricultural residues and fuelwood of inferior quality increases. In the Sahel the stems of cotton, sesame, millet and maize are used (Hoskins 1980; Ki-Zerbo 1981; FAO 1983). In Cape Verde the use of dung, plastic bags and wood of inferior quality has increased (Van den Briel and Brouwer 1985). Where there is a severe fuelwood shortage, green branches are used or trees are cut down, even fruit, spice or foliage trees (Shanahan 1986).

The increased use of agricultural residues, animal dung and green branches and shrubs has certain disadvantages:

- Withdrawal of dung and agricultural residues from the fields results in an decrease in soil fertility and, therefore, in food production (Eckholm *et al.* 1984).
- Using trees and shrubs as fuel implies that there will be less food for cattle, resulting in a decrease in their resistance to diseases, dung production, draught force (Eckholm *et al.* 1984) and probably their milk and meat production will decrease.
- Not all agricultural residues are practical in use. They are less flexible and manageable in burning, and more attention has to be paid to providing the fire with enough fuel (Cecelski 1987b).
- The use of wet wood, wood of inferior quality and other substitutes produces more smoke than when using dry wood of good quality. This smoke in inadequately ventilated kitchens is very harmful to the health of women. According to a WHO-report (WHO 1987) this can cause chronical respiration problems and throat cancer.

The development of the foetus can also be disturbed. Children who are exposed to this smoke have a higher risk of bronchitis. A study carried out in India showed that the benzo-a-pyrene, which was inhaled by the women studies, was alone equivalent to smoking 400 cigarets a day (SNDT University, cited by Batliwala 1982).

Substitution by commercial fuels

A shortage of fuelwood results in an increase in the commercialization of traditionally freely available fuels (Eckholm *et al.* 1984; Longhurst 1986). In Ghana, for example, buying fuelwood in the rainy season costs 1 % of the household budget and 16 % in the dry season (Ardayfio 1986). Spending more money on fuelwood affects the amount of money that can be spent on food (Cecelski 1985).

Substitution of fuelwood with commercial fuels such as charcoal, paraffin, gas and electricity is not very common in rural areas. Most of these fuels are not readily obtainable. Another problem caused by switching to these fuels is the high costs of buying stoves and pans fit for the use of these fuels. However, in urban areas these fuels are more important.

Economizing on the consumption of fuelwood

Fuelwood is used in food preparation, income generating activities, space heating and for hygienic activities. In the first instance excessive use of fuelwood is omitted. For example, women extinguish the cooking fire immediately after the preparation of a meal, or food is cooked using a lid to cover the cooking pot.

Since 80 % of household fuel energy consumption is used for cooking (Cecelski *et al.* 1979), it can be expected that women will try to economize on the consumption of fuelwood by adapting the food preparation and by changing to foods which need less cooking. In India, a possible adaptation in the food preparation is cooking more food than is needed for one meal and warming up a part of it when needed (Dasgupta and Maita 1986). Another study in India, carried out among landless women, shows a decrease in the number of meals per day from three to one (Schenk-Sandbergen 1985). This has also been observed in Rwanda (Lidju and Bamuhiga, cited by Cecelski 1985).

In Senegal, because of lack of fuelwood, cold left-overs or uncooked millet flour mixed with water are eaten (Hoskins 1980). Preparing fewer meals and eating cold or warmed up left-overs of food has also been observed in the Sahel, Haiti (Eckholm *et al.* 1984; Cecelski 1987b), Eçuador (Eckholm *et al.* 1984), Peru (Alcántara 1986) and Nepal (Cecelski 1987c). Keeping prepared food at high (tropical) temperatures, causes a fast increase of micro-organisms in food (Kusin *et al.* 1988). A

decrease in the number of meals eaten per day is especially critical for young children whose breast-feeding needs to be supplemented from the age of 4-6 months. These weaning foods have to be given four to five times per day, because the stomach of young children is too small to meet the daily nutrient needs in two or three meals (FAO 1979; Kusin and van Steenbergen 1986).

Further, cooking foods insufficiently causes problems in palatability and digestibility (Leopold and Ardey 1972; Goudsblom 1985; Pimentel and Pimentel 1985) and can cause intestinal infections. Cereals and pulses are surrounded by a cellulose layer which is opened during cooking, facilitating the intestinal absorption. Some pulses, such as peanuts and soya-beans, contain trypsine-inhibitors which prevent the absorption of proteins. Cooking destroys these trypsine inhibitors (Davidson *et al.* 1979).

Most traditional foods need much energy to prepare. Table 2 gives a review of the energy needed to prepare some common foods. There are different examples of changing food choice resulting partly from fuelwood shortage. In Mexico and Guatemala the consumption of brown beans has decreased (Hoskins 1980; Alcántara 1986; Cecelski 1987c), in Nepal the consumption of uncooked foods has increased (Hoskins 1980; Ardayfio 1986), in Mali a change from many-pot meals to one-pot meals has been observed (Alcántara 1986). According to Hoskins (1980) and Eckholm *et al.* (1984) the introduction of soya beans as an agricultural cash crop in Burkina Faso has failed because of the long time needed to cook them.

Table 2

Energy needed to prepare some common foods

Foods	Preparation energy (kJ/kg)
Rice	3065
Chapati	2986
Tortilla (Mexico)	50.000
Brown beans (Mexico)	300.000
Injera pancake (Ethiopia)	62.500
Dolo-beer (Burkina Faso)	21.000
Potatoes	1603
Meat	5427
Fish	2713

source: (Cecelski 1985), adapted

The most important dish in Kenya is isio, a mixture of cooked maize and different kinds of beans. Isio takes three to four hours to cook. The tendency to substitute isio by ugali, a thick porridge of maize flour and millet cooked in water with a shorter cooking time of about one hour, has been observed (Hosier 1984; Mildeberger 1986; Van Wijngaarden 1984). In Cape Verde the consumption of maize and beans has decreased in favour of the consumption of potatoes and vegetables (Van den Briel and Brouwer 1985). In Sri Lanka one rice meal per day is sometimes substituted by bread, bought in a bakery (Shanahan 1986).

In many developing countries the consumption of snacks, sweets and fruits has increased, because it is cheaper to purchase these foods than to cook oneself due to the high price of fuelwood. However, these changes are not only a result of a shortage of fuelwood, but also of urbanization, changing working patterns and the presence of children in the household, who are going to school. In Mexico this has led to an increase in the consumption of ready made tortillas and white bread (Evans 1984).

Analysis of material show, that in rural households a shortage of fuelwood may cause the following changes in food choice:

- Substitution of pulses and whole cereals for ground cereals or cereals which need less cooking energy;
- Increase of consumption of snacks, ready-made foods, soft drinks, sweets and fruits.

Pulses and whole grains are important for their vitamin B and protein content. Combined, the amino acids of both foods supplement each other, resulting in a protein mixture of high quality (Latham 1979). Substitution of pulses and whole grains for ground grains may endanger vitamin B and energy intake. The composition of side dishes then becomes important as they can compensate for these nutrient shortages.

An increase in the consumption of snacks, ready-made foods, sweets and fruits does not necessary imply a decrease in the quality of food consumption. In a study carried out in Ghana (Ardayfio 1986) traditional meals were substituted by locally bought fruits and traditional snacks, whose nutritional value did not differ from that of the traditional meals. In Mexico, Evans (1984) found that traditional nutritious meals were being substituted by ready-made foods such as white bread, sweets and soft drinks, which resulted in a decrease in nutrient intake.

As income generating activities often require much fuel and where there is a fuelwood shortage, women may decide to economize on its use in these activities. In Nepal women produce fewer pots and prepare less food for selling as snacks than before (Hoskins 1980). In West Africa the production of dolo-beer declines (Cecelski 1985).

In Ghana the fuelwood shortage has caused a decrease in fish smoking, making *gari* from cassava and producing palm oil from palm nuts. Also the preparation of *akplidzi* (a dish prepared from maize flour and different kinds of vegetables and fish) has also decreased because of a lack of fuelwood, in combination with a lack of time. Women used to prepare akplidzi 6 times a week for sale and this constituted an important source of income. Nowadays only women who have enough fuelwood are able to prepare and sell *akplidzi*. They have been able to expand their market (Ardayfio 1986).

Besides economizing on the consumption of fuelwood in food preparation and income generating activities, women also economize on its use in space heating and hygienic activities. Less space heating may increase energy needs to maintain the body temperature (WHO 1985). Combined with an increase in time spent on physical activities, the energy requirements of household members will increase. These higher needs will often not be compensated for by an increase in food consumption, resulting in a negative energy balance and, hence, a decrease in physical condition and/or malnutrition of household members. As a result of inflammations of wounds not hygienically treated with warm water and intestinal infections resulting from drinking unboiled water and eating with dirty hands from insufficiently cleaned plates, the physical condition of household members will be further jeopardized.

Discussion and concluding remarks

As already shown, strategies evolved to cope with a growing fuelwood shortage can jeopardize the nutritional situation of households. Figure 3 summarizes the nutritional and health implications of the three main coping strategies.

Some implications could be the result of more than one strategy. For example, a decrease in the frequency of food preparation could be the result of economizing on fuelwood use in cooking, but it could also be the result of an increase in time expenditures on fuelwood collection. On the other hand, some strategies have contrary effects. Substitution of freely gathered fuelwood with fuels which have to be purchased, is likely to reduce the purchase of foods, whereas economizing on fuelwood use could result in an increase of food purchases. In general households and especially women, develop strategies according to the availability of different resources (see Figure 2). A poor household only shifts to the purchase of food when there is no

alternative and when the cost of food purchases are less than the cost of preparing the food itself. A rich household will probably switch more quickly to buying food.

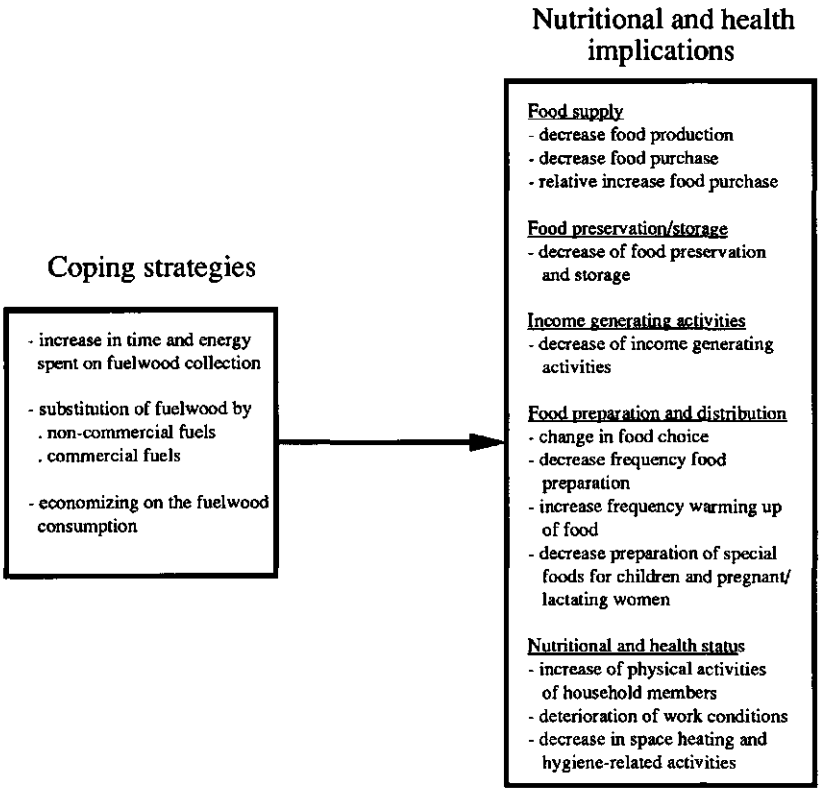

Figure 3
Household strategies to cope with a growing fuelwood shortage and their nutritional and health implications

After analysing the available literature on the relation between fuelwood availability and nutrition in rural households, the conclusion can be drawn that a shortage of fuelwood results in a decrease in quality and quantity of foods consumed and a deterioration in the physical condition of members of the household, especially women and their young children. Vitamin B, protein and energy intake seem to be

especially at risk, and this is aggravated by an increase of requirements caused by an increase in physical activities and in the prevalence of diseases.

However, some qualifications should be made. Despite the reasonable amount of information available on the results of a fuelwood shortage on activities of women especially and thus on the nutritional situation of rural households, almost none of the studies concerned indicate a direct relation between fuelwood availability and nutrition. This relation has never been studied as such and available data are rather diffuse and incomplete. This means that little is known about the influences of, for example, an adaptation of a certain food preparation on the total nutritional situation of a household.

Further, the interpretation of the described changes is hampered because the studies analysed show a number of methodological problems caused by the presence of various confounding variables. Quantitative changes in food consumption may result from a shortage of fuelwood, but more probably from a shortage of food. Most of the studies analysed have been carried out in areas where both food supply and fuelwood supply are problems. Because of this joint appearance (Cecelski 1987a), it is hard to avoid an intertwinement of effects.

Likewise qualitative changes in food consumption are not only caused by a fuelwood shortage, but can also result from a general trend in food habits influenced by processes of urbanization, market integration and changes in activities of women and other household members.

The existence of these confounding variables hampers the establishment of the nutritional impacts of a fuelwood shortage. Nevertheless, this shortage does play at least an important role in the described changes and many negative trends in food habits can be made worse by such as shortage.

With regard to the FAO-prediction that in the year 2000 the total population living in areas with acute fuelwood scarcity and deficits will have doubled (FAO 1981), the role of fuelwood in changing food habits will certainly be more important in the future. Possible negative consequences of a fuelwood shortage on the nutritional situation of rural households will become more evident. The impact of a shortage of fuelwood can be considered as a nutritional problem and should be a point of concern for rural development.

Nutrition and health projects should take full account of the growing shortage of fuelwood when certain food preparations or hygiene-related activities are recommended. When introducing a new crop, agricultural projects should take into consideration the consequences on fuelwood use in cooking these crops and on work load of women. Project planners should also be aware of the fact that agricultural land not only has the function of cultivating crops, but also cultivating fuel. A shortage of

fuelwood means that a compromise has to be made between agricultural, ecological, nutritional and women's aims.

Notes

1. Fuelwood shortage in the household is defined by both the quantity of fuelwood available for household use and the way it is used. The quantity available is determined by the relative level of costs (in labour/time and/or cash) for obtaining fuelwood and the actual quantity of wood used by the household. The way of use includes type, source and quality of fuelwood used throughout the year. For example, relative high costs for obtaining fuelwood and/or a low quality of wood used indicates a shortage of fuelwood in the household.
2. FAO defines a situation of acute fuelwood scarcity as a situation in which the minimum fuelwood needs exceed the fuelwood supply, even when existing resources are overcut. A situation of fuelwood deficits is defined as a situation in which the minimum fuelwood needs can only be met by overcutting and overexploiting existing resources. In contrast with the concept of fuelwood shortage, these definitions only take into account negative consequences for the ecology.

3

Seasonal variations in the nutritional status of women and children under five, and growth performance of 6-10 year old children in Malawi

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Abstract - *Seasonal variations in nutritional status of women and children under five and growth performance of 6-10 year old children living under unimodal climatic conditions in rural Malawi were studied from November 1990 to November 1991. Post-harvest weight gain of women was 7.1 % of their mean yearly body weight. In the pre-harvest season (March) approximately 10 % had BMI values below 17 kg/m^2 of which 4.2 % had values below 16 kg/m^2. This indicates that the women experienced severe seasonal stress. For children under five, wasting was only prevalent in the 6-24 months age group and weight-for-height showed a minimum in March for both the 6-24 months (-1.2 ± 1.4) and the 24-60 months (-0.3 ± 0.9) age groups. For the 6-24 months age group, height-for age decreased from -1.9 to -2.5 SD from November to March and remained at this low level during the next months. For the 24-60 months height-for-age did not show seasonal changes, but stayed on average -2.5 SD. For the 6-10 year old children prevalence of stunting increased during the year of follow-up and also increased with age. A height increment less than -2 SD was observed for boys aged 10 years and girls aged 9 and 10 years.*

Introduction

Food security exists when households have access to enough food needed for a healthy and active life for all household members at all times (FAO/WHO 1992c). Together with sufficient health conditions and adequate maternal and child care, food security leads to nutrition security of the individual household members (Maxwell and Frankenberger 1992). Nutritional status of the population, as measured by anthropometry, is considered a biological outcome of the level of nutrition security (Frankenberger *et al.* 1993). Anthropometric measurements are sensitive measures of nutrition security, although they are not very specific. The existence of malnutrition in a population signals that some aspect(s) of nutrition security are sub optimal but does not specify which one(s) (Dowler *et al.* 1982; Beaton *et al.* 1990; Pelletier *et al.* 1991).

Seasonal food shortages are an annual recurrent event in many developing countries and cause seasonal fluctuations in the level of nutrition security (Ferro-Luzzi *et al.* 1990; Schultink 1991). Especially in areas with an unimodal climate where food production is mainly rainfed, people are dependent on only one harvest a year following one rainy season (Foeken and Hoorweg 1988). The periods of low food availability coincide with a peak in agricultural field work, accompanied with strenuous physical activity (Bleiberg *et al.* 1980; Brun *et al.* 1981; Teokul *et al.* 1986; Ferro-Luzzi *et al.* 1987; Ategbo 1993; van Liere 1993). Together, seasonal variations in food availability and physical activity patterns cause seasonal fluctuation in nutritional status in both adults and children (Teokul *et al.* 1986; Dugdale and Payne 1987; Ferro-Luzzi *et al.* 1987; Schultink 1990; Ategbo 1993). In addition, the prevalence of infectious diseases such as malaria and diarrhoea is highest during the rainy season thus adding to nutritional stress (Rowland *et al.* 1977; Loutan and Lamotte 1984; Tomkins *et al.* 1986; Lindskog *et al.* 1987; Schelp *et al.* 1990; Herrmann *et al.* 1991; Maneelert 1992).

Average body weight loss for adults due to seasonal variation in food availability has been reported to vary from 2 to 5 % of the average body weight (Pagezy 1982; Ferro-Luzzi *et al.* 1987; Durnin *et al.* 1990; Ferro-Luzzi 1990; Schultink 1991). These limited changes in body weight are explained by the fact that most of the reported studies were carried out under conditions of moderate seasonal variations in food availability as it occurs in bimodal climates (Ferro-Luzzi *et al.* 1987; Ferro-Luzzi *et al.* 1990; Schultink 1991). Effects of seasonal fluctuations in food availability on body weight were expected to be more pronounced under unimodal conditions. A study in north-western Benin, a region with a single cropping season in a year, showed an average weight loss of 3 to 4 kg, being 5-6 % of mean yearly body weight (Ategbo 1993).

Children are likely to experience seasonal stress which may effect their growth performance. However, data on the growth patterns of children regularly experiencing seasonal food shortage, is limited (Tomkins *et al.* 1986; Maneelert 1992; Ategbo 1993). A recent longitudinal study on the effects of repeated seasonality on 2 to 6 year old Beninese children showed a significant decrease in the yearly growth rate, leading to a prevalence of stunting of 30 % (Ategbo 1993).

The objective of the present paper is to look into the extent to which seasonality affects body weight fluctuations of women, nutritional status of children under five and growth performance of 6-10 year old children in Malawi.

Subjects and methods

Background information

Data in this paper originate from three separate studies carried out during 1990-1991 in Ntcheu District among women and children belonging to the Ngoni ethnic group. The three studies were approved by the National Research Council of Malawi in July 1990. The first research project aimed at describing and analysing the relationship between fuelwood availability and nutrition of rural households. The second project studied the effects of iodine and/or iron supplementation on the mental and psychomotor performance and the physical development of school children in an iodine-deficient part of Ntcheu District. The third study focused on absorption and retention of oral iodized oil administration for control and prevention of iodine deficiency disorders. As part of these three studies, anthropometric measurements were taken on a regularly basis during the period November 1990-November 1991.

Study area

The three separate studies were simultaneously carried out in Ntcheu District, Central Region, Malawi. This district is situated along the main traffic road (M1), leading from the upper north of the country to the south, at an altitude of 900 m. Vegetation consists largely of woodland savanna with an annual precipitation of 900 mm. concentrated in the rainy season. Daily temperatures vary from 18^{o} C in July to 36^{o} C in October. The population is mainly dependent on smallholder agriculture for food. The most widely cultivated food crop is maize (*Zea mays*), often mixed with finger millet (*Eleusine coracana*), pulses, groundnuts (*Arachis hypogea*) and vegetables. The rainy season from November till April is a period characterized by a low food availability, a higher incidence of diseases and heavy labour demands in agricultural fieldwork. Most of this

field work is done by hand and the traditional hoe. During the cold dry season from April till August, cereals are harvested. The typical adult diet is composed of maize flour as a thick porridge (*nsima*) served with a relish of vegetables and, less frequent, of pulses, meat or fish. Children are breastfed for about 12-18 months; bottle-feeding is not practiced. Breast milk is supplemented with a thin, local, maize porridge from approximately 3 months of age. At about 9 months a child is given *nsima* and by 18 months, the diets of children are the same as those of adults.

Study design and subjects

Study 1

The study on fuelwood availability and nutrition was carried out in four villages, selected on distance to woodlands. Following a village census, two hundred households were randomly selected (50 in each village) meeting criteria concerning permanent residence, origin and size of household. During a baseline study in October/November 1990, anthropometric measurements were taken of all women (n=268) and children under five (n=204) of the 200 households. A group of 120 households was randomly selected for anthropometric follow-up on a two-monthly basis, with the last data collection in September 1991.

Studies 2 and 3

Subjects from the second (n=446) and third (n=504) study were selected out of 6-8 year and 8-10 year old school children respectively, attending primary schools in the northern part of Ntcheu District. The schools were selected on the basis of a sufficient number of attending pupils, highest prevalence of goiter and their accessibility. Only apparently healthy children were considered suitable for entry into these studies. Informed consent of all subjects was obtained from parents or guardians before the onset of the study. Data collection started in October/November 1990 with a baseline study. Other collection rounds for the 8-10 year old children were in January, April, June, October and November 1991. The children aged 6 to 8 were only measured twice (November 1990 and November 1991).

Anthropometry

Anthropometric measurements took place between 8.00 and 11.00 a.m. at a central place in each village (study 1) or at school during the morning hours (study 2 and 3). Weight and height were measured using standard methods as described by Jelliffe and Jelliffe (1989).

Weight was measured at each data collection round, using Tefal weighing scales with a digital display and attached to a wooden board. The balances were calibrated at every weighing session using test weights. The subjects wore a minimum of clothing and no shoes, and body weight was measured to the nearest 0.1 kg (no correction was made for the clothing which was virtually the same throughout all weighing sessions). Small children who were not able to stand alone on the scale were weighed while carried by their mother or caretaker; their weight being calculated as the difference of measurements with and without child.

Height measurements of women were taken during the baseline study only. Height of children was measured at each data collection round. Heights of women and children over two were measured while standing in a horizontal position against a wooden board using a portable microtoise. Lengths of children under two were measured while lying down using a foldable board with a fixed head-rest, a detachable foot-rest and a fixed tape measure.

Data analysis and statistics

All data were analysed by means of SPSS-PC 4.0 software (Norusis 1990).

Women

For analysis women were selected using the following criteria: age between 18 and 60 years, non-pregnant with exception for pregnancy of maximal two months in the last data collection round. Individuals with two or more missing values in one of the data collection rounds were excluded from analysis. This resulted in a study population of 100 women.

For each measurement round mean and standard deviation (SD) was calculated for age (years), weight (kg) and height (cm). From height and body weight measurements, body mass index (BMI) was calculated as ratio of body weight (kg) and squared height (m^2). The women were classified in categories of BMI using the cut-off points 16, 17, 18.5 and 25 kg/m^2 as suggested by James *et al.* (1988) and Ferro-Luzzi *et al.* (1992). Group averages for body weight per measurement round were used to define the minimum and maximum values for individual body weight. Minimum and maximum periods were likewise defined as the weight measured in March 1991 (pre-harvest) and in September 1991 (post-harvest). For individuals, absolute post-harvest weight gain (kg) was calculated as the difference in weight between these two periods. Body weight fluctuation was also expressed as a percentage of the average annual body weight (%).

Children

Individuals with missing values for identification number, age and sex or with one or more missing values for height or weight in one of the data collection rounds were excluded for further analysis. This resulted in a study population of 1025 children at the baseline. For this study population the mean and standard deviation (SD) was calculated for age (months), weight (kg), height (cm) and for the z-scores for weight-for-height (WHZ) and height-for-age (HAZ) using the NCHS/CDC population as reference (Waterlow *et al.* 1977; WHO 1986). Prevalence of wasting and stunting were based on cut-off points of -2 z-scores (WHO 1983).

For the children under five the z-scores for weight-for-height (WHZ) and height-for-age (HAZ) were calculated in a 6-24 months and 24-60 months age group over all six measurement rounds. For the 6-10 year old children z-scores for weight-for-height and height-for-age and percentages of wasted and stunted children were compared between November 1990 and November 1991, for the 6-7 years, 8-9 years and 10 years age group. The yearly weight and height gain were calculated as the difference between the measurement in these periods, and were compared to the NCHS reference population (WHO 1983).

Results

Baseline

The anthropometric characteristics for both women and children at the onset of the study are shown in Table 1. In November 1990 women showed a mean (± SD) weight of 52.3 ± 7.9 kg and BMI of 21.2 ± 2.8 kg/m^2. Table 2 shows that 3 % of the women had a BMI value lower than 17 kg/m^2, which level constitutes a substantial risk to health (James *et al.* 1988).

Among the children in the five age groups, the prevalence of wasting (WHZ < -2) decreased with age from 5.8 % in the 6-24 months age group to 0 % among the 24-60 months old in November 1990. Stunting, however, showed an increase with age from 44.2 % (6-24 months) to 65 % (24-60 months). The percentage of stunted children between 6-10 years was approximately 30 %.

Seasonal variation in nutritional status

The mean yearly body weight of women, averaged over the six measurement rounds, was 52.0 ± 7.8 kg. Deviations from this mean yearly weight are shown in Figure 1.

Table 1

Anthropometric characteristics of women and 6 months to 10 years old children in November 1990, Ntcheu District, Malawi†

	Women	Children				
	18-60 year	6-24 months	24-60 months	6-7 year	8-9 year	10 year
Number	100	52	100	274	428	171
Age (year/month)	37.2 (11.9)	13.8 (4.7)	41.0 (9.5)	84.7 (6.8)	107.5 (7.4)	125.5 (3.2)
Weight (kg)	52.3 (7.9)	8.1 (1.7)	12.8 (2.0)	19.7 (2.7)	23.7 (3.4)	26.5 (3.8)
Height (cm)	157.0 (5.6)	71.3 (5.0)	87.7 (7.0)	114.3 (6.6)	123.0 (6.9)	130.1 (7.0)
BMI* (kg/m^2)	21.0 (2.8)					
WHZ**		-0.9 (0.8)	-0.1 (0.8)	-0.3 (0.8)	-0.1 (0.9)	-0.3 (0.7)
% wasted#		5.8	1.0	1.8	0.7	0.0
HAZ***		-1.9 (1.1)	-2.5 (1.2)	-1.3 (1.2)	-1.5 (1.0)	-1.7 (1.0)
% stunted#		44.2	65.0	27.0	29.6	35.2

† mean (standard deviation)
* Body Mass Index
** Weight-for-height z-score
*** Height-for-age z-score
# < -2 standard deviations

In March, the absolute decrease from the mean yearly weight was 2.2 ± 1.4 kg, corresponding to a relative decrease of 4.3 %. The highest increase relative to the mean yearly weight was measured in September, 1.5 ± 1.4 kg (2.8 % of mean yearly body weight). Post-harvest weight gain of the women in this study was 3.7 ± 2.5 kg (7.1 % of the mean yearly body weight).

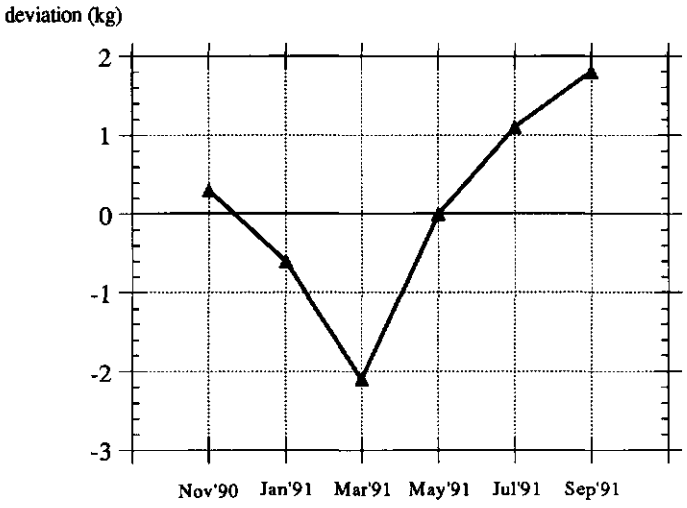

Figure 1

Absolute deviation from mean yearly weight among women as measured between November 1990 and September 1991, Ntcheu District, Malawi.

Table 2 gives the distribution of BMI for three different measurement rounds. In September 1% of the women showed a BMI value lower than 17 kg/m^2, in March this percentage was approximately 10% of which 4% had values below 16 kg/m^2.

Mean body weights of children under five between November 1990 and September 1991 are shown in Figure 2. In both the 6-24 months and the 24-60 months age groups mean body weights showed an increase in every following measurement round except for March.

Table 2

Cumulative percentages of Body Mass Index (BMI) distribution among women (18-59 y) in three different months, Ntcheu District, Malawi

BMI* (kg/m^2)	Nov 1990		Mrch 1991		Sept 1991		degree of CED**
	n	Cum %	n	Cum %	n	Cum %	
<16	2	2.1	4	4.2	0	0.0	grade 3
16 -17	1	3.2	5	9.5	1	1.0	grade 2
17 -18.5	11	14.8	17	27.4	6	7.2	grade 1
18.5 -25	76	94.8	64	94.7	82	91.8	normal
>25	5	100.0	5	100.0	8	100.0	obese

* Cut-off values according to James *et al.* (1988) and Ferro-Luzzi *et al.* (1992)
** chronic energy deficiency (James *et al.* 1988)

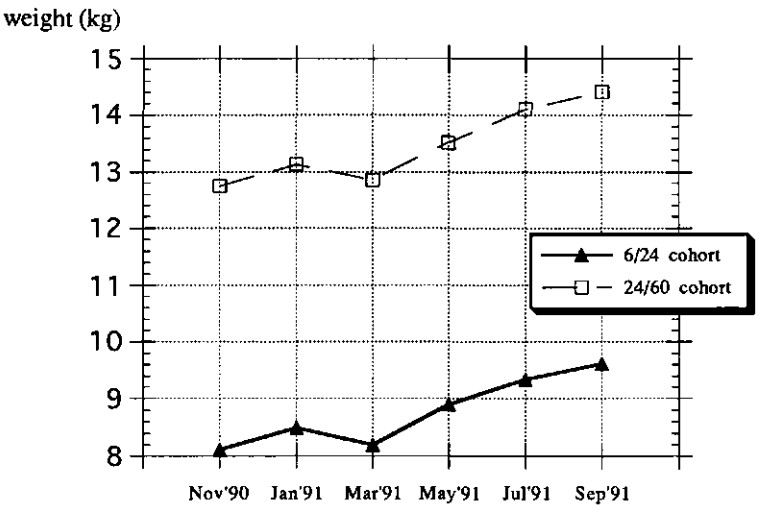

Figure 2

Body weight among children under five between November 1990 and September 1991, Ntcheu District, Malawi

For the children under five years of age, HAZ and WHZ were calculated for every measurement round (Figure 3). In the 6-24 months age group the HAZ decreased from -1.9 ±1.1 in November 1990 to -2.6 ±1.0 in September 1991. In the 24-60 months age group the HAZ remained stable at around -2.5. Mean WHZ in both 6-24 and 24-60 months age groups showed a decrease of 0.3 from November to March followed by an increase of 0.5 to September. Wasting was only prevalent in the 6-24 months age group and reached a maximum of 29 % in March.

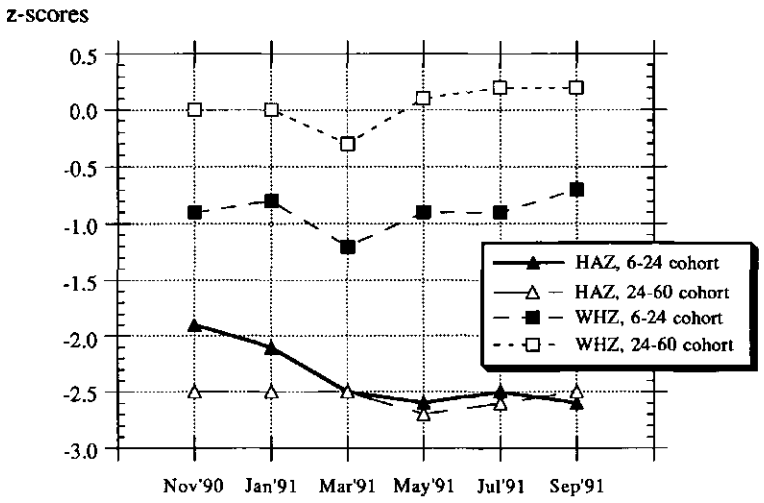

Figure 3

Z-scores for height-for-age (HAZ) and weight-for-height (WHZ) among children under five between November 1990 and September 1991, Ntcheu District, Malawi

Growth performance

The yearly gain in weight (kg/year) and height (cm/year) of 6 to 10 year old children over each year of life are shown in Table 3. For boys and girls, the yearly weight gain increased with age. For all ages, average weight gain of boys and girls were lower than the median weight gain of the reference population, but higher than the weight gains derived from the median minus 2 SD. In the reference population girls gain more weight (in kg/year) than boys from the age of 7. In the present study this difference in weight gain between boys and girls appeared at the age of 9.

Table 3

Yearly gain in weight and height of boys and girls aged 6-10 years from November 1990 to November 1991, Ntcheu District, Malawi.

	Year of life	n	Weight increment (kg/year) Ntcheu*	NCHS Median†	NCHS -2SD¥	Height increment (cm/year) Ntcheu*	NCHS Median†	NCHS -2SD¥
Boys								
	7	44	2.0 (0.7)	2.2	1.6	5.3 (1.3)	5.6	5.1
	8	57	2.0 (0.6)	2.4	1.5	5.4 (1.3)	5.3	4.8
	9	87	2.0 (1.1)	2.8	1.4	4.8 (1.2)	5.2	4.5
	10	72	2.4 (0.8)	3.3	1.6	4.6 (1.2)	5.3	4.5
	11	61	2.3 (0.7)	3.9	2.0	4.2 (1.2)	5.8	4.6
Girls								
	7	40	1.7 (1.0)	2.3	1.3	5.3 (1.5)	6.0	4.8
	8	54	1.9 (0.9)	3.0	1.6	5.2 (1.4)	5.8	4.7
	9	78	2.2 (1.2)	3.7	1.8	5.1 (1.2)	5.8	4.9
	10	75	2.5 (0.9)	4.0	2.2	5.0 (1.0)	6.1	5.4
	11	54	2.8 (1.0)	4.5	2.6	5.2 (1.0)	6.5	6.3

* mean (standard deviation)
† Weight or height increment as derived from median of NCHS population
¥ Weight or height increment as derived from median -2 standard deviations of NCHS population

For boys the yearly height increase declined with age, whereas for girls the height increment remained stable. For all ages, average height gain of boys and girls were lower than the median height gain of the reference population. Ten year old boys in our study showed a mean height increment below -2 SD of the reference population

(4.2 cm/year compared to 4.6 cm/year). For girls, a height increment less than -2 SD of the reference population was observed for the 9 year old (5.0 cm/year) and 10 year old subjects (5.2 cm/year). As shown for the NCHS reference population, a decrease in height increments for boys and girls from 7 to 9 years was followed by an increase in height increments. This pattern of increased height gain starting at the age of 9 was not observed in this study population.

For November 1990 and November 1991 the mean HAZ and the prevalence of stunting for boys and girls aged 6 to 10 years were calculated (Table 4). Prevalence of stunting was high (between 23 and 45 % of the children studied) and increased with age for both sexes (31.2 % to 35.9 % for boys, and 22.6 % to 30.4 % for girls in November 1990, the same is true for November 1991). In the 6-7 years age group the prevalence of stunting for both boys and girls decreased in November 1991 as compared to November 1990, whereas in the 8-9 years group the percentages stayed approximately the same after one year. However, among the 10 year old children prevalence of stunting increased from November 1990 to November 1991 for boys (from 35.9 % to 45.2 %) and girls (from 30.4 % to 42.0 %).

The mean WHZ and the prevalence of wasting for boys and girls aged 6 to 10 years did not change with age and did not show differences between November 1990 and November 1991 (data not shown here).

Table 4

Z-scores for height-for-age and percentages of stunted boys and girls aged 6-10 years in November 1990 and November 1991, Ntcheu District, Malawi

		n	Nov 1990*	<-2 sd**	Nov 1991	<-2 sd
6-7 y group	girls	94	-1.2 (1.2)	22.6	-1.3 (1.0)	19.4
	boys	101	-1.5 (1.2)	31.2	-1.4 (1.1)	22.8
8-9 y group	girls	153	-1.4 (1.0)	25.2	-1.5 (0.9)	25.5
	boys	159	-1.6 (1.1)	33.2	-1.6 (1.0)	33.5
10 y group	girls	54	-1.6 (1.0)	30.4	-1.8 (1.2)	42.9
	boys	61	-1.6 (1.1)	35.9	-1.9 (1.0)	45.2

* mean (standard deviation)
** Percentage of children with a z-score for weight-for-age <-2 SD

Discussion

The present study was carried out in Ntcheu District, an area which has one harvest per year. The study was carried out during 1990-1991, a year with poor rains and, hence, lower harvest yields. As a consequence, in 95 % of the households food stores were already depleted in February; in average years under normal conditions this figure is 48 % in this month (Brouwer 1992). This gives reason to suppose that seasonal food shortages and, hence, seasonality in nutritional status were more pronounced compared to other years.

Women

Mean body weight of the women during the pre-harvest season (March 1991) was 3.7 ± 2.5 kg lower than during the post-harvest season in September 1991, corresponding to 7.1 % of the mean yearly body weight in 1991. Another study in Malawi showed a comparable weight change between seasons of 4.2 kg (8 % of yearly mean body weight) among tobacco farmers. The same study reported a weight change of 1.9 kg (3 %) among subsistence farmers (Beckerson 1983). The reduction in body weight found in the present study is greater compared to those reported for other rural African populations living in areas with one rainy season. Ategbo (1993) found that women living under unimodal climatic conditions showed post-harvest weight gains of 2.8, 1.8 and 1.4 kg (corresponding to 5.6 %, 3.6 % and 2.8 % of mean yearly body weight) in 1989, 1990 and 1991 respectively. Loutan and Lamotte (1984) reported a weight loss of 2.4 ± 2.7 kg for women (4.6 % of body weight) for a nomadic population in Niger. Smaller body weight losses during the pre-harvest season, varying from 1.5 to 2 kg, were reported for Burkina Faso, Senegal and Gambia (Bleiberg *et al.* 1980; Prentice *et al.* 1981; Rosetta 1986). Body weight losses during pre-harvest season were reflected in BMI, which decreased during the pre-harvest season. In March 1991 almost 10 % of the women was found to have a BMI below 17 kg/m^2; even 4.2 % of the women had a BMI value below 16 kg/m^2.

The high yearly body weight fluctuation of 7.1 % in 1991 and the high percentage of women with a BMI lower than 17 kg/m^2 indicates a significant seasonal stress on women's body weight in Ntcheu District, Malawi. The reduction of body weight during the rainy season is due to a combination of factors, including food shortages at household level, a higher incidence of diseases such as malaria, and the high labour demands in agriculture (Quinn *et al.* 1990; Sijm 1990). Unfortunately, the health histories of the women are not known, therefore the relation between health and seasonality could not be fully studied.

Children

The nutritional situation of children in the present study clearly demonstrated the widespread problem of nutrition insecurity. Wasting, which reflects current nutritional status, was only prevalent in the 6-24 months age group. Lindskog *et al.* (1987) reported in a study among underfives in Central Malawi, that wasting sharply increased from 6 to 18 months, which did not improve until after the age of 2 years. Among the underfives, WHZ showed significant differences between the pre-harvest and the post-harvest season, which is also shown by studies in other African countries (Tomkins *et al.* 1986; Niemeijer *et al.* 1991; Ategbo 1993).

Stunting indicates failure to develop one's full genetic potential for physical growth and reflects chronic and repeated periods of nutrition insecurity. The proportion of stunting in the 6-60 months age group was between 44-65 %. This level of stunting is comparable to that reported in other studies in Malawi (Beckerson 1983; Malawi Government 1984; Ounpuu 1988). The present study showed a sharp decrease in HAZ among children younger than 2 years, whereas older children showed a low but stable z-score. These results are comparable to those found in studies in Malawi and other African countries. Lindskog *et al.* (1987) reported a progressively deterioration of HAZ after the age of 6 months until 2 years, whereafter the HAZ remained unchanged. Also Tomkins *et al.* (1986) reported that the growth of young children in the Gambia proceeded at consistently slower rate than expected from the international standards. By the age of three years, average height was approximately minus 2 SD below 'normal'. Niemeijer *et al* (1991) also showed in Kenya a continuously deterioration in height-for-age among the youngest children, whereas children of 24 months and older showed a rather stable HAZ.

Among the 6-10 year old children the prevalence of stunting increased with age for both sexes. The percentage of stunted children in this age group is, however, lower as compared to the 6-60 months age group. This may be partly explained by the fact that the 6-10 year old children were selected among apparently healthy primary school children, who probably represent the most healthy part of the total 6-10 year population.

In the group of 10 year old children the prevalence of stunting increased significant during the year of follow-up (35.9 % to 45.2 % for boys and 30.4 % to 42.9 % for girls). The prepuberal growth spurt as observed at the age of 10 in the NCHS/CDC reference population, did not occur at the same age in the present study population. This suggests that the cumulative nutritional stress in consecutive years may cause that this growth spurt occurs several years later and that, for girls, the menarche is delayed (Eveleth 1985; Jelliffe and Jelliffe 1989).

The high prevalence of stunting among children indicates that the problem of malnutrition in Malawi is primarily one of a chronic nature. The difference in weight-for-height between the post-harvest and pre-harvest season shows that malnutrition has also a seasonal component. The prevalence of wasting among children younger than 2 years and not among older children may suggest problems in child feeding. No special feeding for young children exists in rural households. Their meals depend on the preparation of adult meals, usually twice a day (Quinn *et al.* 1990). Due to a limited stomach capacity and the low calorie content of the cereal-based meals, young children are not able to consume sufficient quantities to satisfy daily needs (Malawi Government and UNICEF 1987d; Quinn *et al.* 1990; Sijm 1990). Older children may be able to snack more frequently and this enables them to consume larger amounts of food (Ferguson *et al.* 1993).

The sharp increase in stunting among the younger children shows that the most critical period for malnutrition may be soon after birth until the age of 2. The relative low level of wasting opposed to the high prevalence of stunting may suggest that the high level of severely stunted children in this population may be due, in part, to other factors rather than being exclusively associated with deficits in energy and protein. Ferguson *et al.* (1993ab) suggests, for example, that the reported sub optimal zinc status among rural preschoolers in Malawi may play a role in the growth retardation.

The results of this study are not an exception to other anthropometric studies in developing countries. Failure to growth occurs in the period of four months to two years, and this is not recaptured at a later age. If a child is already stunted at a young age, he will probably remain small throughout the growing years, becoming a small adult (Martorell 1985). The process of 'becoming small' has converted to the state of 'being small' (Beaton 1989). This process may result in a stabilization of height in a community, which is also confirmed by the absence of changes in height among Malawian women over a period of more then 60 years (Quinn 1993; personal communication). This is of particular concern because stunting or small body size is associated with adverse health conditions. Small body size is related to a reduced working capacity and endurance (Martorell 1985; Beaton 1989). Short mothers have a reduced capacity to conceive, deliver infants who are more likely to die and show an increased parity due to short intervals between births (Martorell 1985). Stunting among children is also associated with reduced mental development whose effects may become manifest in other aspects of later performance which depend on early learning (Beaton 1989). Smallness may be a result of adaptation to disadvantaged environments in order to keep at least the minimum health required for survival and health, but it goes at the

cost of the potential for change (Beaton 1989). It is, therefore, important to look into why this phenomenon occurs and what the main determinants of smallness are.

4

When households run out of fuel

Responses of rural households to a decreasing fuelwood availability, Ntcheu District, Malawi

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Abstract - *This paper examines strategies used by rural households in Central Malawi to cope with a decreasing fuelwood availability. With increasing distance from woodlands households initially collected further away, spending more time on collection. But when distance from woodlands increased, households returned to nearby places using less time for collection and switching to lower-quality wood. Results indicate that distance to collection place and collection time are not reliable indicators of fuelwood shortages as so often postulated in the literature. Households within the same village differed in collection strategies particularly as regards collection distance and collection frequency. Households that tended to collect further away and more frequently were large in size with more female adults. These households also collected more wood, even per capita, compared to smaller households, suggesting that smaller households economized on fuelwood use. This paper supports the idea that level of fuelwood used is not only determined by fuelwood availability, but the more by labour availability.*

Introduction

In most African countries fuelwood and charcoal are the main sources of household energy. Rural households depend on fuelwood in particular. In Malawi about 60 % of the total fuelwood demand is consumed by rural households and this wood is mainly used for food preparation (French 1986; Armitage and Schramm 1989). However, in Malawi, woodlands from which most wood is obtained are becoming depleted as a result of clearance of land for agriculture, excessive livestock grazing and the demands for wood by the tobacco industry. Furthermore, the high price of gas and oil and the uncertain supply through neighbouring countries, retards the transition from fuelwood to liquid fuel (Malawi Government 1987a). The depletion of the woodlands combined with the persistent dependency on fuelwood will eventually pose a serious problem for household energy provision (French 1986). Fuelwood supply is already considered critical in densely populated areas of the Central and Southern Regions of Malawi. In addition, the influx of refugees from Mozambique constitutes a further pressure on existing woodlands in the border regions (ETC 1987a).

Rural households develop different strategies to cope with decreasing fuelwood availability. The concept of household coping strategies has, until now, mainly been used in research on food security and seasonal food shortages. The term 'strategy' is used to describe what households do when faced with a threat and refers to overall planned actions. The term 'response' is used for each of the individual actions undertaken within a strategy (Corbett 1988). Several responses may be undertaken by different household members at the same time or sequentially, as part of the same overall strategy. Longhurst (1986) and Foeken and Hoorweg (1988) distinguish preventive responses and responses to meet actual stress. Contrary to seasonal food shortages that have a transitory character, fuelwood shortages have a more chronic character as the situation is usually worsening with time. Most responses will aim to meet actual stress, only some will aim at prevention of worse effects in the future (for example, the planting of trees).

An earlier review paper (Chapter 2) discussed existing literature and information on behavioural responses of rural populations to a decreasing fuelwood availability (Table 1). These responses include collection at longer distances, spending more time on collection, enlisting younger and older household members and adjusting the weight of the bundle collected. Adaptations also occur in type of fuel used, by a switch to fuel of an inferior quality, to wood from fruit trees or by purchasing fuelwood. People also try to cut back on the amount of fuelwood used. It is often assumed that these various responses in a population can be used as indicators of fuelwood scarcity and that these responses will

Table 1

Responses of rural households to fuelwood scarcity.

Responses	Source
1. Fuel collection	
• increase in distance	(Howes 1985; ETC 1987b; Groen 1988/89)
• increase in collection time	(Hoskins 1980; Howes 1985; Schenk-Sandbergen 1985; ETC 1987b; Groen 1988/89)
• change in who collects (more children, older women, men)	(Fleuret and Fleuret 1978; FAO 1983; Eckholm *et al.* 1984; Howes 1985; ETC 1987b; Groen 1988/89; Ngugi and Bradley 1986)
• increase in frequency of collection	
• change in weight of bundle collected	(Ki-Zerbo 1981; Cecelski 1987b)
2. Type of fuel used	
• use of less preferred types of fuel (twigs, crop residues)	(Hoskins 1980; Ki-Zerbo 1981; Malawi Government 1981; FAO 1983; Hosier 1984; Howes 1985; Ngugi and Bradley 1986; ETC 1987b; Bradley 1988; Groen 1988/89; Dankelman and Davidson 1989)
• increase in purchase of fuelwood	(Malawi Government 1981; Eckholm *et al.* 1984; Howes 1985; Longhurst 1985; ETC 1987b; Groen 1988/89)
• increased use of fruit trees	(Malawi Government 1981; Shanahan 1986)
3 Fuel use	
• reduction in energy end-uses	(Hoskins 1980; Cecelski 1985; Ardayfio 1986; ETC 1987b; Groen 1988/89)
• decrease in stock building	(Ngugi and Bradley 1986; Bradley 1991)
• decrease in sales and exchange of fuelwood	

based on Chapter 2

occur more frequently in areas with less fuelwood availability (ETC 1987b). Most of the literature, however, is based on limited observations rather than on substantial research. Moreover, the actual responses depend on individual decisions at household level and are dependent on the available labour, household entitlements, access to woodlands as well as cultural practices. Consequently, there is urgent need for detailed data on different populations (Cline-Cole *et al.* 1990).

This paper presents empirical evidence on the responses of rural households to a decreasing fuelwood availability in Malawi. The study described is part of a research project that looked into the consequences of a decreasing fuelwood availability for the nutritional conditions of rural households in Ntcheu District. Following a general description of fuel supply and use patterns, these responses are examined in two ways. First, fuel supply and use patterns in four villages located at different distances from woodlands are compared and seasonal variations are studied. Second, households with different fuel collection strategies are compared concerning fuel supply and use patterns, and socio-economic characteristics.

Study population and design

Ntcheu District

Research was carried out in Ntcheu District in the Central Region of Malawi near the Mozambican border in the West. Ntcheu is one of the districts with apparent fuelwood supply problems, especially in the densely populated areas of the district (ETC 1987a). The district is characterized by a relatively high population density (105 inhabitants per squared kilometer) with an annual population growth of 4.6% (Malawi Government 1987b). The vegetation consists largely of woodland savanna with an annual precipitation of 900 mm concentrated in the rainy season (Malawi Government 1989). There are three seasons; a cool dry season from mid-April to mid-August (post-harvest season), a hot period during which relative little humidity builds up between August and mid-November (dry-season), and a period of tropical rains between November and April (rainy season). Daily temperatures vary from 18^{o} C in July to 36^{o} C in October. The main economic activity is subsistence farming. The most widely grown food crop is maize; other crops are finger millet, pulses, groundnuts and vegetables. Primary sources of fuelwood are natural forests and savanna woodlands.

Study population and design

The research locations are four villages situated along the (sandy) Ntcheu-Kasinje road. Selection was based on distance from woodlands (see Figure 3 in Chapter 1), being less than 1.5 km (Muuso), 2.5-3 km (Kachinjika), 4-6 km (Chimpuza), and more than 6 km (Magola).

Following a census of the four villages, 200 households were randomly selected (50 in each village) meeting criteria concerning permanence of residence, origin and size of household. A general questionnaire was administered to each household in Oct.-Nov. 1990 (dry season). Questions concerned demographic characteristics (head of household, household composition), farm characteristics (size of land holding, cash crop cultivation), off-farm employment, fuel uses (type of fuel, end-uses, exchange, stock), fuel purchase and collection (place, distance, frequency, time, amount, persons responsible). To determine the weight of wood collected, women were asked to lay out wood equivalent to the amount collected last time and this amount was weighed by the research team.

In order to capture within year variations in fuel supply and use patterns, further data were also collected for a random sub-sample of 120 households during two more seasons, namely the rainy season (Jan.-Mar. 1991) and the post-harvest dry season (Jun.-Aug. 1991). For 113 households data sets were obtained for all three seasons.

Data analysis

To describe fuel supply and use patterns, data concerning fuelwood used for domestic purposes were first analysed for the total research population of 200 households. Averages and distributions were calculated for type of fuel used, fuel supply (collection or purchase), exchange and presence of stock of fuelwood. The total collection time and total quantity of fuelwood collected were calculated with the help of information on time spent per trip, frequency of collection, number of persons collecting and amount of fuelwood collected per trip.

Next, fuel supply and fuel use were compared between the four villages with particular attention for fuel collection characteristics, types of fuel used, amounts of wood collected, and seasonal variation in fuel collection.

Subsequent, the analysis focused on a comparison between households categorized in four strategy-groups, based on a distinction between collection distance (far/near) and collection frequency (high/low). The categorization in strategy-groups is further described under *fuel collection strategies*. Analyses were carried out with use of statistics for non-parametric data (Siegel and Castellan 1988). Differences between the four villages as regards fuel supply and fuel use patterns and seasons and between the

four strategy-groups as regards socio-economic characteristics, fuel supply and use variables were tested with help of the Kruskal-Wallis and Chi square tests ($p<0.05$). If these tests showed significance, multi-comparison was used in order to determine which subgroups differed with the help of the Mann-Whitney or Chi square tests ($p<0.01$). Differences between seasons were tested with Friedman two-way analysis of variance by ranks and the Cochran Q test ($p<0.05$). If these tests showed significance, the Wilcoxon signed rank test for matched pairs and McNemar change test ($p<0.01$) were used to determine which seasons differed. All data were analysed by means of SYSTAT and SPSS-PC 4.0 software (Wilkinson 1989; Norusis 1990, respectively).

Fuel supply and fuel use patterns

End uses and type of fuel used

All households used fuelwood for cooking, space heating, and heating bath water. In addition, 46 % of the households used fuel for smoking fish or meat and 11 % for brewing beer. Only 3 % used fuel for brick making, since bricks are usually dried in the sun. There was no curing of tobacco or making of charcoal in the research area.

The dominant type of fuel used was fuelwood, in the form of splitwood, branches and twigs.[1] For food preparation women strongly preferred the first two types of wood and in particular those from the indigenous tsamba tree (*Brachistegia spp.*). Wood from the following trees was also used regularly: mthethe (*Acacia polycantha*), sederela (*Toona ciliata*), mwanga (*Pericopsis angolensis*), and the blue gum (*Eucalyptus globulus*). Also cuttings from mango trees (*Mangifera indica*), which are pruned yearly, were used although they are not favoured by women because of their poor burning quality. Charcoal was seldom used and none of the households burned animal dung. The only non-wood fuel used was paraffin, used for lighting, by 84 % of the households. Few households used dry grass for lighting when paraffin was not available.

Fuel collection versus fuel purchases

Nearly all households (98%) reported that the wood used for cooking was collected. Households with a money income from activities such as beer brewing and brick making, tended to purchase wood, although the number was rather low (5 out of 29). In case wood was purchased, mainly splitwood and branches were bought from a salesman coming to the houses. Households buying wood did this on average once a month spending 5 MK.[2] Paraffin was bought on the local markets or in Ntcheu town.

Most households bought paraffin either weekly (27%) or monthly (29%), but the consumption was very limited: an average of only 2 MK per month was spent on this fuel.

Women were almost exclusively responsible for the collection of fuelwood; 95% of all collectors being female. Sometimes, however, men assisted but this happened only in exceptional situations if, for instance, the woman was not able to collect wood because of illness or old age. The wood collectors were mainly between the age of 16 and 59 years (78% of the collectors). They received some help from young and older household members: 12% of the collectors was younger than 16 years and 10% was 60 years or above.

Wood was mostly collected from natural forest and communal lands (74%), whereas 26% of the households also collected wood from their own farm or from the farm of their neighbours. The wood collected was transported by headload; no other means of transport was used.

Exchange of wood for food

Since 1986 the number of Mozambican refugees in Malawi had greatly increased. They receive food aid from the United Nations High Commissioner for Refugees (UNHCR) consisting of maize flour, pulses, groundnuts, sugar, salt and cooking oil. A considerable trade of commodities has developed since then between the Mozambican and Malawian populations. Fuelwood is one of the commodities exchanged by Malawians for maize flour and sometimes cooking oil from the refugees. The exchange most frequently occurred during the dry season (35 % of the households). During the rainy season this kind of exchange occurred less often (14 %) although food stocks were low at that time, which probably indicates that heavy farm labour stopped women of travelling to the refugee-areas. In the post-harvest season, when households can rely on their new harvest, only 1 % of the households exchanged wood.

Stock

Storage of wood has several benefits. The stored wood can be used in times of emergencies such as illness or funerals and in times when labour demands prevent women from collecting fuelwood. Wood is also stored and dried for use during the rainy season when the wood in the woodlands and bushes is often too wet for direct use. A stock was defined as any wood stored near the house, if the amount would last for more than one week. On average, 35 % of the households had a stock in the dry season. This percentage increased during the rainy season, when 52 % of the households had a stock . During the post-harvest season this diminished to 17 %.

Apparently, during the dry season time is invested to build up stocks for the rainy season. In all seasons, stocks mainly comprised splitwood and branches, but during the rainy season 14 % of the households also stored crop residues (such as maize stalks and maize cobs).

Fuel collection in four villages located at different distances from woodlands

The area under study experiences a transition to less fuelwood availability with the threat of future scarcities. Most households reported that they were able to collect enough wood, but 24 % already replied the contrary. Aerial photographs of the four research villages showed that with greater distance from woodlands the tree and shrub cover immediately surrounding the villages also decreased. Households from different villages indicated more problems with fuel collection with increasing distance from woodlands. All households in Muuso, situated less than 1.5 km from woodlands, were able to collect enough wood. About 10 % of the households in Kachinjika (2.5-3 km from woodlands) and Chimpuza (4-6 km from woodlands) indicated that they were not able to collect enough wood, whereas in Magola (more than 6 km from woodlands) this percentage was more then double (24%).

Fuel collection

Table 2 shows fuel supply and fuel use characteristics of the four villages in the dry season (Oct.-Nov. 1990). With increasing distance from woodlands (Muuso versus Kachinjika), fuelwood was initially collected at longer distances (1.1 km and 4.0 km respectively) and households spent increasing time on collection (6.0 and 10.0 hr/week). When woodlands had to be reached much further away (Chimpuza and Magola), households returned to other, nearby, places (3.0 km and 1.0 km respectively), reducing collection time (6.0 hr/week). No significant differences were found in frequency of fuelwood collection between the villages.

Data indicate that when households returned to nearby places (Chimpuza and Magola), more switched to twigs which are found in bushes surrounding the village (12 and 37% respectively use twigs in food preparation). Also the use of cuttings from mango trees was increased in villages located at greater distance from woodlands. Both twigs and mango cuttings are considered inferior fuelwood that have low burning quality (Chapter 5).

Total amount and per capita amount of wood collected per week declined with increasing distance from woodlands, with the lowest value in the village located at 4-6 km from woodlands (Chimpuza: 33 kg/week and 8.1 kg/cap/week respectively). In the village located at more then 6 km from woodlands, the total amount and per capita wood collected were again higher. This can be explained by the increased use of twigs, as cooking on twigs requires greater amounts of wood (Chapter 5) and, therefore, more wood needs to be collected.

Table 2

Fuel collection characteristics of households in four villages located at increasing distances from woodlands, Ntcheu District, Malawi (n=200) *

	Villages			
Distance from woodlands	Muuso < 1.5 km (n=51)	Kachinjika 2.5-3 km (n=49)	Chimpuza 4-6 km (n=50)	Magola > 6 km (n=51)
Fuel collection				
• Collection distance (km)	1.1 (1.0-2.0)	4.0 † (3.0-4.8)	3.0 (2.0-4.0)	1.0†¥~ (0.5-2.0)
• Collection frequency (times/week)	2.0 (2.0-3.0)	2.0 (1.5-3.0)	2.0 (1.0-3.0)	3.0 (2.0-4.0)
• Total collection time (hours/week)	6.0 (4.0-6.3)	10.0 † (6.0-15.0)	6.0 ¥ (4.0-10.0)	6.0 ¥ (3.0-9.0)
Type of fuel used				
• Households using twigs (%)	6	8	12	37†¥~
• Households using wood from mango trees (%)	22	78 †	62 †	77 †
Total amount of wood collected				
• Total amount of wood collected (kg/week)	42.6 (33.4-62.0)	44.2 (29.5-59.5)	33.0 † (21.0-49.8)	39.7 (26.7-52.0)
• Wood collected per capita (kg/week/capita)	9.2 (6.1-14.0)	9.0 (6.1-11.8)	8.1 (4.9-12.4)	9.9 (6.9-14.8)

* Median (25th-75th percentiles)
† Significantly different from Muuso, p<0.01
¥ Significantly different from Kachinjika, p<0.01
~ Significantly different from Chimpuza, p<0.01

Table 4
Seasonal variation in fuel collection among households in four villages differing in distance to woodlands, Ntcheu District, Malawi (n=113)*

	Villages											
	Muusso (< 1.5 km)[a]			Kachinjika (2.5-3 km)[a]			Chimpuza (4-6 km)[a]			Magola (> 6 km)[a]		
number of households	dry 26	rainy 22	post-harvest 22	dry 27	rainy 19	post-harvest 24	dry 31	rainy 22	post-harvest 29	dry 29	rainy 17	post-harvest 22
Collection distance (km)	2.0 (1.0-2.1)	1.5 (1.0-2.0)	2.0 (1.0-3.0)	4.0 (3.2-4.8)	3.0 † (2.3-4.0)	3.0 † (2.0-4.0)	4.0 (2.0-4.5)	3.0 (2.0-4.0)	2.0 (1.5-4.4)	1.0 (0.5-1.8)	1.5 (0.9-2.0)	1.0 (0.9-1.6)
Per capita wood (kg)	10.1 (6.1-13.5)	11.9 (6.0-17.6)	10.4 (8.2-14.9)	9.2 (5.9-12.3)	10.5 (6.0-17.8)	11.1 (7.6-17.4)	8.0 (3.7-12.5)	9.8 (7.6-14.4)	12.0 † (8.0-16.7)	9.8 (4.8-13.4)	10.5 (4.0-14.8)	9.4 (7.2-14.6)
Total collection time (hr)	6.0 (4.0-8.1)	4.0 (4.0-6.5)	6.8 (5.5-12.0)	12.0 (6.0-15.0)	8.0 (6.0-12.0)	8.0 (6.0-12.0)	6.0 (4.0-10.0)	8.0 (4.8-15.4)	8.0 (6.0-11.0)	4.5 (2.6-8.0)	4.0 † (2.0-6.0)	4.0 (2.2-6.0)
Use of twigs (%)[b]	4	19	8	7	11	11	10	23	13	41	21	31

* Median (25th-75th percentiles)
[a] Between brackets: distance to woodlands
[b] Percentage of households using twigs
† Significant different from dry season, $p<0.01$

Seasonal variation

Fuel collection was also studied during the rainy (Jan.-Mar. 1991) and the post-harvest season (Jun.-Aug. 1991), among a sub-sample of the larger research population. Table 3 shows that during the rainy season the number of households collecting fuelwood was smaller compared to other seasons (except the village nearest to woodlands). In both the rainy and the post-harvest season, the percentage of households collecting fuelwood in the village at more than 6 km from woodlands (Magola), was smaller compared to that in the other villages. Households not collecting fuelwood usually used wood from stocks that they have laid on.

No significant differences between the seasons were found as regards distance to collection place, per capita amount of wood collected, total weekly collection time and the use of twigs, with a few exceptions (Table 4).

Table 3

Percentage of households that actually collected fuelwood the week prior to the interview in three seasons, Ntcheu District, Malawi

	Villages			
Distance from woodlands	Muuso < 1.5 km (n=26)	Kachinjika 2.5-3 km (n=27)	Chimpuza 4-6 km (n=31)	Magola > 6 km (n=29)
Dry season	100	100	100	100
Rainy season	85	70	71	59
Post-harvest season	85	89	94	76

Fuel collection strategies

Apart from differences between villages there are also differences in fuelwood collection between households within the same village. The choice of households where to collect, how often to collect and how much time to spend on collection is not only dependent on geographical location and fuelwood availability but also depends on individual decisions at household level. With greater distance from woodlands some households will collect at a longer distance but others may decide to collect nearby,

perhaps more frequently. Fuel supply and fuel use showed considerable variation within villages as indicated by the range of scores in Table 2.

Examination of the data revealed that households differed especially in two basic characteristics namely as regards collection distance and collection frequency.[4] These two variables were subsequently used for the categorization of households into four strategy-groups, namely households with short collection distance and low collection frequency (referred to as **df**); long distance and low frequency (**Df**); short distance and high frequency (**dF**) and long distance and high frequency (**DF**). As the interest of this paper was in the differences between households within the same village but showing different responses, it was chosen to use a classification relative to village. In each village households were categorized above or below the median of the two respective variables for that village. This resulted in four strategy-groups for each village. Results of a comparison of household characteristics and fuel supply and fuel use characteristics between the four strategy-groups, differed little across villages and similar strategy-groups from different villages were subsequently merged. The comparison between strategy-groups that follows below is consequently independent of the earlier discussed differences between villages.

Collection time and amount of wood collected

Households collecting at further distances spent more time on collection as travel time is increased (Table 5). Households collecting more frequently also showed an increased total collection time. Logically, households collecting at a greater distance and collecting frequently (**DF**) spent most time (15 hours/week), whereas those staying nearby and collecting less often (**df**) spent 'only' 4 hours a week. Most important, households collecting more often (**dF** and **DF**), gathered far greater amounts of wood (54 and 69 kg) than those collecting less frequent (**df** and **Df**: 32 kg).

Household Characteristics

Table 6 shows the household characteristics and fuel end uses of the four strategy-groups. Households collecting more often (**dF** and **DF**) were generally larger in size and at the same time had more adult females who usually do the collection of fuelwood. In addition, these households also had larger farms, especially **DF** households. This has two explanations. Firstly, large households need larger farms for subsistence. Secondly, in Ntcheu District, more land usually means more plots at greater distances and, since women tend to combine fuel collection with field work, they are more likely to collect at further distances.

Table 5

Time spent on collection and total wood collected by fuel collection strategies, Ntcheu District, Malawi (n=200)*

	short distance low frequency df (72)	long distance low frequency Df (60)	short distance high frequency dF (44)	long distance high frequency DF (24)
Total weekly collection time (hr)	4.0 (2.5-6.0)	6.0 † (5.0-9.0)	9.5†¥ (6.1-15.0)	15.0†¥~ (12.0-20.0)
Total amount wood collected (kg)	32.3 (22.4-41.2)	31.8 (23.4-42.8)	53.9†¥ (43.8-75.0)	69.3†¥ (52.7-90.7)
Wood collected per capita (kg)	8.2 (5.3-11.5)	7.7 (5.1-11.8)	10.5 (7.7-15.3)	11.8†¥ (8.4-18.9)

* Median (25th-75th percentiles)
† Significantly different from df
¥ Significantly different from Df
~ Significantly different from dF

Table 6

Socio-economic characteristics and fuel end-uses by fuel collection strategies, Ntcheu District, Malawi (%, n=200)

	short distance low frequency df (72)	long distance low frequency Df (60)	short distance high frequency dF (44)	long distance high frequency DF (24)
Household size				
≤ 3	43	38	16	8
3-5	32	32	32	38
5-7	13	15	30	17
≥ 7	13	15	23	38
Number of female adults [a]				
≤ 1	76	85	68	67
> 1	24	15	32	33
Size of farm (ha)				
≤ 0.5	14	7	7	8
0.5 - 1	46	52	46	25
1 - 1.5	17	18	27	38
> 1.5	24	23	21	29
End Use				
space heating	96	100	100	100
fish smoking	53	33	63	28
beer brewing	13	15	7	8

a. Females aged 16-59

The larger amount of wood collected in the **dF** and **DF** strategy groups is needed to cover the greater fuel energy needs due to the larger household size. No differences existed in end uses for the fuel between the strategy-groups (except for smoking fish: households collecting nearby tended to smoke fish more often). Still the larger household size as such is not the only reason for the greater fuelwood consumption. After correction for household size, the differences in amount of fuelwood collected per capita remained (Table 5). Smaller households tended to collect less wood, even per capita, and this indicates that these smaller households economize on fuelwood use. The reason for this probably lies in the fact that smaller households dispose of less labour and find it more difficult to collect fuelwood.

Involvement of household members, type of fuelwood used, storage and exchange of fuelwood

Table 7 gives further information on fuel collection and fuel use in the four strategy-groups.

Table 7

Persons involved in fuelwood collection, type of fuel used and fuel end-uses of rural households by fuel collection strategy, Ntcheu District, Malawi (%, n=200)

	short distance low frequency df (72)	long distance low frequency Df (60)	short distance high frequency dF (44)	long distance high frequency DF (24)
Household members involved				
• No. persons collecting *	1.0 (1.0-1.0)	1.0 (1.0-1.0)	2.0†¥ (1.0-2.0)	2.0†¥ (1.0-3.0)
• Households enlisting young or old members	18	18	43	38
Type of fuel used				
• Households using twigs	15	12	27	8
• Households using wood of mango trees	58	60	61	58
Fuel end-use				
• Households having stock	31	30	34	46
• Households exchanging fuelwood	38	38	23	29

* Median (25th-75th percentiles)
† Significantly different from df
¥ Significantly different from Df
~ Significantly different from dF

Logically, the number of persons involved in collection was larger among households collecting more frequently (**dF** and **DF**). As shown in Table 5, these households comprised more adult females and they will share the collection of fuelwood. Furthermore, Table 7 shows that **dF** and **DF** households were more likely to involve younger members as well as elderly people in fuel collection (43 and 38 % of the households respectively) compared to 18 % in the other groups. The extra costs in terms of collection time is apparently spread among more household members.

In respect of type of fuel used there were no significant differences between the groups but there was a tendency for households collecting at a short distance (**df** and **dF**) to use more twigs. This same trend also showed up in the earlier village analysis. No further differences were found as regards the use of mango cuttings, stock piling of fuelwood and exchanging of fuelwood for food.

Discussion and conclusions

The present paper describes and analyses the responses to a decreasing fuelwood availability among rural households in Ntcheu District, Malawi. Responses were examined in two different ways. Firstly, by comparing fuel supply and use patterns in four villages located at different distances from woodlands. Secondly, by comparing households that use different collection strategies with regard to collection distance and collection frequency to meet their energy needs.

The comparison of villages revealed that with increasing distance from woodlands households initially collected further away, spending more time on collection. But when distance from woodlands increased further, households returned to nearby places, using less time for collection, and switch to the use of twigs of which a greater amount has to be collected because of its low burning qualities. Therefore, results of the present study indicates that distance to collection place and collection time as such are not reliable indicators of fuelwood shortages as so often postulated in the literature (Hoskins 1980; Howes 1985; Schenk-Sandbergen 1985; ETC 1987b; Groen 1988/89). A short collection distance and reduced collection time does not necessarily represent a situation of surplus fuelwood availability.

This is the more so because households from the same village often show considerable differences in collection strategies. Households collection strategies differed particularly as regards collection distance and collection frequency. Within the same village some households may collect far away, others nearby and, likewise, some households collect frequently, others less often. Households that tend to collect further

away and more frequently are large in size with more female adults. More households members partake in collecting fuelwood where more effort is needed and part of this extra effort is provided by the younger and the older household members. These larger households also collected more wood, even per capita, compared to smaller households. Smaller households tended to collect less wood per capita. This finding is particularly noteworthy because usually per capita wood collection is larger in small households (Fleuret and Fleuret 1978; Hosier 1984). This indicates that in the present study population, smaller households do economize on fuelwood use.

Small households are either households comprising a young married couple possibly with small children, or households with an old couple whose children are married and started their own household. Women in these households have little opportunity to share production and reproduction duties (Hayes 1990; Kayongo-Male and Onyango 1991). The ensuing time constraints will keep women from spending more time in fuelwood collection and they respond to a decreasing fuelwood availability by reducing the amount of wood collected and consumed. If this is true it means that households are more vulnerable in certain parts of the life cycle (Kayongo-Male and Onyango 1991), and less at other times, for example during the middle domestic stages when households are larger and more labour is available.

The results of this study support the idea that the amount of wood collected and, hence, consumed, is not only decided by fuelwood availability, but the more by labour availability. As noted by Dewees (1989), even in situations where fuel is available in abundance, level of fuel consumption can be quite low when there are constraints in household labour. Conversely, if labour is abundant, time spent on collection and the level of fuel consumption can be quite high.

Despite literature references to a strong seasonality in fuel collection and fuel use (Hosier 1984; Howes 1985), this study showed very small differences between seasons. Seasonality did not affect the amount of wood collected per capita. During the rainy season the number of households collecting fuelwood is smaller compared to the other seasons. Households not collecting fuelwood usually use wood from stocks they have built up during the dry season. The use of stocked wood is a way to save time in a period when agricultural field work asks a lot of women's time.

The household in the present study were suffering fuelwood problems, although conditions in Malawi still compare favorably with other parts of Africa, such as the Sahel. Fuelwood is essentially still regarded a 'free' good by the population and very little fuelwood is actually purchased. Although households had to go further away to collect it, the extra costs and sacrifices were not so high that people preferred to pay for the wood. For the same reason the role of household income is not opportune in the

present case. Nevertheless, it appears that under these conditions people start with increasing collection efforts, together with economizing in fuelwood use and a shift to lesser quality fuel. As households start to collect these fuels nearby their houses, the surrounding areas will be further depleted from wood, bringing the households in an even worse position in future. This will force households to spend more of their already limited time and cash resources on fuel, or to switch to even lower quality of fuels such as maize stalks and animal dung. In all cases, fuel consumption is expected to be reduced. A cut back in amount of fuelwood used in food preparation may jeopardize both quantity and quality of food consumed (FAO 1990/91, see also Chapter 2).

Data in this study refer to specific rural conditions in Malawi. The relative small numbers of households involved allowed for only a limited disaggregation. More research is needed in other rural environments and in urban conditions as well in order to come to firm conclusions. However, the present results already give starting points for development efforts to reverse or prevent negative effects of a decreasing fuelwood availability. Most households in the research area collected wood within a distance of 4-5 km. Soussan (1988) already noted that the distance women can walk with a bundle of fuelwood is limited, up to 10 km in extreme circumstances. In consequence, large fuelwood plantations that have to supply whole regions are less suitable for village supply because they are situated at too large distances. This study agrees with Mung'ala and Openshaw (1984) that village woodlots, roadside and boundary tree planting and farm tree planting if not competing with crops should be stimulated. Furthermore, populations are never homogeneous and, consequently, not all are affected in the same way. This study showed that especially smaller households are vulnerable in terms of amount of wood collected and, therefore, should receive careful attention in development efforts.

Notes

1. Splitwood: logs and heavy branches of various tree species which are usually split with axes into smaller pieces to make them suitable for use in a three-stone fire. Branches: wood with a diameter of 2-5 cm. Twigs: all woody materials with diameters less than 2 cm.
2. MK= Malawi Kwacha. In 1990-1991 minimum government wage was 40 MK/month. Average household income in research population was 25 MK/month. 1 MK ~ 0.4 US$ in 1990/1991.
3. Aerial photographs dated from 1982 and were kindly made at our disposal by the Office of the President and Cabinet, Survey Department, Blantyre.

4. The relations between distance, time per collection trip, frequency and size of a bundle were examined with the help of PRINCALS, a non-linear principal component analysis (Gifi 1985) to reduce the number of variables. Analysis revealed two dimensions, explaining 46 % and 30 % of the variance respectively (eigen value > 0.2). The first dimension was related to distance to collection place and, hence, to trip time and the second dimension represented frequency of collection. Size of bundle was related to both dimensions. Component loadings were as follows:

	distance	trip time	frequency	size of bundle
dimension 1	.90	.90	-.21	.42
dimension 2	.22	.27	.80	-.65

5

Wood quality and wood preferences in relation to food preparation and diet composition in Central Malawi

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Abstract - *This paper reports a study of wood quality and preferences for type of wood in relation to food preparation and diet composition, Ntcheu District, Malawi. Women preferred splitwood or branches and were reluctant to use twigs and maize stalks because the former is transformed into more charcoal of a better quality with longer burning duration, needed less attention to maintain the fire, produced no smoke/ash, eliminated the need for expensive metal cooking pots, and required less time and fuel to prepare dishes. Time studies, however, showed that use of twigs did not prolong cooking time, but more attention was needed to maintain the fire, which required the time of women in another way. As a response to a hypothetical fuelwood scarcity, breakfast was skipped. Women also replaced dishes requiring long cooking such as beans, or omitted less important foods such as snacks. However, the dish nsima accompanied with relish was the mainstay of the diet, and was hardly ever left out.*

Introduction

Household food security -the ability of households to produce or purchase enough foods to meet biological needs of all of its members- is a commonly acknowledged essential condition for good nutrition (FAO/WHO 1992c; Von Braun *et al.* 1992; WHO 1992). In this respect, the nutritional situation of many households in developing countries is precarious, depending on a variety of factors including economic, social, cultural, environmental and biological variables (Falconer and Arnold 1988; Lindskog and Lundqvist 1989; Maxwell and Frankenberger 1992; Quinn *et al.* 1990; Zeitlin and Brown 1992).

However, household food security is not the only condition essential for good nutrition, since energy is needed to prepare food to make it suitable for consumption. Fuelwood is the main source of energy for rural households in developing countries, supplying 80-90 % of the total energy consumed (Eckholm *et al.* 1984; World Bank 1992). A decrease in fuelwood availability may therefore affect the nutritional situation of rural households (Chapter 2).

Women play a major role in food supply and preparation (FAO 1979) and in fuelwood provision and use (Groen 1988/89). They are the first to be confronted with the consequences of a decreasing fuelwood availability and they must find ways to cope with it (Kumar and Hotchkiss 1988). More time and energy have to be spent on collecting fuelwood and ways of using fuel more sparingly need to be found. Women may also switch to alternative fuels (Chapter 2). Rural populations usually cannot afford to switch to commercial fuels (Foley 1985). They dependen on freely accessible fuels such as twigs, crop residues and even animal dung, which they consider inferior (Hosier 1984; Howes 1985).

Fuelwood is not a uniform and homogeneous fuel type. Characteristics of fuel comprise the heat generated, the duration of the fire, smell, smokiness and the amount of residues (WHO 1984). The type of food cooked may also determine the wood quality cooks prefer (Schenk-Sandbergen 1985; Groen 1988/89). For instance, the smoking of fish requires a different type of fuelwood and another way of burning than the slow heating of pulses and the quick frying of maize.

The increasing use of inferior fuels such as twigs, crop residues and animal dung has certain disadvantages. Time spent on cooking will increase, as the use of inferior fuels requires more of the women's attention (Cecelski 1987b). Inferior fuels produce smoke which may have negative effects on the health of persons who stay near the fire, often women and young children (WHO 1987). Withdrawal of crop residues

and animal dung from agricultural land results in a decrease in soil fertility and, hence, in food production (Eckholm *et al.* 1984; O'Keefe and Raskin 1985).

Existing information on wood preferences, the switch to inferior fuels and the effects on food preparation and diet composition is scarce. The present paper reports a study of these less emphasized issues. This study, part of a larger research project on the consequences of fuelwood shortages on the nutritional situation of rural households, examined three aspects. First, cooking experiments were carried out to determine differences in cooking time and amount of fuel used for preparing different dishes. Secondly, the preferences of women for different qualities of fuel were studied. Lastly, information on dietary adaptation in response to fuelwood shortage was collected.

Materials and methods

Research area and study background

The research project as a whole was carried out in Ntcheu District, situated in the Central Region of Malawi near the western Mozambican border at an altitude of 900 m. The district consists largely of woodland savanna with an annual precipitation of 900 mm, concentrated in the rainy season (October until March). Daily temperatures vary from 18° C in July to 36° C in October.

The research locations are four villages located along the (sandy) Ntcheu-Kasinje road. The villages differed in distance from woodland, being less than 1.5 km (Muuso-1), 2.5-3 km (Kachinjika), 4-6 km (Chimpuza) and more than 6 km(Magola) from woodland. The inhabitants of the four villages number in total approximately 3200 and are mainly subsistence farmers. The larger research population comprised 200 households meeting criteria concerning permanence residence, origin and size of household, selected randomly from these four villages . Sub-studies in the larger research programme comprise a one-year study on body weight of women and young children, a household survey on fuel supply and use patterns, a household food consumption study and a time allocation study among women.

Among the larger research population the cultivated farm size is on average 2.8 acre (≈ 1.1 ha). The main food crop grown is maize (*Zea mays*), often inter cropped with finger millet (*Eleusine corana*). Other crops are pulses, groundnuts and (leaf) vegetables. About one-third of the households have fruit trees, mostly mango trees (*Mangifera indica*). Food preparation and fuelwood collection are mainly the responsibility of women. When food is sufficiently available, women usually cook

three times a day. Breakfast consists of a maize flour porridge (*phala*) or tea with sugar, milk, and white bread for those who can afford it. During lunch and dinner a stiff porridge made of maize flour (*nsima*) with a relish of (leaf) vegetables or, sometimes, of (dry) beans, meat or fish is prepared. Between meals boiled or fried maize kernels, cooked cassava, cooked sweet potatoes as well as fruits and sugarcane, if in season, are consumed. A three-stone fire is used for cooking. Fuelwood, as splitwood, branches or twigs, forms the major energy source. Wood is mainly collected in the surrounding natural forests, or on the owner's farm. In general, two or three bundles of fuelwood with an average weight of 20 kg are collected weekly in a household. This collection takes, on average, about 8 hours per week.

Cooking experiments

Three types of fuels (splitwood, branches and twigs[1]) were compared with respect to the time taken and the amount of fuel needed to boil water and to cook four different dishes. In the case of the boiling of water, maize stalks were also used as fuel.[2] The wood and the maize stalks used in this study were air-dried. The wood species have not been taken into account as it was assumed that the caloric value of different species are comparable.[3]

Standard recipes and cooking procedures were used to prepare respectively nsima, relish of pumpkin leaves, relish of dry beans, and cassava. A three-stone fire located in an indoor kitchen and a clay pot commonly used in rural households, were used. The fire was started with paper (or dry grass in case of water) followed by addition of the fuels. Once the fire was burning, the clay pot was put on the fire and the cooking procedures were followed. A stopwatch was used to record the time from putting the pot on the fire until the boiling point of the water was reached or until the dishes were ready. Immediately afterwards the fire was extinguished by pouring water on it.

The amount of wood consumed was calculated by subtracting the weight of the left over wood from that of the initial amount, measured with a Tefal digital weighing scale. Before the start of the next trial, the pot was cooled by filling with cold water and letting it stand. The fireplace was cleaned of remaining ash and charred wood. For each type of fuel and dish the trials were repeated five times (in the case of boiling water eight times) in a random sequence. Means and standard deviations of the amount of fuel used and time taken were calculated. Differences between the types of fuel were tested using the Mann-Whitney test (Siegel and Castellan 1988) with 95 % probability level.

Wood preferences

Ten knowledgeable women between the ages of 18 and 59 years, were selected from the larger research population in such a way that they represent the existing socio-economic diversity in the four villages. The women were each presented with small bundles of splitwood, branches, twigs and maize stalks, and asked to rank them according to their preferences, if all types were available, and to explain the reasons for their order of choices. Next, they were asked to indicate the type of fuels they did or did not prefer to cook the following dishes: nsima; relish of leaf vegetables, of dry legumes, of meat, of fish and of eggs; fried maize/groundnuts; tubers/roots; unripe banana; and roasted meat/fish. The daily use of the favoured type of fuel was discussed as well as the alternatives in case this type of fuel was not available.

Dietary adaptation

Information on dietary adaptation was complemented by interviews on changes made in diet composition in case the fuelwood supply, even that of inferior fuels, fails. Twenty women, 18-59 years old, were selected randomly from two research villages located at a relatively large distance from forest reserves (Magola and Chimpuza) and an extra village, Kalazi, located more than 10 km from a forest reserve and, thus, having a more severe fuelwood deficit.

A standard daily diet, verbally described by the interviewer, was selected, consisting of maize porridge (*phala*) for breakfast, a stiff maize porridge (*nsima*) with a pumpkin leaf relish for lunch, boiled maize kernels as a snack and nsima with a relish of cooked dry beans for dinner. Women were asked what they would change in this diet if the ingredients were available but the fuelwood supply was not sufficient to cook all meals. Probing was stepwise: after each adaptation mentioned by the women, they were asked what they would change next if wood was still not sufficient.

Results

Time and amount of fuel required for cooking

The results concerning time and amount of fuel required for cooking various dishes are presented in Table 1. There were considerable differences in cooking time and amount of fuel needed for the preparation of the different dishes. The relish of dry beans needed most time and fuel for preparation compared to the other dishes. Consistently more twigs were needed in preparation of all dishes compared to branches and splitwood. The amount of fuel needed when cooking on branches or splitwood did not

differ significantly, except in the case of dry beans preparation where it appeared that less branches were required than splitwood, probably because branch wood is more compact.

Table 1

Time and amount of fuel needed to boil 3 litres of cold water and cook different dishes by type of fuel, Ntcheu District, Malawi[a]

Dish[b]	Type of fuel	time (min) mean (s.d)	amount (kg) mean (s.d)
3 litres water	splitwood	^{c}20 (1.4)	^{c}1.4 (0.3)
	branches	^{cd}23 (3.9)	^{cd}1.5 (0.2)
	twigs	^{d}24 (1.4)	^{d}1.8 (0.3)
	maize stalks	^{d}25 (2.6)	^{cd}1.6 (0.3)
nsima[f]	splitwood	^{d}27 (1.9)	^{d}0.9 (0.1)
(8.8 kJ)	branches	^{c}23 (0.8)	^{c}0.8 (0.05)
	twigs	^{c}23 (0.8)	^{e}1.3(0.1)
relish of	splitwood	^{d}26 (1.9)	^{c}0.8 (0.05)
pumpkin	branches	^{cd}25 (5.6)	^{c}0.8 (0.06)
leaves[g]	twigs	^{c}22 (0.6)	^{d}1.3 (0.1)
(0.4 kJ)			
cassava[h]	splitwood	^{c}31 (0.8)	^{c}1.5 (0.07)
(6.8 kJ)	branches	^{c}32 (0.5)	^{c}1.4 (0.06)
	twigs	^{c}32 (0.8)	^{d}1.7 (0.08)
dry beans[i]	splitwood	^{d}168 (2.7)	^{d}6.9 (0.08)
(10.2 kJ)	branches	^{c}150 (1.3)	^{c}5.7 (0.08)
	twigs	^{c}143 (1.5)	^{e}7.4 (0.08)

[a] See notes number 2, page 92

[b] Food energy content of the dish in kJoules

[c,d,e] Per dish, values in the same column with similar superscripts are not significantly different (Mann-Whitney, 95% probability level)

[f] Ingredients: 600 g maize flour, 2 litres of water

[g] Ingredients: 270 g cut and cleaned pumpkin leaves, 220 g red ripe tomatoes, 10 g salt, 5 litres of water

[h] Ingredients: 1120 g peeled cassava (diameter 4-6 cm, length 8-10 cm), 5 g salt, 1 litre of water

[i] Ingredients: 750 g dry red beans, 225 red ripe tomatoes, 40 g salt, 1 litre of water

The results with regard to time were less clear. On the whole, cooking with twigs took less time than with branches and splitwood. With using splitwood, the cooking time tended to be slightly longer compared to using branches. Distinguishing between short- and long-time cooking dishes contributes to an understanding of the results. With dishes requiring a short cooking time (nsima, vegetable relish, cassava), differences in time needed for cooking between the three fuel types, were at most 5 minutes, which is of little importance. The results for boiling water were slightly different, but again the differences were small. However, in the case of dry beans the difference in cooking time using either twigs or splitwood amounted to 20 minutes.

We may conclude, therefore, that with dishes requiring a cooking time of half an hour or less, there were minor differences in cooking time using twigs, splitwood or branches. However, with dishes requiring a cooking time of two to two and one-half hours, using twigs meant a reduction in cooking time compared to use of branches or splitwood.

Table 1 further indicates that in respect of food energy content of the dishes, *nsima* required little wood for preparation. Dishes such as relish of vegetables or cassava requiring as much or even more wood, had a much lower food energy content. Beans especially provided proportionally few calories with respect to the amount of wood required for preparation.

The daily needs in terms of cooking time and amounts of fuel for two common daily diets for a household comprising 4 persons were calculated based on Table 1 (Table 2 and 3) . Starting with a diet without bean dishes, and excluding the time needed to prepare the ingredients beforehand, it was estimated that a woman generally spent 155 minutes per day (2.5 hours) on cooking, using 6.3 kg splitwood. When using twigs, the cooking time decreased by 10 minutes but the amount of fuel needed increased by 2.5 kg. When beans were prepared the figures were higher: using splitwood the cooking time was 273 minutes (4.5 hours) requiring 11.6 kg of fuelwood, compared to twigs with 245 minutes (4 hours) and 13.5 kg of wood. Assuming that households in the research area usually cook dry beans twice a week, an average household of 4 persons needed about 55 kg of wood for cooking when using splitwood, and 70.5 kg when using twigs.

Table 2

Time and amount of fuel needed for daily cooking with vegetable relish using splitwood or twigs, Ntcheu District, Malawi

	time (min)		fuel (kg)	
	type of fuel		type of fuel	
Daily diet	splitwood	twigs	splitwood	twigs
Tea	20	24	1.4	1.8
Nsima	27	23	0.9	1.3
Leaf vegetables	25	22	0.8	1.3
Cassava	31	32	1.5	1.7
Nsima	27	23	0.9	1.3
Leaf vegetables	25	22	0.8	1.3
TOTAL	155	146	6.3	8.7

Table 3

Time and amount of fuel needed for daily cooking with relish of dry beans using splitwood or twigs, Ntcheu District, Malawi

	time (min)		fuel (kg)	
	type of fuel		type of fuel	
Daily diet	splitwood	twigs	splitwood	twigs
Tea	20	24	1.4	1.8
Nsima	27	23	0.9	1.3
Dry beans	168	143	6.9	7.4
Cassava	31	32	1.5	1.7
Nsima	27	23	0.9	1.3
(Dry beans)[a]				
TOTAL	273	245	11.6	13.5

[a] Left over from lunch

Preferences for types of fuelwood

Women preferred splitwood and branches as fuelwood with little difference between the two (out of 10 women, 6 preferred splitwood and 4 preferred branches). Twigs came third, and maize stalks were placed last by all women. The criteria women mentioned in respect to their preferences are given in Table 4.

Reasons for preferring splitwood and branches to twigs and maize stalks were a longer duration of burning, less time needed to maintain the fire, less smoke and ash, no need for (expensive) metal pots, and less time and lesser amounts of fuel needed to prepare dishes.

However, the main reason given was that during the cooking process splitwood and branches transformed into glowing charcoal, which continued to produce enough heat after a fire ceased burning and, thus, cooking still continued. When a fire of twigs or maize stalks went out, cooking simply stopped. And, as one woman said "if the porridge cools down, lumps will appear and the *nsima* is spoiled". Other advantages were that glowing charcoal could be used in traditional irons for pressing and could be used to start a new fire. One woman said if she had no charcoal, she would borrow a burning piece from her neighbour to start her own fire, as money for matches was not available. Using twigs meant she had to go to her neighbour every time she wished to prepare food.

The extent to which women needed to be present to maintain the fire also depended on the duration of the fire. Most women thought that twigs and especially maize stalks burn very quickly compared to splitwood or branches. As a result, a fire of twigs or maize stalks required close attention to continuously feed the fire. This need decreased possibilities to combine cooking with other activities. Since splitwood or branches required less attention, women were able to carry out other activities concurrently such as cleaning plates and fetching water. Probably because of need to be near the fire, some women also complained that food preparation took longer when twigs or maize stalks were used. The type of cooking pot also determined cooking time. Most women used clay pots, which required much heat to become hot, so they preferred to use splitwood or branches. One woman said she used a metal cooking pot instead of a clay one when cooking on twigs. However, not many women in the villages possessed metal cooking pots. A last reason, indirectly related to women's time use, was that cooking with twigs or maize stalks required more fuel which may result in an increase of time spent on collecting fuel.

Apart from time related reasons, the smoke and ash production of maize stalks prevented women from using them. The smoke polluted the kitchen walls and roof and might cause health complaints. One woman said the smoke caused sore eyes and a

headache. Another woman complained of coughing during cooking with maize stalks. Further, a fire of maize stalks must be fanned regularly. The ash might blow into the cooking pot and spoil the food. The ash of maize stalks also filled the space between the three stones quickly and suffocated the fire unless it was removed frequently.

Table 4
Criteria with which women gave preference to different fuel types, Ntcheu District, Malawi (n=10)

Criteria	No. women mentioning
Duration of burning	10
Transformation of fuelwood into charcoal	9
Smoke/ash production during cooking	7
Time needed to maintain fire	6
Type of cooking pot	5
Time needed to prepare food	5
Amount of fuel needed to prepare food	4

It was not clear why women preferred either splitwood or branches. One reason mentioned was the content of a bundle: one woman preferred splitwood because a bundle could be used for a longer time compared to a bundle of branches. A few women preferred branches, because they considered the charcoal from branches of a better quality than that of splitwood. They suggested that this was because the wood of branches was more dense compared to splitwood. Another reason was related with the work necessary before using different types of wood. Women generally preferred that type of wood which could be used immediately and which needed the least work. However, they seemed to differ in their opinion as to what required more labour, splitwood or branches. One woman used to splitwood at the place of collection before taking it home. She preferred this to branches because she had to cut the latter into smaller pieces before use which delayed the cooking. Another woman collected large pieces of wood and split them at home just before using them. She preferred branches, because they could be used right away.

Use of different fuel types in relation to food preparation

Although all women preferred splitwood or branches, this did not imply that they always used these types of fuel. Actual use depended on availability and the time women had to collect them.

Especially in the two villages at relatively short distances from woodland (Muuso-1 and Kachinjika), where fuelwood was readily available, women did not consider twigs and maize stalks to be fuel and used them only to start the fire, after which they immediately added splitwood or branches. Twigs were hardly used on their own and maize stalks never, except only "when they were really stranded". The use of twigs was more common in the other two villages at relatively long distances from woodland (Magola and Chimpuza). Although branches and splitwood were preferred, twigs were used when the former were not available. However, the use of maize stalks was avoided as much as possible. Further, twigs and maize stalks might be used when the women were very busy, for example when pounding maize, or when they were very tired after working in the field. Instead of making a long, tiring trip to collect splitwood and branches, they would collect twigs near the house. Maize stalks were used only during "critical" shortages; as one woman explained " when I do not have wood and I am planning to go for collection and suddenly I have to attend a funeral".[4] Furthermore, maize stalks were not available throughout the year, but only during the months after harvest (May-October).

Although women were sometimes forced to use inferior fuels, they could not use these fuels for all types of dishes. Dishes that required a long cooking time were difficult to prepare on twigs or maize stalks. Examples of long-time cooking dishes were dry beans, pumpkin fruits, cooked yam and meat. These dishes would be prepared only when the favoured wood was available or when women felt they had enough time to use the inferior woods.

Women called dishes such as vegetables, fish, eggs, and cooked bananas or mangoes "easy to cook", because they needed a short cooking time and could be prepared on twigs. Roasting of meat and fish was always done on splitwood and branches. Roasting needed charcoal because fire would burn the meat and smoke would give the meat/fish a bitter taste. Thus maize stalks were unsuitable for roasting. On the other hand, some women preferred to use twigs for frying maize or groundnuts. Twigs burned quickly and they heated the commonly used (metal) frying pan quickly, compared to splitwood or branches.

In the last stage only one meal was left; the first reaction to the question on how to adapt further when wood was still not enough, was: "I will try to find something to cook on, otherwise I will just go to bed without eating anything". None of the women suggested to separate the two dishes, *nsima* and relish, and leaving out one of them. Because of this they were asked what they would do if they had just enough fuelwood to cook one dish. Only four women would prepare either *nsima* or relish. The others would replace both *nsima* and relish by one other dish, "because you cannot eat *nsima* without relish". Thirteen women would cook porridge, one woman would prepare tea with bread and another woman would make banana fritters.

At the end of the interview women were asked whether the adaptations mentioned reflected a realistic situation. Most of the women stated that they were sometimes forced to drop or replace dishes due to fuelwood shortage. However, they would always try to find wood or other fuels to prepare lunch and at least dinner. Omission of these meals occurred mainly due to food shortages or lack of time rather then lack of fuelwood.

Discussion and conclusion

From the interviews and observations it emerged that women were well aware of the quality of wood they used for cooking. All women preferred either splitwood or branches and were reluctant to use twigs and maize stalks. Reluctance to use twigs for cooking was, among other reasons, due to a reported prolongation of cooking time. Surprisingly, time experiments showed that using twigs did not prolong cooking time. Equal masses of different woods should theoretically generate the same amount of heat (Poynton, 1984). However, not all woods deliver heat in the same way. Compact woods burn only reluctantly and deliver heat slowly. Twigs, on the other hand, have a low volume-to-surface area ratio and burn quickly, delivering heat almost explosively (Bussmann *et al.* 1983). Ideally, when twigs are fed continuously to the fire, the heat delivered will be high, and thus cooking time will be shortened. However, in daily life, women did not always have time to stay with the fire as under experimental conditions, and they did not always add twigs in time. As a consequence, the heat supply would not be continuous so the food would cool down and had to be warmed again, probably increasing actual cooking time.

These observations show that "cooking time" had two aspects in this population. On the one hand it indicated the actual time period needed to cook food until it was done. On the other hand it indicated the amount of attention women needed

to give to the fire. A shortening of the cooking time in the first sense did not automatically mean that women needed to give less attention to the fire, that is less time in the second sense. Although the actual cooking time was shortened using twigs, the women complained that the cooking took more time because they had to give closer attention to the fire, preventing them from doing other household chores in the meantime, which consequently had to be postponed to another time of the day.

It is obvious is that "time", in the two meanings mentioned above, was an important underlying reason to prefer splitwood or branches. Also other authors reported the role of time in choice of type of fuelwood. There is often a trade-off between the time spent collecting fuels and the time that must be devoted to preparing food or tending the fire (Batliwala 1983). Although twigs and residues are considered inferior fuels, they are, however, used if they are more easily available than fuelwood (Meijs 1988/89). On the other hand, women will sometimes spend more time collecting higher quality of fuel in order to minimize time spent on cooking (Bagchi 1987).

It can be concluded that the switch to twigs and the shortage of fuel has its consequences on women's time use as well as diet composition. The present study showed that *nsima* with a relish proved to be the most important meal which would not be omitted from the diet under almost any circumstances. Women would make great effort to find wood in order to prepare at least one or two meals a day. Omitting these favoured meals would be experienced by the women as hardship (Den Hartog and Brouwer 1990). Further, in respect of food energy content of the dishes, *nsima* required little wood for preparation, which might be another reason why *nsima* had come to be so popular. As a first response to a hypothetical fuelwood scarcity, breakfast would be skipped as it appeared to be the least important meal. Next, women would replace long-time cooking dishes such as beans or omit less important dishes such as snacks.

These changes in diet composition will have nutritional consequences. A reduced frequency in meals and snacks will decrease the quantity and quality of food intake. Beans have a high protein content and are good sources of B vitamins such as thiamin and niacin as well as minerals such as calcium and iron (Aykroyd and Doughty 1982). Although beans formed a relatively small part of the Malawi diet mainly based on cereals, simultaneously ingestion with cereals would raise the protein quality comparable to that of animal proteins (Aykroyd and Doughty 1982). Especially in areas where animal proteins are not easily available, replacement of beans by vegetables that are poor sources of protein, might endanger the fulfillment of the special protein needs of young children and pregnant and lactating women (WHO 1985; Cameron and Hofvander 1983).

In this study women were asked to react on a hypothetical situation, measuring intention rather than actual behaviour. Although intention is the best predictor of behaviour (Ajzen and Fishbein 1980) and although the women interviewed stated that the adaptations mentioned reflected a rather realistic situation, food consumption studies and time allocation studies should be carried out in order to verify the reported findings.

Notes

1. Splitwood: logs and heavy branches of various tree species which are usually split with axes into smaller pieces to make them suitable for use in a 3-stone-fire. Branches: wood with a diameter between 2 and 5 cm. Twigs: all woody materials with diameters less than 2 cm.
2. The experiments of boiling water took place in October 1990 when maize stalks were still available. However, cooking of the dishes took place in January. Maize stalks were no longer available at that time and were therefore not used during the experiments. Data on the use of maize stalks during boiling of water are given but not further discussed.
3. In an earlier study by the first author wood samples were taken in Kenya and analysed for caloric value. The caloric value of wood is related to its elemental composition and the structural components made up from these elements (Harker *et al.* 1982). The average elemental composition of dry wood varies little from 49.5 % carbon, 6 % hydrogen and 3.5 % oxygen (Bialy 1979). This accounts for the fact that nearly 90 % of the gross caloric values of different wood species are between 18,000 and 21,000 kJ/kg (Harker *et al.* 1982). However, the observed spread of caloric values is 15,000 - 25,000 kJ/kg (Anderson and Tillman 1977) and may be accounted for by the variation in both the proportion and caloric value of the five main wood components: resins, cellulose, hemi-cellulose, lignin and mineral matter (Tillman 1978).

   Samples were taken of the following species of wood: blue gum (*Eucalyptus globulus*), grevillea (*Grevillea robusta*), mukinduri (*Croton megalocarpus*), murarachua (*Juniperus procera*), muhuti (*Erythrina abyssinica*), black wattle (*Acacia mearnsii*), muthiga (*Warburgia ugandensis*) and the lemon tree (*Citrus limonia*). The samples were air dried for about 4 months. A part of each sample has been planed, ground to wood meal in a ball mill type Petsch and sieved (425u). The caloric value of each sample was analysed in duplicate using bomb calorimetry (see table below).

   On average, the species analysed show a caloric value of about 14,780 kJ/kg with a range of 13,500 to 15,883 kJ/kg. These values are somewhat lower than those of dry wood species as mentioned by Harker *et al.* (1982), probably due to a higher water content (20 %) of the air dried wood samples (Rijsdijk 1977; Raaymakers 1984). In general, one may assume that the caloric content of different dry or air dried wood species is comparable.

Caloric value of different wood species

Species	Caloric Value (kJ/kg)
Eucalyptus globulus	15824
Grevillea robusta	15721
Citrus limonia	13797
Erythrina abyssinica	15883
Croton megalocarpus	14677
Juniperus procera	14217
Warburgia ugandensis	14622
Acacia mearnsii	13499

6

Do food and fuel compete for women's time?

a study on the relationship between time spent on fuelwood collection and on other (food-related) activities of rural women in Central Malawi

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Abstract - *The present study examines the relation between time spent on fuelwood collection and time spent on other activities during a period of hard agricultural field work and a period of moderate field work. Irrespective of time spent in garden work, women reduced time spent on food processing and resting on days they collected fuelwood. Time spent on other activities such as food preparation and food purchase, was reduced when besides fuelwood collection also garden work put a high demand on women's time. Effects on time allocation was not only outcome of extra time spent on fuelwood collection, but moreover of more fundamental issues related to competing demands for labour. This study did not find evidence that women spent more working hours, omitted activities from their daily pattern or received more help from others during fuelwood collection days. This suggests that women were just more busy during fuelwood collection days.*

Introduction

Most African countries depend entirely on biomass fuels, particularly fuelwood, as their main source of fuel for food preparation. Large scale deforestation especially in the arid and semi-arid countries and in the eastern and south-eastern parts of Africa, however, threatens the supply of woodfuel (FAO 1981) with little opportunity to switch to modern fuel sources such as electricity and oil products. Affected by a decreasing fuelwood availability households will try and find adaptations with regard to fuel supply and use patterns (Chapter 2). In rural conditions, fuel supply and use are mainly dependent on access to physical wood resources (Meijs 1988/89). A decreasing woodfuel availability is directly related to household time allocation as people either have to collect over longer distances or have to collect more frequently (ETC 1987b; Groen 1988/89; Howes 1985; Kumar and Hotchkiss 1988).

It is generally known, that women in Africa have heavy workloads and any increase in workload of one activity will have an impact on the performance of other activities (Cecelski 1985). When workload increases women will have several options to cope with it. They may decide to work longer hours, to economize on time spent per activity or to postpone or omit activities from their normal activity pattern. They may also ask the assistance of other household members. Existing literature suggests that increased labour in wood collection lead to longer working hours and affect time spent on food production, food processing, food preparation, income generating activities and leisure time (Kumar and Hotchkiss 1988; Cecelski 1985; Hoskins 1980; Ardayfio 1986). A reduction in time spent on these activities may have an effect on family nutrition and health, especially that of women and children (Holmboe-Ottesen *et al.* 1988; Popkin 1980). Furthermore, increased collection time also lead to a shift in labour division within the households. Children, especially (young) girls, may help their mother and sometimes men may assist in fuelwood collection (Howes 1985; Cecelski 1985; Eckholm *et al.* 1984; Fleuret and Fleuret 1978).

While it is widely argued that increase of time spent on wood collection changes time allocation on other activities, studies which support this are rather scarce and anecdotal. Most studies show the time effort women have to invest to collect fuelwood, which varies from as little as half an hour to as much as five hours daily per household, but a limited number of studies analysed the relationship with other activities quantitatively. Furthermore, the issue is complicated by the fact that the increased workload on wood collection is usually not the only labour constraint. Especially during the agricultural season as field work consumes most of women's time, effects of an increased collection time will be difficult to detect.

The present study examines whether an increase in time spent on fuelwood collection goes at the expense of time spent on other activities through the analysis of time allocation patterns. Time allocation patterns of women are described during the rainy season, a period of hard field work, and the post-harvest season, a period of moderate field work. Differences in these patterns between wood collection days and non-collection days are analysed among households spending over one hour per day on wood collection. Activity frequency on collection and non-collection days are compared in order to analyse whether women omit activities on collection days. To answer the question whether wood collection leads to a shift in labour division, the assistance of other household members during collection and non-collection days is compared. Data interpretation was facilitated by information from a three-generation study into changes in fuel supply and use patterns over a period of 50 years (Temmink 1993).

Research area

Research was carried out in Ntcheu District, located in the Central Region of Malawi near the Mozambican border. This district has been identified as one of the districts having apparent fuelwood supply problems, especially in the densely populated areas (ETC 1987a). The district is characterized by a relatively high population density (105 inhabitants per squared kilometer) with an annual population growth of 4.6 % (Malawi Government 1987b). The vegetation consists largely of woodland savanna with an annual precipitation of 900 mm concentrated in the rainy season. There are three seasons; a cool dry period from mid-April to mid-August, a hot period during which relative little humidity builds up between August and mid-November, and a period of tropical rains between November and April. Daily temperatures vary from 18° C in July to 36° C in October.

The study population belongs to the Ngoni ethnic group and follow a matrilineal system of inheritance and practice matrilocal marriage. Households usually occupy several dwellings located in compounds. These compounds are concentrated in villages with the agricultural fields partly surrounding these villages and partly located at further distances due to land scarcity. The majority of the households are monogamous and nuclear comprising husband, wife and children. Increasing male migration and high divorce rate resulted in a high proportion (30 %) of female headed households. People are mainly dependent on smallholder agriculture for food. The most widely cultivated crops are local varieties of maize (*Zea mays*), mixed with other crops such as finger millet (*Eleusine coracana*), pulses, groundnuts (*Arachis hypogea*) and vegetables.

Staple food production is a task of both men and women. During the agricultural season, men and women leave very early to their fields and return in the afternoon. Men usually clear land (August- September) and together men and women do the land preparation (August-September), planting, ridging and weeding (November-February) and harvesting (April-June). Women carry the harvest home in baskets. Women are exclusively responsible for food processing, preparation and distribution of food as well as water fetching and fuelwood collection. They are assisted by younger and older female household members. Water is usually available from boreholes by hand pumps, located within the villages. Fuelwood is mainly collected from natural forests and communal woodlands; some households collect wood from their own farms or farms of neighbours. Income generating activities of women are casual labour in fields of others and trade of raw and processed foods such as local beer, kachasu (a local home-made gin), dumplings and scones.

Subjects

The research locations are four villages situated along the (sandy) Ntcheu-Kasinje road. Selection was based on distance from woodlands, being less than 1.5 km (Muuso), 2.5-3 km (Kachinjika), 4-6 km (Chimpuza) and more than 6 km (Magola). Following a village census, 200 households were randomly selected (50 in each village) meeting criteria concerning permanence of residence, origin and size of household. A base-line study among these households was carried out in the dry season (Oct.-Nov. 1990) in order to collect background data on demography, farm characteristics, off-farm employment, fuel supply and use patterns.

Time allocation of women

A sub-sample of 30 households was randomly selected out of the larger research population of 200 households for a women's time allocation study. Within each household, the principal woman was selected for the time allocation study, meeting the following criteria:

- being in the age group 16-59 years
- responsible for food preparation and fuelwood collection.

Activity frequency and labour division

In addition, an activity frequency study was carried out among 120 households, also randomly selected from the larger research population. In each household, all persons

involved in food preparation and/or fuelwood collection were selected and asked about their activities.

Design and methods

Methodological considerations

The two basic methods to obtain time-activity data in developing countries are observation (including direct observation and random spot check observation) and recall interviews (Messer 1989). These methods were tested out in the present study. To collect time allocation data, the direct observation method was selected because of disadvantages experienced in the two other methods. The random spot check approach, as described by Tripp (1982), was not used because the respondents were often not at home, especially during rainy season. Other household members were not present or could not provide sufficiently detailed information on the activities of the respondent during her absence. The 24-hour recall on activities performed the day before interview starting from the time of waking (Leones 1991) did not provide accurate and complete data. Respondents selectively recalled activities and tend to forget activities taking little time or of less importance to them. Furthermore, it appeared impossible to recall reliable data on duration of the activities, also not by using local time indicators such as position of the sun, school times, size of shadows and early-morning cockcrow. However, respondents were able to report whether or not they performed specific and well-defined activities during the days in the week before interview, and this method was, therefore, selected to measure activity frequency and household labour division.

Time allocation of women

Time allocation data were collected using the direct observation method (see previous section). Subjects were observed for three consecutive days during the rainy season (Jan.-Mar. 1991, a period of hard field work) and the post-harvest season (Jun.-Aug. 1991, a period of moderate field work). Observations were carried out by a research team of well-trained male Malawian enumerators fluent in the local language under close supervision of the researcher.

Allocation of the first observation day was randomly done. An observation day started as soon as the subject awoke (in general around 5:30 a.m.) and ended in the evening after dinner (in general around 7:00 p.m.). Activities were recorded using the minute-to-minute registration technique. Of each activity a short description was given on the form. When more activities were carried out simultaneously, the main activity

(according to enumerators) was recorded. Out-of-sight activities were recorded by recall. Recall confirmed the assumption that after dinner subjects stayed inside their compounds, mainly chatting and resting before going to sleep.

For each season data of 29 households were available; a full data set for both seasons was available for 25 households.

Table 1

Classification of activities of rural women, Ntcheu District, Malawi

Activity category	Examples
Food preparation	cooking of meals (breakfast, lunch, dinner); warming-up of food; washing, peeling and chopping of ingredients; making fire, adding firewood; stirring; handling firewood to be used for cooking
Food processing	processing of maize (shelling, grading, soaking, drying, pounding; peeling, preparing and storing of vegetables, groundnuts, fish; going to maize mill
Food purchase	visit to market, shop; exchanging fuelwood with refugees
Water collection	walking to and from water pump; pumping, cleaning and filling
Fuel collection	walking to and from collection place; gathering, cutting, bundling
Agricultural field work	walking to and from field; planting, weeding, ridging, banking harvesting
Animal care	grazing cattle, goats; feeding livestock; preparing and gathering animal feed; cleaning, building, maintenance of animal shelters, paying tax
Income generating activities	brewing beer; baking cakes, scones, doughnuts; agricultural products; wage labour, piece work, collection of wood for exchange
Hygienic activities	cleaning, sweeping the house; washing clothes; washing dishes buckets, pails, baskets, mats
Household maintenance	making, maintaining and repairing floors, walls, food stores, fences, roofs, garden-tools, furniture, (kitchen) equipment
Personal care	self-care; care for others (bathing, combing hair, washing hands, getting dressed, nursing, going to hospital)
Food consumption	eating; drinking
Meetings	church services; funerals; village meetings; visits outside the village
Resting/Chatting	resting; sleeping; laying down; chatting
Miscellaneous	walking when purpose was unknown, waiting for somebody, chasing animals away from food, disturbance by research team, etc.

Activity frequency and labour division

Data on activity frequency and labour division were collected using the recall method (see section on methodological considerations). By means of a list of 14 activities[1], all subjects were asked whether and how often they performed these activities during the week prior to the interview day. Interviews were carried out once during the rainy season (January-March 1991) and once in the post-harvest season (June-August 1991).

Data analysis

All data were analysed by means of SPSS-PC 4.0 and SYSTAT software (Norusis 1990; Wilkinson 1989).

Time allocation of women

Based on the descriptions given on the form, the observed activities were categorized in 15 distinct categories according to function of activity by the enumerators (see Table 1). The initial list of categories was based on earlier research in Malawi (Beckerson 1983; Ounpuu 1988) and was slightly revised after a sub-study.[2] Time spent in minutes per day were calculated per activity. As time allocation of women on Sundays differed significantly from the other weekdays, these days were left out from further analysis.[3] Daily time spent on each activity category was calculated as a mean of the three observed days. The inter-quartile range (25th-75th percentiles) was calculated for each activity category as a measure for distribution. As the data on the different categories of time allocation were not normally distributed, statistical analysis for non-parametric data was used (Siegel and Castellan 1988). Differences in time allocation between seasons were tested with the Wilcoxon signed rank test for matched pairs, using the data of 25 households with full data set for both seasons. To analyse differences between fuelwood collection and non-collection days, those households spending more than one hour on collection per day were selected as in this group effects are more likely to be seen (rainy season: n=8, post-harvest season: n=8). Differences were tested with the Wilcoxon signed rank test for matched pairs. For all observation days comprising fuelwood collection (rainy season: n=27, post-harvest season: n=27), Spearman rank-order correlation coefficients (r_S) were calculated between time spent on fuelwood collection and time spent on other activities. A summary of number of households involved in the different analyses is given in Table 2.

Activity frequency and labour division

As the time allocation study showed that the time spending of women on Sundays significantly differed from other weekdays, these days were left out from further analysis. For the principal woman (being 16-59 yr. old and responsible for food preparation and fuelwood collection) in each household, weekdays were divided into collection and non-collection days. Of the 120 women interviewed, 78 in the rainy season and 85 in the post-harvest season had one or more fuelwood collection days. Those who did not collect fuelwood in the week prior to the interview day, were left out from further analysis. For each type of day, frequency of other activities and, only for women receiving help from other household members (rainy season: n=23, post-harvest season: n=25), frequency of activities of these members were calculated. Differences in activities and help between collection and non-collection days of the main woman, were analysed using Wilcoxon signed rank test for matched pairs (Siegel and Castellan 1988). A summary of number of households involved in the different analyses is given in Table 2.

Table 2
Summary of number of households involved in different analyses

	rainy season	post-harvest season
Time allocation of women		
- daily activity patterns	29	29
- collection vs. non-collection days	8	8
- correlations	27	27
Activity frequency and labour division		
- collection vs. non collection days	78	85
- assistance of household members	23	25

Results

Time allocation of women in the rainy and the post-harvest season

A general daily activity pattern for both the rainy and the post-harvest season is described in Table 3. During the rainy season the activity pattern of women took more time (825 minutes/day) compared to the post-harvest season (732 minutes/day). The

rainy season is typically the period of agricultural field work for women, who then spent daily about 4.5 hours in the field. During the observation period (January to March) field work comprised mainly weeding, ridging and banking, and sometimes planting of sweet potatoes. After the harvest, June to August, women spent daily on average 1 hour in the field on preparation of the field or in the vegetable gardens (Dimba gardens).[4] During the rainy season, women spent significantly less time on food processing, food consumption, hygienic activities, animal care, household maintenance, meetings and resting compared to the post-harvest season. However, no difference existed in time spent on fuelwood collection between the two seasons, as on average, women spent 20 minutes per day on this activity.

A further breakdown of time allocation in several sub-categories offers a better understanding of the seasonal differences (Table 4). Although in total, time spent on food preparation does not differ between the two seasons, sub-categorization of this activity showed that during the rainy season time spent on relish preparation and preparatory activities such as washing, peeling, and cutting of ingredients, was increased. Preparatory activities also include the collection of vegetables prior to food preparation. It may be possible that time spent on this particular activity increased, as during the rainy season households are running short of food and may rely on collected wild foods. However, present data do not allow to confirm this. The reduction of time spent on food processing during the rainy season was mainly due to a decrease in preparation of food for further use. Within the hygienic activities, women spent less time in sweeping the area around their house in the rainy season compared to the post-harvest season.

Fuelwood collection versus non-collection days

Except for seasonal changes, weekdays are quite similar and activities such as food preparation, water fetching, hygienic activities and personal care recur every day. Other activities regularly carried out are fuelwood collection, food processing activities and purchase of food, whereas attending meetings and income generating activities are less frequently occurring activities. Agricultural field work is a daily activity during the rainy season, but is less frequently performed during the post-harvest season.

The presentation of time allocation data as a daily activity pattern should therefore be interpreted with care. Especially time spent on non-daily activities such as

Table 3

Average daily time allocation of rural women on weekdays during two seasons, Ntcheu District, Malawi[a]

	Rainy season (n=29)		Post-harvest season (n=29)		
	minutes[b]	%n[c]	minutes[b]	%n[c]	
Food preparation	126 (102-156)	100	102 (81-109)	100	
Food processing	19 (0-33)	62	60 (4-112)	86	†
Food purchase	35 (0-21)	69	7 (0-13)	55	
Water fetching	34 (19-46)	100	41 (23-63)	97	
Fuelwood collection	19 (0-29)	62	20 (0-36)	66	
Agricultural fieldwork	279 (232-341)	97	63 (0-134)	45	†
Animal care	0 (0-0.3)	28	4 (0-3)	38	†
Income generating activities	5 (0-2)	28	19 (0-10)	35	
Hygienic activities	49 (26-57)	100	62 (41-86)	100	†
Household maintenance	1 (0-0)	7	21 (0-32)	41	†
Personal care	71 (37-99)	100	65 (43-81)	100	
Food consumption	36 (28-42)	100	39 (32-46)	100	†
Meetings	5 (0-2)	24	42 (0-38)	55	†
Resting	128 (74-176)	100	172 (102-238)	100	†
Miscellaneous	19 (7-27)	100	13 (8-16)	100	
Total	825 (803-852)		732 (716-749)		†

[a] Based on an average of three observation days per woman in a period of 6-7 weeks in Jan-Mar 1991 (rainy season) and in Jun-Aug 1991 (post-harvest season).

[b] Mean (25th-75th percentiles) of total group

[c] Sub-group that is actually engaged in activity

† Differences between seasons is significant $p<0.05$ (n=25)

Table 4

Average daily time allocation on different domestic tasks of rural women on weekdays during two seasons, Ntcheu District, Malawi[a]

	Rainy season (n=29)		Post-harvest season (n=29)		
	minutes[b]	%n[c]	minutes[b]	%n[c]	
Food preparation					
Preparatory activities	61 (45-79)	100	41 (24-53)	100	†
Meal preparation	40 (28-51)	100	43 (31-49)	100	
Relish preparation	20 (10-20)	100	13 (7-19)	100	†
Wood handling	16 (2-11)	83	5 (2-8)	86	
Food processing					
Preparation for further use	10 (0-11)	55	44 (4-69)	86	†
Pounding maize	3 (0-0)	10	11 (0-0)	21	
Visit grain mill	6 (0-8)	28	6 (0-0)	14	
Fuelwood collection					
Walking	12 (0-17)	52	7 (0-10)	59	
Chopping, bundling	7 (0-11)	59	13 (0-24)	55	
Hygienic activities					
Cleaning inside house	8 (3-10)	90	6 (3-9)	97	
Sweeping around house	6 (0-9)	62	13 (0-24)	100	†
Washing clothes	8 (0-11)	48	14 (0-27)	52	
Washing dishes	28 (14-39)	100	29 (17-40)	100	
Care					
Self-care	34 (25-38)	100	38 (28-46)	100	
Care for others	37 (3-67)	97	28 (7-37)	97	

[a] Based on an average of three observation days per woman in a period 0f 6-7 weeks in Jan-Mar 1991 (rainy season) and in Jun-Aug 1991 (post-harvest season).

[b] Mean (25th-75th percentiles) of total group

[c] Sub-group that is actually engaged in activity

† Differences between seasons is significant $p<0.05$ (n=25)

fuelwood collection is heavily diluted. Households, in general, collect fuelwood 2 to 3 times a week. During the rainy season, 18 out of 29 households collected fuelwood on at least one of the observation days, spending on average 60 minutes per day (inter-quartile range: 18-92 min.). For the post-harvest season 19 households collected fuelwood on one of the observation days with an average time spending of 65 minutes (inter-quartile range: 11-105 min.).

In order to analyse whether households economize time spent on other activities during fuelwood collection days, time allocation patterns of fuelwood collection and non-collection days were compared among households spending more than one hour on fuelwood collection during one of the observation days. Table 5 shows the results of both the rainy season and the post-harvest season.

During collection days in both seasons, not only time spent on fuelwood collection was increased, but women also spent more time on agricultural field work, although the time costs of field work during the post-harvest season was much less compared to the rainy season. This may suggest that in both seasons women combine fuelwood collection with agricultural field work.

In both the rainy and the post-harvest season, no differences existed in total time spending between collection and non-collection days. The extra time spent on fuelwood collection and agricultural field work on collection days in rainy season (134 min.) and post-harvest season (150 min.) was mainly compensated for by a reduction of total time spent on other activities. Although none of the separate activities was significantly different, data suggest that in the rainy season time was mainly reduced in food purchase, resting, food processing and food preparation. Time spent on personal care seemed to be increased on collection days. During post-harvest season, although not significant for all activities, data suggest that time was mainly reduced on resting and food processing. Time spent on water fetching and, although not significant, on food preparation were increased during collection days.

A further specification of domestic tasks during both seasons indicated that during the rainy season the reduction of time spent in food preparation on collection days was mainly due to a decrease in time spent on preparatory activities (by 17 min.) and relish preparation (by 9 min.). In both seasons pounding of maize and visit to mill are activities not carried out during collection days. During the rainy season the increase in time spent on personal care was completely due to an increase in time spent on care of others (by 40 min.). During the rainy season, prevalence of illnesses such as malaria and colds is increased and people visit hospitals more frequently. Data may suggest that fuelwood collection was combined with walking to the hospital when especially undertaken to receive treatment for other household members.

Table 5

Activity pattern of women on fuelwood collection and non-collection days in rainy season (n=8) and post-harvest season (n=8), Ntcheu District, Malawi [a b]

	Rainy season				Post-harvest season			
	collection day		non-collection day		collection days		non-collection days	
Fuelwood collection	**107**	**(80-108)**	**0**	**(0-0)** †	**125**	**(89-158)**	**0**	**(0-0)** †
Agricultural fieldwork	**292**	**(196-415)**	**265**	**(74-404)**	**37**	**(0-52)**	**12**	**(0-0)**
Other activities	**428**	**(326-520)**	**558**	**(397-735)**	**589**	**(561-657)**	**729**	**(709-737)** †
Food preparation	103	(79-124)	126	(86-159)	108	(66-147)	88	(74-101)
Food processing	11	(0-18)	38	(0-107)	35	(0-86)	100	(0-157)
Food purchase	13	(0-4)	75	(0-44)	2	(0-2)	29	(0-57) †
Water fetching	28	(6-52)	22	(1-45)	59	(32-97)	35	(15-51) †
Animal care	1	(0-0)	0	(0-0)	0	(0-0)	2	(0-4)
Income generating activities	0	(0-0)	4	(0-0)	17	(0-2)	23	(0-21)
Hygienic activities	47	(33-65)	55	(10-98)	70	(25-124)	62	(28-88)
Household maintenance	0	(0-0)	0	(0-0)	6	(0-15)	8	(0-3)
Personal care	91	(32-123)	51	(25-81)	75	(34-114)	74	(43-67)
Food consumption	32	(19-30)	27	(19-30)	39	(27-50)	40	(31-45)
Meetings	0	(0-0)	0	(0-0)	47	(0-86)	61	(0-153)
Resting	95	(44-157)	134	(38-236)	117	(41-174)	197	(84-299)
Miscellaneous	7	(3-12)	26	(8-36) †	15	(5-16)	9	(6-11)
Total	**827**	**(806-865)**	**823**	**(798-854)**	**751**	**(724-787)**	**740**	**(711-765)**

[a] Women are selected on the basis of spending more than 60 minutes on fuelwood collection during one of the observation days

[b] Mean (25th-75th percentiles)

† Differences within season between collection and non-collection days is significant $p<0.05$

In order to examine whether an increase in time spent on fuelwood collection was correlated with a decrease in time spent on other activities, Spearman rank-order correlation coefficients between time spent on fuelwood collection and time spent on other activities were calculated for all fuelwood collection days. Results of the rainy season showed (Table 6), that increase in time spent on fuel collection was correlated with a decrease in time spent on food preparation, fetching water, resting and the miscellaneous activities and, to a lesser extent, on income generating activities, food consumption and meetings. Correlations with agricultural field work (r_S=0.22) and animal care (r_S=0.30) were positive, although the correlation with animal care is suspected due to the low number of women carrying out this activity.

Table 6

Spearman rank-order correlation coefficients of time spent on fuelwood collection and on other activities during rainy season (n=27) and post-harvest season (n=27), Ntcheu District, Malawi

Fuelwood Collection versus	rainy season	post-harvest season
Food preparation	-0.47 †	-0.07 †
Food processing	-0.07	-0.02
Food purchasing	-0.14	-0.18
Water fetching	-0.37 †	0.19
Agricultural fieldwork	0.22	0.20
Animal care	0.30	-0.41 †
Income generating activities	-0.28	0.03
Hygienic activities	0.08	0.20
Household maintenance	-0.18	0.09
Personal care	-0.11	-0.14
Food consumption	-0.26	-0.14
Meetings	-0.20	0.11
Resting	-0.32 †	-0.39 †
Miscellaneous	-0.39 †	-0.00

† $p<0.05$

Correlations in the post-harvest season were much weaker. Increase in time spent on fuelwood collection was correlated with a decrease in time spent on resting and food preparation, although the last showed a very low correlation. Correlations with agricultural field work (r_S=0.20) and hygienic activities (r_S=0.20) are positive,

although not significant. The relative high correlation with animal care (r_S=-0.41) is again suspected due to low number of women involved in this activity.

Activity frequency and labour division

Women may economize on time spent on activities by omitting activities from the daily pattern or by performing the activity but spending less time. Table 7 shows the frequency of different activities on fuelwood collection days and non-collection days during both seasons. Data indicate that in both seasons frequency of field work was increased during collection days, again suggesting that fuelwood collection was combined with fieldwork. In both seasons, no reduction in frequency in any other activity occurred.

When women spent less time per activity, they could ask the help of other household members to assist them in these activities. In most of the households (65 %) one woman carried out all activities, in 32 % of the households tasks were divided among two women and in 3 % three women shared the different tasks. Among the households where more members shared tasks, the help was mainly received from younger girls (58 % between 11-19 years old and 6 % between 6-10 years old) and sometimes from elderly women (9 % was 60 years old or more).

The assistance of other household members on collection and non-collection days of the principal woman, was compared (Table 7). Results indicate that in both seasons no differences existed in frequencies of activities of assisting household members between collection and non-collection days of the principal women. This indicates, that household members did not assist in tasks during collection days, which they normally do not carry out on non-collection days.

Discussion and conclusions

Time allocation data are valuable tools for describing the behaviour of people and the changes therein (Messer 1989; Johnson 1990; Wollenberg 1988). In general, direct observation is considered as the most accurate and reliable method to collect detailed data on time allocation (Leones 1991; Wollenberg 1988), especially in areas with little knowledge on activity patterns of the population. On the other hand, the method has some short comings such as limitation to small numbers of individuals and short periods of time (Johnson 1990). Representativeness of the sample was met by randomly selection of individuals from the research population. However, the relative

Table 7

Frequency of activities carried out on fuelwood collection and non-collection weekdays during the rainy and post-harvest season by the principal woman and other household members, Ntcheu District, Malawi [a]

	Rainy season				Post-harvest season			
	principal woman (n=78)		other members (n=23)		principal women (n=85)		other members (n=25)	
	coll.day	ncoll.day	coll.day	ncoll.day	coll.day	ncoll.day	coll.day	ncoll.day
Food preparation[b]	3.1 (2.3-4.0)	3.0 (2.4-4.0)	1.5 (0.7-2.0)	1.6 (0.5-2.8)	4.1 (3.3-5.0)	4.0 (3.1-5.0)	1.6 (0.0-3.0)	1.6 (1.1-2.1)
Food processing[c]	0.1 (0.0-0.2)	0.1 (0.0-0.2)	0.1 (0.0-0.0)	0.1 (0.0-0.2)	0.2 (0.0-0.3)	0.1 (0.0-0.2)	0.2 (0.0-0.3)	0.2 (0.0-0.3)
Water fetching	2.6 (2.0-3.0)	2.6 (2.0-3.3)	1.8 (1.0-2.5)	1.8 (1.0-2.4)	3.0 (2.0-4.0)	3.0 (2.2--3.5)	2.0 (1.0-3.0)	2.1 (1.0-3.0)
Agricultural field work	0.8 (0.7-1.0)	0.5 † (0.3-0.8)	0.8 (0.5-1.0)	0.7 (0.0-1.0)	0.3 (0.0-0.8)	0.2 † (0.0-0.5)	0.1 (0.0-0.0)	0.2 (0.0-0.3)
Hygienic activities[d]	1.2 (0.7-1.7)	1.3 (0.8-1.7)	0.6 (0.0-1.0)	0.6 (0.3-1.0)	1.4 (1.0-2.0)	1.4 (1.2-1.8)	0.7 (0.7-1.0)	0.7 (0.2-1.2)

legend: coll.day = fuelwood collection day; ncoll.day = non-collection day

[a] Mean (25th-75th percentiles)

[b] Food preparation includes preparation of breakfast, lunch and dinner, preparation of bean's relish and other relish, warming up of relish

[c] Food processing includes pounding of maize, visit to mill

[d] Hygienic activities includes sweeping inside and outside the house, washing clothes

† Differences within season between collection and non-collection days is significant $p<0.05$

small number of individuals did not allow to perform disaggregate analysis according to, for example, socio-economic variables. Another limitation is the restriction of data collection to two observation periods of 6-7 weeks, although days were randomly allocated. As these periods can be considered as 'extreme' (in garden labour and food availability), they compensate for the absence of a complete year. Furthermore, the way people spent their time is a significant feature of life-style and varies from culture to culture (Messer 1989). Generalizing results found among the Ngoni ethnic group to population groups with other characteristics, should therefore be done with much care. However, this study gives insight in the mechanisms how women deal with time.

Data from both the rainy and the post-harvest season offered the possibility to analyse time allocation patterns in a period of hard field work (January-March 1991) and a period of moderate field work (June-August 1991). Results indicate that when women have to collect fuelwood, they economize time spent on resting and food processing. Time spent on other activities such as food preparation and food purchase is affected when, besides fuelwood collection, also agricultural field work asks a great deal of women's time. This conclusion is supported by the negative correlations of fuelwood collection time with time spent on almost all other activities during the rainy season, whereas during the post-harvest season collection time is only negatively correlated with a limited number of activities.

Fuelwood collection, together with agricultural field work and water fetching, are the most human energy consuming activities (WHO 1985; James and Schofield 1990). If time spent on fuelwood collection goes at the costs of time spent in less human energy consuming activities such resting, the energy requirements of women will increase (Maloiy *et al.* 1986). High energy expenditure is undoubtedly an additional stress for rural women whose nutritional status is relatively low (Lado 1992). The reduction of time spent on food preparation, especially in rainy season, may indicate that women prepare food that need less cooking time or reduce frequency of cooking. This may affect the nutritional adequacy of the diet both in terms of quantity and quality.

Results showed, that the activity pattern of women in the research area still shows some flexibility to meet extra demands in time. The extra time needed for field work is, among others, met by longer working hours per day. The extra demand fuelwood collection places on time, is not met by an increase in total time spending. Nor do women omit activities from their daily pattern. All activities are still carried out, but women perform the activities in a shorter time. This suggest that women are busier during collection days, which is also supported by the reduction of leisure time during these days. Women in the research area also admitted they still carry out all the

activities, but that they have to perform them faster. However, this could not be verified by the present study as time allocation data do not provide good measures of labour intensity, only of the amount of time spent on a task (Leones 1991; Wollenberg 1988). Furthermore, as the domestic and productive tasks have always been a woman's responsibility, women generally feel that not performing one of these activities is tantamount to admitting failure as a women and wife (Holmboe-Ottesen *et al.* 1988; Bradley 1991). This could be illustrated by a citation of one of the women " We still carry out all the activities, because we are women, so we have to work even if we are tired". As also argued in a previous chapter (Chapter 4), women do not increase time spent on fuelwood collection without limits. When costs in terms of time become to high, or, as suggested in this paper, women are forced to omit activities, women will look for other strategies to cope with fuelwood shortages that ask less time of them, such as collecting wood more nearby or even purchase wood when funds are available.

There are no indications that women receive more help from others during collection days. This may suggest that the other household members are already fully involved in all tasks. They will not have time to take over extra tasks from the principal women without compromising on their own time allocation. However, although other household members do not perform tasks during collection days they normally do not carry out on other days, the study did not allow to analyse whether the household members spent more time on some activities.

In literature is has been widely argued that increased time spent on fuelwood collection affects time spent on other activities such as food production, food processing, food preparation, income generating activities and leisure time (Kumar and Hotchkiss 1988; Cecelski 1985; Hoskins 1980). Also, increased collection time may lead to involvement of especially younger girls in domestic tasks (Howes 1985; Cecelski 1985; Eckholm *et al.* 1984; Fleuret and Fleuret 1978). This study showed, that women reduced time spent on resting and food processing on days the collected fuelwood. Time spent on other activities such as food preparation and food purchase was reduced when besides fuel collection also agricultural field work put a high demand on women's time. The present paper, therefore, suggests that effects on time allocation are not only outcomes of extra time spent in fuelwood collection, but moreover of more fundamental issues related to competing demands for labour.

Notes

1. These activities include: agricultural field work, fuelwood collection, preparation of breakfast, lunch and dinner, preparation of bean's relish and other relish, warming up of relish, sweeping inside and outside the house, water fetching, pounding maize, visit to mill and washing clothes.
2. Results of time allocation studies highly depend on the way activities are defined and on how activities are grouped (Johnson 1990). In a sub-study, special attention was paid to this categorization. The categorization used by the researcher was compared with the way women grouped their activities by means of drawings of different activities. It was obvious that researcher and women used different criteria for grouping activities. While the researcher categorized activities according to function, women used the concept of time as a decisive characteristic in terms of order of activities, duration of activity, frequency and planned or unexpected character of activity. The grouping of activities by women was not suitable for analytical purposes. However, the existing categorization was as much as possible adjusted to the opinion of the women, but stayed based on function of activity (Stocking-Korzen 1991).
3. According to the culture Sundays are rest-days and women are not supposed to work. No time is spent in the field and generally no women carry out income generating activities. Also fuelwood collection is an activity not carried out at Sundays. In view of the already anticipated differences between Sundays and weekdays, the observation period of 6 households including the Sunday, were extended for one day.
4. Dimba gardens are pieces of land that, due to proximity to some source of water (a stream or well) retain their moisture for all or most of the year.

7

Household fuel use and food consumption: relationship and seasonal effects in Central Malawi

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Abstract - *The present study analysed the relationship between household fuel use on the one hand, and food preparation and consumption on the other. Data were collected in the rainy season, a period of relatively low food availability, and in the post-harvest season, a period of sufficient food availability. In both seasons, a high fuel use was associated with a high energy intake. In the rainy season, this association was mainly determined by food availability whereas in the post-harvest season fuelwood availability was a detrminant of food intake as the correlations became stronger with decreasing fuelwood availability. In both seasons, households with a high fuel use showed a high energy intake from cooked foods made of cereals. Only in the post-harvest season, a high fuel use was also related with a high energy intake from other food groups, especially beans. In the rainy season, vegetable intake was increased with an increase in fuel use, but this did not affect energy intake due to the low calorie content of vegetables. Especially the reduction of intake from food groups other than cereals forms a point of concern in view of the already overwhelming dependence on cereals. A reduced fuel use may reduce the already marginal quality of the diet.*

Introduction

Fuelwood is the primary source of household energy for developing countries. Rural populations use fuelwood mainly to cook and preserve food. But due to widespread deforestation especially in the arid and semi-arid countries and the eastern and south-eastern parts of Africa, fuelwood supplies are being depleted rapidly (FAO 1981).

Women, as they are mainly responsible for fuel acquisition, respond to the decreasing fuelwood availability and develop actions to cope with it. These actions include a reduction in fuel consumption (Chapter 2). As 80 % of household fuel energy consumption is used for cooking (Cecelski *et al.* 1979), it seems logic that a shortage of fuel affects dietary patterns and food intake. Women may reduce cooking time or cooking frequency by preparing fewer meals, by cooking larger amounts of food at one time or eating cold or warmed up food that was previously prepared (Eckholm *et al.* 1984; Alcántara 1986; Dasgupta and Maita 1986; Cecelski 1987). Foods with longer cooking times such as pulses and whole cereals may be substituted by less fuel consuming foods (Hoskins 1980; Hosier 1984; Alcántara 1986; Ardayfio 1986; Mildeberger 1986; Shanahan 1986; Cecelski 1987). Due to fuel shortage the consumption of snacks, ready-made foods, soft drinks, sweets and fruits may be increased (Evans 1984; Ardayfio 1986). Insufficient heat treatment in food preparation and preservation may lead to food contamination and food spoilage (Motarjemi *et al.* 1993). Changes in food consumption might affect quality and quantity of food intake (Chapter 2).

There are many references in current literature to the relationship between fuel shortage and nutrition. However, most of these references are based on limited research or anecdotal evidence. More data are needed before the assumptions regarding nutritional impact of a fuelwood shortage can be taken as facts and safely used as the basis for development strategies and implementations (FAO 1990/91).

The aim of the present study was to analyse the association between household fuelwood use on the one hand, and household food preparation and consumption on the other in an area under conditions of moderate fuelwood scarcity. The analyses are based on data collected in two seasons: the rainy (pre-harvest) season, a period of relatively low food availability, and the post-harvest season, a period of sufficient food availability.

Study area

The present study was carried out in Ntcheu District in the Central Region of Malawi. The district is characterized by a relatively high population density (105 inhabitants per km^2) with an annual population growth of 4.6 % (Malawi Government 1987b). The vegetation consists largely of woodland savanna with an annual precipitation of 900 mm concentrated during the months of November till April. The Ngoni, the main ethnic group in Ntcheu District, are subsistence farmers. Main food crops cultivated are local varieties of maize (*Zea mays*), inter cropped with finger millet (*Eleusine coracana*), sorghum (*Sorghum vulgare*) and groundnuts (*Arachis hypogea*). Other crops grown are pulses, fruit trees and vegetables such as turnips (*Brassica juncea*), pumpkin leaves (*Cucurbita maxima*), sugar cane (*Saccharum officinarum*), tomatoes (*Lycopersicum*) and onions (*Allium cepa*). Some households grow vegetables during the whole year in *dimba* gardens: pieces of land which retain their moisture because of proximity to some source of water (Hirschmann and Vaughan 1983/84). There are three seasons: a rainy season from November till April which is the period of most agricultural labour; a cold dry season from April till August when most crops are harvested (Figure 1) and a hot dry season from August till October. Staple food production is a task of both men and women, but women take care of the processing, preparation and distribution of foods. To supplement own production, people buy maize, vegetables, fruits, sugar, local salt, tea and snacks such as boiled eggs, scones and dumplings at market places, small local groceries and from neighbours. Due to the presence of Mozambican refugees during the research period, Malawians exchanged fuelwood and beans for maize flour refugees received from aid agencies. Fuelwood is mainly collected from natural forests and communal woodlands and is predominantly a women's task. Households were suffering fuelwood problems although conditions still compare favourable with other parts of Africa. Most households reported to be able to collect enough fuelwood although 24 % already replied to the contrary. Households in villages situated at a long distance from woodlands experienced more problems in fuelwood collection (Chapter 4).

Subjects and study design

The research locations are four villages situated along the Ntcheu-Kasinje road. Selection of villages was based on distance from woodlands, being less than 1.5 km (Muuso), 2.5-3 km (Kachinjika), 4-6 km (Chimpuza) and more than 6 km (Magola)

from woodlands. Following a village census, 200 households were randomly selected (50 in each village) meeting criteria concerning permanent residence, origin and size of household. A general questionnaire was administered to each household in Oct-Nov 1990 (dry season) concerning demographic and farm characteristics, off-farm employment, fuel use and supply patterns.

From this larger study population, 120 households were randomly selected to be involved in a household food consumption and fuelwood use study. Data were collected for two seasons: rainy season (Jan-Mar 1991), a period of hard fieldwork and relatively low food availability, and post-harvest season (Jun-Aug 1991) characterized by moderate fieldwork and sufficient food availability.

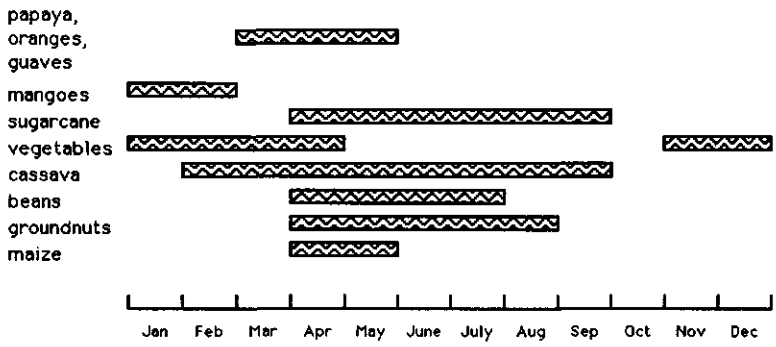

Figure 1

Agricultural calendar in the research area, Ntcheu District, Malawi (blocks indicate harvest time)

Methods

Household food preparation and consumption

Data on frequency of food preparation were collected using the recall method. All persons in the households involved in food preparation were asked how often they prepared breakfast, lunch, dinner, relish of beans and vegetable relish and how often they warmed up previously prepared food during the week prior to the interview day.

The 24-hour recall (Cameron and van Staveren 1988) was used to measure household food consumption. Allocation of interviews to different weekdays was done on a randomly basis. In each household the woman responsible for food preparation was asked to recall all foods and dishes prepared and consumed by the household members the day before the interview day. She was also asked to show the exact amount of ingredients used and these amounts were weighed. When the ingredient was not available, the woman was asked to indicate the size, or to show the bowl used and to indicate volume of the ingredient by means of water. The amount of water was weighed in order to estimate volume. Conversion factors from size or volume to weight were determined afterwards. For all foods consumed, the percentage consumed and the number of people having taken part in the consumption (divided in 0-5 and 6-15 year old children and adults of 16 years and above) were indicated. Source of ingredient was recorded, whether it was provided by own production (stock or field), purchased, a gift or otherwise.

Amount of fuelwood collected and used

All persons involved in fuelwood collection were asked their frequency of collection the week prior to the interview day. They were asked to show the bundle they normally collected and this bundle was weighed.

Women responsible for food preparation were asked to lay out wood equivalent to the amount of wood used for domestic purposes the day covered by the 24-hour food consumption recall, and to indicate the type of wood (being splitwood, branches, twigs, crop residues or any combination of these). This amount was weighed.

Data analysis

Household food preparation and consumption

Frequency of food preparation and warming up of foods in the household was calculated by adding cooking frequency mentioned for each individual member of the household.

The amounts of all foods consumed in the household as measured by the 24-hour recall were converted into energy and protein intake using food composition tables (Platt 1962; Leung Wu *et al.* 1968; West *et al.* 1988). For description of household food intake, energy and protein intake were calculated per consumer unit for each food consumed based on the number of partakers (divided in age groups of 0-5, 6-15 and 16+ years old) in consumption of the particular food. A consumer unit is equal to a reference adult male of 18-29 years of age. Energy requirement of the reference adult male was estimated at 12.3 MJ per day, using body weight (59.1 kg), BMR (in kcal: 15.3*body weight+679) and energy requirements (in kcal: 1.86*BMR) according to James and Schofield (1990). For lack of quantitative data on physical activity pattern of men the same average value was used throughout the year. All other household members were expressed as ratio of this reference adult male based on their estimated nutritional requirements. The ENREQ spreadsheet (James and Schofield 1990) was used to calculate the energy requirements. ENREQ is based on the method proposed in the report of the joint FAO/WHO/UNU Expert Consultation on Energy and Protein Requirements (WHO 1985) and takes into account sex, age, body size, pregnancy, activity patterns and infections (0-5 y: 0.37*cu; 6-15 y: 0.62*cu; 16+ y: 0.84*cu). Daily energy and protein intake was calculated by adding up intake per food consumed, expressed per consumer unit. Likewise, intake for different food groups, mealtimes and food sources were calculated.

For analysis of the association between household fuel use and household energy intake, total energy intake was calculated by adding up total intake per food consumed, expressed per household and not per consumer unit. Energy intake was expressed as total daily energy intake, as intake through cooked food and food not prepared by the household, and as intake through cereals and other food groups.

Amount of fuelwood collected and used.

Total weekly amount of fuelwood collected was calculated based on frequency of collection, number of persons involved and amount of wood collected per trip.

Statistics

All data were analysed by means of SPSS-PC 4.0 software (Norusis 1990). Medians of total fuelwood collected and frequency of food preparation in the rainy and the post-harvest season were compared using the Wilcoxon signed rank test for pairs (Siegel and Castellan 1988). Spearman rank-order correlation was used to study the association between total fuelwood collected and frequency of food preparation. Means of fuel use, total energy and protein intake, and contributions in energy intake of food groups, mealtimes and food sources in the rainy and the post-harvest season were compared using the paired t test and Chi-squared test. Multiple linear regression analysis was used in order to predict household fuel use (Kleinbaum *et al.* 1988). Partial correlations (holding household size constant) were used to study the association between household fuel use and total energy intake, intake from cooked food and food not prepared in the household, and intake from cereals and other food groups.

Results

Seasonal variation in fuelwood collection and use.

Table 1 shows that no seasonal differences existed in total weekly amount of fuelwood collected and daily fuelwood use. Households collected approximately 50 kg fuelwood per week for domestic purposes and used on average 7 kg of fuelwood per day for food preparation and water heating. The correlation between total weekly wood collected and daily fuelwood use was high: in the rainy season r_S=0.70, $p<0.001$ and in the post-harvest season r_S=0.64, $p<0.001$. No differences between the seasons existed in percentage of households using twigs (18 %) and using fuel for cooking only (3-9 %).

The size of the household, the total yearly income of the household, the use of twigs, the purpose of the fuel used and the village of origin were used in a multiple regression analysis as possible explanatory variables of household fuel consumption (Table 2). In the rainy season, a period with a relatively low food availability, twig use and purpose of fuel used were significantly related to household fuel use. Households using twigs used less fuel compared to those using splitwood and branches. Households using fuelwood only for cooking used less fuelwood than those using fuel for cooking and water heating. Size of household, yearly household income and village of origin were not related with household fuel use.

Table 1

Weekly fuelwood collected and daily fuelwood use of rural households during two seasons, Ntcheu District, Malawi.

	rainy season		post-harvest season	
Fuelwood collected				
Total amount collected (kg/week)*	51.2	(36.0-63.0)	50.3	(40.6-63.7)
Fuelwood use				
Fuelwood consumed (kg/day)**	7.2	(2.6)	6.5	(2.0)
Use of twigs (%)	18		17	
Purpose of fuel (%)				
cooking	9		3	
cooking and water heating	91		97	

* median (25th-75th percentiles)

** mean (standard deviation)

Table 2

Determinants of household fuel use in a multiple linear regression model, Ntcheu District, Malawi

Determinants	rainy season		post-harvest season	
	B*	p-value	B*	p-value
Household size	0.11	0.260	0.36	0.000
Yearly income	0.11	0.251	0.11	0.228
Twig use**	-0.22	0.018	-0.10	0.246
Purpose of fuel***	0.25	0.008	0.02	0.808
Magola vs. Muuso	-0.15	0.195	-0.35	0.003
Chimpuza vs. Muuso	-0.17	0.141	-0.26	0.016
Kachinjika vs. Muuso	-0.07	0.531	-0.16	0.129
Model R^2	0.14	0.002	0.25	0.000

* B=standardized beta, dependant variable is household fuel use (kg/day)

** dummy variable for twig use: no twig use=0; twig use=1.

*** dummy variable for purpose of fuel used: cooking only=0; cooking+water heating=1.

In the post-harvest season, a period with sufficient food availability, household size and village of origin were the main predictors of fuel use. The amount of fuelwood used increased with increasing household size. Households originating from Magola

and Chimpuza, situated more than 6 km and 4-6 km from woodlands respectively, used significantly less wood than those from Muuso, situated nearest to woodlands. The standardized beta's show that fuel use reduced with increasing distance from woodlands. Yearly income, use of twigs, purpose of fuelwood used were not related to daily household fuel use.

Seasonal variation in food preparation and intake.

Frequency of food preparation and mean household energy intake in the rainy and the post-harvest season are presented in Table 3. Total energy intake ranged from 9.5 MJ in the rainy season to 12.0 MJ in the post-harvest season. Carbohydrates provided the majority of the energy intake, being 83 and 79 % with the highest contribution in the rainy season. In the post-harvest season there was a slight shift from carbohydrates to fat, as the contribution of fat to energy intake raised from 6 to 10 %. However, even in the post-harvest season, the contribution of fat remained below the lower limit of 15 energy % for a safe fat intake as suggested by the WHO (1990). Protein intake remained around 11 % in both seasons, which is just above the lower limit (10%) and can be considered as safe (WHO 1990).

Table 3

Frequency of food preparation and food intake of rural households during two seasons, Ntcheu District, Malawi

	rainy season	post harvest season	
Food intake			
Total energy intake (MJ/cu/day)*	9.5 (4.0)	12.0 (4.5)	†
carbohydrates (en%)	83 (8)	79 (7)	†
protein (en%)	11 (3)	12 (2)	
fat (en%)	6 (6)	10 (6)	†
*Weekly frequency of preparation***			
breakfast	0 (0-5)	7 (3-7)	†
lunch (staple only)	7 (6-7)	7 (7-7)	†
dinner (staple only)	7 (7-7)	7 (7-7)	†
beans relish	0 (0-1)	1 (1-2)	†
other relish	7 (7-9)	6 (6-7)	
warming up of food	1 (0-5)	6 (2-7)	†

* mean (standard deviation)

** median (25th-75th percentiles)

† $p < 0.05$

In both seasons lunch, dinner and vegetable relish were prepared daily (Table 3). In the rainy season, households prepared hardly breakfast, but in the post-harvest season breakfast was prepared seven days a week. Beans relish was hardly prepared during the rainy season, whereas households cooked beans on average once a week during the post-harvest season. Warming up of food took most frequently place during the post-harvest season.

Contribution to energy and protein intake of the different food groups, mealtimes and food sources are presented in Table 4. The diet of the research population consisted predominantly of cereals, which accounted for 76 to 85 % of the total dietary energy and 67 to 75 % of the total protein intake. The highest contribution was found in the rainy season and the lowest during the post-harvest season. Maize was the major cereal available in both seasons. Legumes and nuts, mainly beans and groundnuts, were the second highest source, supplying 3 to 9 % of energy and 7 to 19 % of protein intake in the rainy and the post-harvest season respectively.

The contribution of the other food groups was very little. Cassava and sweet potatoes were the main roots consumed during the post-harvest season, accounting for 4 % of energy and 2 % of protein intake. Vegetables, in the form of green leafy vegetables, contributed only 2% of energy intake in both seasons and 5-7 % of protein intake with the highest contribution in the rainy season. Consumption of fruits, especially mangoes, was restricted to the rainy season, accounting for 5 % of energy and 2 % of protein intake. Animal products such as chicken meat and beef, contributed mainly to protein intake (5-9 % with the highest contribution in the rainy season). Fats and oils supplied negligible amounts of protein and energy. Especially the consumption of sugarcane in the post-harvest season, raised the contribution to energy intake of the miscellaneous group from 2 % in the rainy season to 7 % in the post-harvest season.

Lunch and dinner are the main sources of energy and protein intake, supplying on average 40 % in both seasons. During these mealtimes, a thick porridge made of maize flour (*nsima*) is prepared and served with a relish made of vegetables and, sometimes, with beans or meat. Breakfast, comprising of a thin maize flour porridge (*phala*) or tea with bread, accounted for a higher contribution to energy intake in the post-harvest season (12 % compared to 8 % in the rainy season), but season did not affect contribution of breakfast to protein intake. Consumption of food in between the meals such as fried maize kernels or scones, added little to energy and protein intake in both seasons.

Table 4

Relative contribution of different food groups, mealtimes and food sources to energy and protein intake (%) in the rainy and post-harvest season, Ntcheu District, Malawi (n=111)

		ENERGY					PROTEIN			
		rainy		post-harvest			rainy		post-harvest	
Total intake	MJ (sd)	9.5	(4.0)	12.0	(4.5)	g (sd)	62	(29)	86	(39)
		%	(sd)	%	(sd)		%	(sd)	%	(sd)
Food groups										
Cereals		85	(38)	76	(28)*		75	(35)	67	(25)*
Roots, tubers, starchy fruits		0	(3)	4	(7)*		0	(1)	2	(3)*
Legumes, nuts		3	(8)	9	(14)*		7	(20)	19	(31)*
Vegetables		2	(2)	2	(2)		7	(8)	5	(6)*
Fruits		5	(9)	0	(1)*		2	(4)	0	(1)*
Animal products		3	(13)	2	(10)		9	(29)	5	(20)
Fats, oils		0	(0)	0	(1)		0	(0)	0	(0)
Miscellaneous[1]		2	(5)	7	(9)*		1	(4)	2	(10)
Mealtime										
Breakfast		8	(13)	12	(11)*		6	(10)	7	(9)
Lunch		41	(22)	41	(19)		43	(27)	43	(24)
Dinner		42	(19)	41	(16)		45	(24)	45	(22)
In-between		9	(13)	7	(9)		6	(11)	5	(9)
Food source										
Own production		25	(45)	88	(34)*		29	(47)	86	(41)*
Purchase		65	(48)	11	(16)*		63	(50)	10	(21)*
Gift		5	(19)	2	(7)		5	(17)	3	(14)
Other sources[2]		5	(21)	0	(2)*		4	(18)	10	(4)*

* different from rainy season, $p<0.05$

[1] Miscellaneous includes beer cocoa, herbs, scones, pepper, dumplings, sugar, sugarcane, tea, yeast

[2] Other food sources include exchange with refugees, food-for-work, food aid

During the post-harvest season, most of the households relied on their own produced food, supplying 88 % of the energy and 86 % of the protein intake. When, in the rainy season, this own production ran short, many household switched to the purchase of food, and these purchases accounted for 65 % of the energy and 63 % of the protein intake. The contributions of gifts was small and no differences existed between the seasons. Other sources such as food aid and exchange supplied mainly energy during the rainy season (5 % of total energy intake) and protein during the post-harvest season (10 % of total protein intake).

Relationship between household fuel use and energy intake.

Table 5 shows the partial correlations between household fuel use and household energy intake variables holding household size constant, separately for the rainy and the post-harvest season. Differences in household size were controlled for because they introduce correlation that obviously does not reflect a nutritional impact of a fuelwood shortage. Household energy intake was positively associated with household size in both seasons, r_p=0.51, p<0.001 in the rainy season and r_p=0.62, p<0.001 in the post-harvest season, and so was household fuel use (r_p=0.15, p=0.132 and r_p=0.42, p<0.001, respectively).

Table 5

Partial correlation coefficients (holding household size constant) between household fuel use and household energy intake variables in the rainy and the post-harvest season (n=109)

	Household fuel use (kg/day)	
	rainy season	post-harvest season
Total energy intake (MJ/day)	0.28**	0.26**
- intake from cooked food	0.26**	0.26**
. cereals	0.25**	0.25**
. other†	0.07	0.21*
- intake from foods not prepared by household†	0.14	0.00

† partial rank-order correlation coefficient
* p<0.05, ** p<0.01

In both seasons the amount of fuel use was positively associated with total household energy intake, and especially with the energy intake from foods prepared by the household. In both seasons, a high fuel use was significantly associated with a high intake from cooked cereals and in post-harvest season also with a high intake from other food groups.

Table 6 shows the correlation between total weekly fuelwood collected and weekly frequency of food preparation. During both seasons, households collecting more wood also prepared more frequently beans, although during the rainy season the significance of the correlation was at borderline probably due to the small number of households preparing beans. The preparation of other relishes was positively associated with total wood collected in the rainy season, but this association was not present in the post-harvest season. The total amount of fuelwood collected was not related to frequency of preparation of breakfast, lunch and dinner. Also no relation existed between amount of fuelwood and number of times food was warmed up.

Table 6

Spearman rank-order correlation coefficients between fuel consumption and weekly frequency of preparation of different dishes, Ntcheu District, Malawi

Frequency of preparation	Fuel consumption			
	rainy season		post-harvest season	
	r_s	p	r_s	p
Breakfast	0.11	0.168	-0.08	0.216
Lunch (staple only)	0.14	0.104	0.12	0.130
Dinner (staple only)	0.14	0.104	-0.12	0.113
Beans relish	0.18	0.053	0.22	0.016
Other relish	0.25	0.009	0.02	0.417
Warming up of food	0.13	0.119	-0.10	0.171

Combination of the results of Table 5 and Table 6 suggest that the increased cereal intake was not due to an increase in frequency of preparation of breakfast, lunch or dinner. Most probably, cereal intake increased through increase of consumption of snack foods such as fried maize kernels or by increased amounts of cereals cooked. In the rainy season beans are hardly being prepared and intake from foods other than cereals is mainly from vegetables. Vegetables contribute little to energy intake, which explains the absence of a correlation between fuel use and energy intake from other food groups in Table 5. In the post-harvest season, beans are more frequently

prepared. Since beans contribute more to energy intake, the correlation of 0.16 in the post-harvest season may be due to an increased beans preparation by households which use more fuelwood.

One may expect that the association between fuel use and energy intake becomes stronger with increasing fuelwood scarcity. When wood becomes scarce, excessive use of wood is omitted, wood use will be restricted to cooking, and households may adapt their food preparation and intake in order to save fuelwood use. In Table 7 the partial correlations between household fuel use and energy intake are shown, separately for the four villages.

Table 7

Partial correlation coefficients (holding household size constant) between household fuel use and household energy intake variables in the rainy and the post-harvest season, in four villages, Ntcheu District, Malawi

	Household fuel use (kg/day)			
distance from woodlands	Muuso < 1.5 km (n=26)	Kachinjika 2.5-3 km (n=26)	Chimpuza 4-6 km (n=31)	Magola > 6 km (n=26)
rainy season				
Total energy intake (MJ/day)	0.29	0.06	0.45 **	0.27
- intake from cooked food	0.30	0.07	0.43 **	0.17
. cereals	0.33	0.05	0.36 *	0.20
. other†	-0.16	0.01	0.17	0.07
- intake from foods not prepared by household†	-0.11	0.11	0.31 *	0.33
post-harvest season				
Total energy intake (MJ/day)	0.06	0.55 ***	0.59 ***	-0.22
- intake from cooked food	0.08	0.55 ***	0.54 ***	-0.17
. cereals	0.05	0.59 ***	0.43 **	0.01
. other†	0.33	0.12	0.49 **	-0.32
- intake from foods not prepared by household†	-0.32	-0.04	0.08	0.10

† partial rank-order correlation coefficient

* p<0.05, ** p<0.01, *** p<0.001

In the rainy season, the pattern of stronger correlations with decreasing fuelwood availability was not visible. Only in Chimpuza, situated at a distance of 4-6 km from woodlands, the correlations were stronger. In the post-harvest season, the correlations showed a clear trend. In Muuso, situated nearest to woodlands, fuel use is not associated with energy intake. At a distance of 2.5-3 km (Kachinjika) a high fuel use was related with a high energy-intake from cooked food, especially from cereals. At a further distance, 4-6 km (Chimpuza), high fuel use was not only associated with a high energy intake from cereals but also with a high energy intake from other food groups. In Magola, the village situated more than 6 km from woodlands, the association between fuel use and energy intake disappeared in the post-harvest season. In this village, a higher fuel use was negatively associated with the energy-intake from other food groups, which means that in this village a high fuel use was associated with a low intake from other food groups.

Discussion

The aim of the present study was to analyse the relationship between household fuel use on the one hand, and food preparation and consumption on the other hand. In view of expected seasonal differences in food availability and dietary pattern, data were collected in two seasons: a season with a relatively low food availability (rainy season) and a season with sufficient food availability (post-harvest season).

Results of the present study should be interpreted with care because of possible measurement errors in the methodologies used for estimation of fuel use and food consumption. The quantity of fuelwood collected, as measured based on average weight of a bundle collected multiplied by the number of collection trips in a household, may not only be used for food preparation. Variations in bundle size and the use of wood from other sources than collection could not be taken into account. The measurement relied on respondents recall which may or may not be reliable especially when collection patterns do not follow a regular pattern. The method used to measure daily quantity of fuelwood used measures more accurately the fuelwood actually consumed (Howes 1985), but it still has the disadvantage of relying on the respondents memory. As only one day was measured, it did not capture day-to-day variations in fuelwood consumption. However, the high correlation between the results of both methods reveal that both methods arrive at comparable quantities which indicates a good level of accordance. There are numerous sources of errors involved in the food

consumption method used, including insufficient sampling of habitual diet, inaccurate recall and reporting, and incomplete knowledge of nutrient content of foods (Cameron and van Staveren 1988; Paul and Southgate 1988; Gibson 1990; Huss-Ashmore and Curry 1991). Therefore, the present study is mainly focused on relative differences rather than on absolute levels of fuelwood use and food consumption.

The food patterns as described in the present paper, are rather imbalanced and rely heavily on cereals, particularly maize. Comparison with earlier descriptions of dietary patterns in Malawi reveal that the diet changed little over the past 90 years (Duff 1903, Werner 1906, Platt 1940, Williamson 1965, Williamson 1972). *Nsima*, a thick porridge made out of maize flour that is accompanied by vegetable relishes, provide the majority of calories in the diet. "New" elements in the diet were mainly supplementary foods: tea, sugar, bread and margarine for breakfast, or cookies as snacks. Changes in the diet over the past years mainly lead to a limitation of varieties consumed. Meat of hunted game such as deer and hares is hardly consumed nowadays (Read 1959) and wild leaves are mainly replaced by cultivated vegetables (Read 1938). The food consumption data showed seasonal changes, with the rainy season being a period of lowered intake. The existence of seasonal hunger among the Ngoni was first mentioned by Nurse (Nurse 1975), who reported the greatest decline in weight of adult males in March, just before the harvest. Her observation that Ngoni used cash resources to lessen the impact of famine, is also confirmed by the percentage of food purchases in the present study, that was surprisingly high as compared to what is reported for other African countries (Dei 1989; Neumann *et al.* 1989; van Liere 1993). This may indicate the existence of a rather advanced cash economy in the research area.

In both the rainy and the post-harvest season, a high fuel use was significantly associated with a high energy intake. In the rainy season, households using more fuel showed a higher energy intake from cereal-based dishes, and in the post-harvest season in addition from other food groups. The increase in cereal intake was not due to an increase in frequency of preparation, but more probably to increased snacking or an increase of amount of cereals cooked per time. Although in the rainy season the frequency of vegetables relish preparation increased with an increase in fuel use, this was not manifested in a higher energy intake from this food group due to the low calorie-content. In the post-harvest season a high fuel use was associated with an increased frequency of beans preparation and this resulted in a significant correlation between fuel use and energy intake from this food group.

The observed association between fuel use and energy intake does not necessarily imply a causal relationship but rather reflects a mutual effect. The association may be caused by food availability: households with more food at their

disposal will use more fuel. And the association may be caused by fuelwood availability: households having less fuel will prepare less food. Results of this study indicate that in the rainy season, a period of relatively low food availability, the association between fuel use and food intake is mainly determined by food availability. In the post-harvest season, a period with a sufficient food availability, fuelwood availability forms a bottle neck to energy intake and determines the association between fuel use and food intake. This study offers evidence for this statement in more than one way.

First, the difference in determinants of household fuel use in the two seasons may indicate that in the rainy season fuel use is not determined by fuel scarcity, but more by food availability or labour availability. While household size and village of origin were predictors of fuel use in the post-harvest season, these variables were not associated with fuel use in the rainy season. Especially the clear decrease of fuel use in the villages situated at a long distance from woodlands indicates a strong relationship between fuel use and fuel availability in the post-harvest season. The absence of such a relation in the rainy season suggests that fuel availability does not determine fuel use. More important predictors may be labour and food availability. The association with twig use and purpose of fuel indicates a relation with labour: the use of twigs and the omitting of water heating are a way of time saving of women. The importance of food availability in the rainy season is illustrated when comparing fuel use and level of energy-intake between both seasons. While the amount of fuel used in both seasons remains at the same level, energy intake in the rainy season is much lower compared to the post-harvest season. However, comparison of the amount of fuel between season should be carried out with care: the higher water content of the wood measured in the rainy season could overestimate the amount of fuel used when compared to the dry wood used in post-harvest season.

Second, the correlations between fuel use and energy intake in the different villages reveal differential impact in the post-harvest season. These villages were situated at increasing distances from woodlands and the results imply that fuel use decreased in the villages at longer distances from woodlands. It was expected that the association between fuel use and food intake would increase when fuelwood became more scarce. In the rainy season, this pattern was not found. The correlations seem to follow level of food availability rather than that of fuel availability. The high correlations in Chimpuza may be the combined result of low food availability and fuel scarcity, as the level of fuel use in this village is low compared to the other villages. In the post-harvest season, a clear increase of the association between energy intake and fuel use is seen when fuel availability decrease. With increasing fuelwood shortages,

households seem to economize first on the amount of cereals cooked. When fuel availability decreases further, also the preparation of foods from other food groups such as beans is being reduced. This increase of association with decreasing fuelwood availability indicates that in the post-harvest season, the association is mainly directed by fuelwood availability.

Comparison of the correlations in the different villages also revealed another phenomenon. In the village situated more than 6 km from woodlands, the association between fuel use and energy intake disappeared and even became negative due to an association between high fuel use and a low intake from other food groups. This suggests that in Magola households start to use other strategies to cope with a fuelwood scarcity, with which the relation between fuel use and energy intake disappears. Although this could not be studied in detail, several suggestions could be made to explain this disappearance. One of the explanations may be the increased twig use in Magola. The use of twigs implies that more wood in terms of weight has to be collected due to the low burning qualities of twigs. In addition, long cooking dishes such as beans can not be cooked on twigs (Chapter 5). This means that in this village the increased amount of twigs collected goes together with a reduction in beans intake. A second explanation is the increased exchange in this village with other Malawians. In the research area, people go to refugee areas to exchange wood for food such as maize flour. However, due to shortage of wood, some women in Magola go to the refugee area to exchange food and especially beans for fuelwood, especially with the Malawians. This indicates that although they have more wood, they will not prepare beans.

In summary, this study showed a clear relation between fuel use and food intake. In the rainy season, this association is mainly determined by food availability, whereas in the post-harvest season fuelwood availability forms a bottle neck to food intake as the correlations become stronger with decreasing fuelwood availability. Data indicate that as a first reaction, households start to economize on the intake from cereals, probably by reducing the amount cooked or a reduction of snacking, followed by a reduction in beans preparation. This is in line with what other authors report (Hoskins 1980; Hosier 1984; Alcántara 1986; Ardayfio 1986; Mildeberger 1986; Shanahan 1986; Cecelski 1987). However, changes in the diet such as omitting of breakfast and increase of warming up of previously prepared food, in other studies attributed to fuel shortages (Alcántara 1986; Ardayfio 1986; Cecelski 1987), are more associated with season than with fuel use. This might suggest that these changes are the consequences of other problems such as food shortage, lack of time and income, prevailing in the community rather then fuel consumption.

This study showed that already under conditions of moderate fuel scarcity in rural areas in Malawi, dietary pattern and food consumption is affected. Especially the reduction of intake from food groups other than cereals forms a point of concern as the diet is already overwhelmingly dependent on cereals. These changes in the diet not only affect energy intake but also may reduce the already marginal quality of the diet. Rural development projects aimed to improve household nutrition or nutrition of special groups are therefore advised to pay special attention to the availability of fuelwood. Especially in the periods when food is sufficiently available, a shortage in fuelwood may prevent women from bringing important improvements into practice.

8

Food and fuel: a hidden dimension in human nutrition

General discussion

Fuelwood forms the main source of energy to many rural households in Africa and is predominantly used for food preparation and processing. Due to large-scale deforestation, the fuelwood supply to these households is threatened. Many factors influence household food and nutrition security, but the role of fuelwood shortages has received little attention.

In Chapter 1 a model was presented, showing how a decreasing fuelwood availability may influence nutrition security, comprising the three elements food security, health and care (see Figure 2, page 18). The impact of changes in fuelwood availability on nutrition is determined by the coping strategies developed by households. These strategies include a switch to alternative fuels, an increase in time spent on fuel collection and a reduction of fuelwood use. The switch to commercial fuels may affect expenditure patterns which may influence food supply. The use of inferior fuels may deteriorate health conditions of those who spend much time near the cooking fire such as women and young children, through indoor air pollution. At the same time, an increased collection time may affect time allocation and labour division in rural households and through this other aspects of nutrition security such as food production and child care. Finally, a reduction of fuel use may jeopardize quantity and quality of food intake (Chapter 2). This model served as a framework for the research described in this thesis.

The purpose of this research was to describe and analyse the relationship between fuelwood availability and nutrition in rural households. It focused mainly on

women within these households. Household fuel supply and use are largely the responsibility of women (Groen 1988/1989). Food is exclusively prepared by women who also contribute for a significant part to agricultural production (McGuire and Popkin 1990; FAO 1979). Women are the first to be confronted with the consequences of a decreasing fuelwood availability and, accordingly, play a vital role in the impact on nutrition.

The research was carried out in Ntcheu District in Malawi. This district is identified as one of the districts having apparent fuelwood supply problems, especially in the densely populated areas of the district (ETC 1987a). Ntcheu District was selected because of the existence of areas with a fuelwood deficit and areas with an adequate supply. Furthermore, Ntcheu District is considered as an area with surplus maize production as is also reflected in the relatively low prevalence of malnutrition among children under five compared to other districts (Malawi Government 1989). This last criterion was used in order to avoid strong confounding of the association between food and fuel by a low level of food availability. The research locations were four villages. Their selection was based on the distance from woodlands, being less than 1.5 km, 2.5-3 km, 4-6 km and more than 6 km. The distance from woodlands was used as an indicator of fuelwood availability: the further the distance, the lower the availability.

The strategies households used to cope with a decreasing fuelwood availability (lower part of the model in Figure 2, page 18) were studied in a fuel supply and use study, carried out in three seasons: dry season (Oct.-Nov. 1990), rainy season (Jan.-Mar. 1991) and post-harvest season (Jun.-Aug. 1991). Next, the impact of the three main strategies (switch to alternative fuels, increase in collection time and reduction in fuel use) on nutrition security comprising food security, care and health (middle part of the model), was studied in three separated studies. First, concerning the use of alternative fuels, a qualitative study was carried out on women's preferences of different wood qualities in relation to diet composition and food preparation. This study also included cooking experiments. Second, a women's time allocation study was used to analyse whether the time spent on fuelwood collection affects the time spent on food production and other (food-related) activities. In this study household labour division was also examined. Third, the association between level of fuel use and household food preparation and consumption was studied in a household food consumption study. In view of the seasonality in food availability and labour demands, both the time allocation study and the household food consumption study were carried out in two seasons, the rainy season, a period of relatively low food availability and hard agricultural fieldwork, and the post-harvest season, a period of adequate food availability and moderate fieldwork. Interpretation of the results of these studies was

facilitated by a food ethnographic study and a three generation study which were carried out within the framework of the research; an extensive summary of these studies is included in Appendices 1 and 2.

In the following, the results of these studies will be discussed. First, some characteristics of the research area and population are discussed that are important to the interpretation of the results. Next, strategies that evolved in households to cope with a decreasing fuelwood availability are discussed under the heading *household coping strategies*. The impact of these strategies on nutrition are considered under *impact on nutrition security*, which is divided into three sub-sections: use of alternative fuels, increased collection time, and fuel use and food consumption. Further, some methodological considerations are given. Finally, the main conclusions from the research are summarized and suggestions for further research and implementation for rural development efforts will be made.

Research area and population

The study population belonged to the ethnic group of the Ngoni and showed some typical characteristics which form the background against which the results should be interpreted. The characteristics concern the level of fuelwood availability, the nutritional situation of the population and the dietary patterns.

First, the research area is in a situation of moderate fuelwood scarcity and conditions seem to compare favourably with those in other parts of Africa such as the Sahel. The fuelwood availability had gradually diminished in the last years with a sudden aggravation in recent years due to the extra pressure on existing resources by the influx of refugees. However, situations of severe fuelwood scarcity were not encountered. Comparison of aerial photographs of the research area of 20 years ago with recent ones indicated that the tree and shrub cover was reduced in this period. A three generation study carried out in the framework of this research (see Appendix 2) showed that in a period of 40 years fuelwood availability had decreased (Temmink 1993). The number of places where fuelwood could be collected became limited. The good quality woods such as splitwood and branches were available at distances further away and the highly preferred *Tsamba* tree could hardly be found in the area. Older women indicated that they never talked about fuelwood in former days, but that nowadays fuelwood was often an issue of conversation among women. The arrival of refugees in the research area was pointed out as one of the main reasons of the sudden reduction in fuelwood availability of the last years since much wood was collected for

exchange of maize flour with the refugees. Most of the households were still able to collect enough fuelwood to cover family needs, although the number of households reporting to have problems was increasing (Chapter 4). Furthermore, fuelwood was still regarded as a 'free' good by the population and very little fuelwood was actually purchased (Chapter 4).

Second, the results described in Chapter 3 showed that a large part of the population in the research area is nutritionally insecure. The research was carried out in 1990-1991, a year with poor rains and, hence, lower harvest yields. As a consequence, in 95 % of the households food stores were already depleted in February, whereas in average years under normal conditions this figure was 48 % in this month (Brouwer 1992). The high yearly body weight fluctuation of 7 % in 1991 and the relatively high percentage of women (10 %) with BMI levels lower than 17 kg/m^2 indicates a significant seasonal stress. The reduction in body weight during the rainy season is due to a combination of factors, including food shortages at household level, higher incidence of diseases such as malaria, and high labour demands in agriculture (Quinn *et al.* 1990; Sijm 1990). The high prevalence of stunting among children indicates that the problem of malnutrition is primarily one of a chronic nature, and this, combined with the low level of wasting, suggests that the high level of stunting may be due, in part, to other factors than being exclusively associated with deficits in energy and protein. The prevalence of wasting among children under two and not among older children may suggest a problem in child feeding.

Third, the dietary pattern of the research population is overwhelmingly dependent on cereals, especially maize (Chapter 7). The mainstay of the diet is *nsima*, a stiff maize flour porridge, served with a relish of vegetables and sometimes beans or meat. *Nsima* contributes the largest part of the energy intake of the households, and is mainly served during lunch and dinner. Other foods such as legumes, vegetables and fats are minor sources of energy. As a consequence, the contribution of carbohydrates to energy intake is too high and that of fat is too low, whereas the protein intake falls within the recommended range (WHO 1990). Although the energy intake of the research population, especially in the post-harvest season, seems to be adequate, the quality of the diet is a point of serious concern.

Household coping strategies

According to the model presented in Figure 2 in Chapter 1, the impact of a decreasing fuelwood availability is determined by the household coping strategies that evolved. In

this study, these strategies were studied in two ways. First, by comparing four villages located at different distances from woodlands, and, second, by comparing households using different collection strategies to meet their energy needs.

In the research area, women are exclusively responsible for the collection of fuelwood, assisted by young girls and older female household members (Chapter 4). Also, the fuel preparation (chopping and drying) and care of the fire are women's tasks. Men do not share in fuelwood collection. Occasionally, men cut down trees, most of the times for building purposes, but the cutting and transporting of the wood is done by women. This makes that women are the firsts to face the depletion of wood from the areas where they normally collect; they are the ones who will develop strategies to cope with this shortage.

Comparison of villages revealed that with increasing distance from woodlands, households initially collected further away, spending more time on collection. But when the distance from the woodlands increased much further, households returned to other, nearby places, thus using less time but switching to fuelwood of an inferior quality such as twigs (Chapter 4). Furthermore, households within the same village showed considerable differences in collection strategies particularly as regards collection distance and collection frequency. The choice for distance and frequency determined time spent on collection, type of fuel used and amount of fuelwood collected. Those households collecting further away and more frequently, spent most time in collection and were able to collect large amounts of good-quality wood. Those households collecting nearby and less frequently, spent less time on collection, but collected the lowest amount of wood and more often used twigs which are considered inferior. Whether households collected further away or more frequently appeared to be determined mainly by the (female) labour availability in the household. Some of these findings are further discussed in the following.

First of all, the results of the study indicate that the distance to the collection place and the collection time as such are not reliable indicators of fuelwood shortages as so often postulated in the literature (Hoskins 1980; Howes 1985; Schenk-Sandbergen 1985; ETC 1987b; Groen 1988/1989). A short collection distance and reduced collection time do not necessarily represent a situation of surplus fuelwood availability. Most households in the research area collected wood within a distance of 4-5 km. Soussan (1988) also reported that the distance women can walk with a bundle of fuelwood is limited, up to 10 km in extreme circumstances. As in a situation of fuelwood scarcity, households return to collect fuelwood nearby their houses, the surrounding areas will also become depleted from fuelwood, which brings the households in an even worse position in future.

Next, the collection strategy chosen appeared to determine the total amount of fuelwood collected, the total time spent in collection as well as the type of fuel used. These three outcomes were highly interdependent. Households that are able to spent more time in collection, are the ones which collect enough fuelwood of high quality. In contrast, those that do not have enough time available to collect fuelwood, will economize on the use of wood and will use wood of a lower quality. This indicates that each strategy has its own costs, either in terms of time or in terms of quantity and quality of fuel.

Finally, (female) labour availability appeared to play an important role in the strategies developed. Those households collecting further away and more frequently were larger in size, with more female adults. Apparently, in such households more members take part in collecting fuelwood and part of this extra effort is provided by the younger and the older household members. In contrast, women in smaller households have little opportunity to share production and reproduction duties (Hayes 1990; Kayongo-Male and Onyango 1991). The ensuing time constraints will keep them from spending more time in collection. The importance of labour availability to level of fuelwood consumption was also stressed by Dewees (1989). He argues that even if fuel is available in abundance, labour constraints may cause quite a low level of fuelwood consumption. Jiggins (1989) also reported that labour deficit households have limited room to manoeuver. It can be, therefore, suggested that in a situation of fuelwood shortage, especially those households experiencing labour constraints will develop a strategy of spending limited time in collection and economizing on amount of fuelwood used.

Impact on nutrition security

The former section has shown that in a situation of decreasing fuelwood availability, some households collect further away and increase their collection frequency, resulting in an increase in collection time. Others will start collecting wood nearby their houses, thus reducing the amount of fuel collected and switching to a lower-quality wood. The impact of these outcomes, increase in collection time, switch to inferior fuels and reduction of fuel use, on nutrition security is discussed in the following three subsections.

Increase in collection time

The relationship between time spent on fuelwood collection and time allocation on food production and reproduction tasks appeared to be seasonal (Chapter 6). In the post-harvest season, a period with moderate to low labour demands in agricultural fieldwork, the time spent on fuelwood collection was at the expense of the time spent on resting and food processing (such as maize pounding). In the rainy season when agricultural fieldwork consumes most of the women's labour, collection time caused an additional reduction in time spent on other activities such as food preparation and food purchase. The differential effects in both seasons suggest that the extent to which fuelwood collection affects time spent on other activities depends on the presence of other labour constraints in the households.

In both seasons, the time spent on food production was not reduced. This agrees with Cecelski (1987a) who argues that women give priority to activities concerned with food production and, therefore, economize mainly on time spent in domestic tasks. No evidence was found that women spend more working hours, omit activities from their daily pattern or receive more help from others during fuelwood collection days. This suggests that all activities are still carried out, but that women perform these in a shorter time. Therefore, one may assume that women are just busier during collection days and this is also supported by the reduction in leisure time during these days.

It may be postulated that changes in time allocation affects nutrition security through increase in energy requirements of women and a reduction of quantity and quality of food intake, although these postulations require further study. Fuelwood collection, together with agricultural fieldwork and water fetching, are the most energy consuming activities (WHO 1985; James and Schofield 1990). As fuelwood collection takes place at the expense of time spent in less human energy consuming activities such as resting, the energy requirements of women will increase (Maloiy *et al.* 1986), which means an additional stress for rural women whose nutritional status is already marginal (Lado 1992). Reduction of time spent on food processing (such as maize pounding) and, in the rainy season, on food preparation and purchase may have direct adverse effects on the food availability of the households. Less food will be prepared for future use, less food will be purchased and a reduction in food preparation time may influence both the amount and the quality of the food consumed (Kumar and Hotchkiss 1988).

Use of inferior fuels

The effects of the use of inferior fuels were studied in a qualitative study (Chapter 5). Women considered twigs inferior because of their low burning quality and preferred to

use splitwood and branches. In the villages nearby woodlands, twigs were not considered as fuel but were only used to start the fire. In the villages at a longer distance from woodlands households increasingly used twigs as an alternative cooking fuel.

The use of inferior fuels can affect nutrition security through time allocation of women, through food preparation and diet composition and through air pollution. Firstly, the use of twigs requires more attention to maintain the fire. This prevents women from doing other household chores, which consequently have to be postponed to another time of the day (Chapter 2). Comparison with the results described under household coping strategies suggests that there is a trade-off between the time spent on collection and the time that must be devoted to food preparation. Twigs are collected because they are easily available and minimize the time spent on collection. On the other hand more time needs to be spent on food preparation. The collection of good quality wood takes more time but minimizes the time spent on food preparation. This is in line what other authors have reported (Batliwala 1983; Meijs 1988/1989; Bagchi 1987).

Secondly, twigs cannot be used for all types of dishes (Chapter 5). Especially the dishes that require a long cooking time such as dry beans, pumpkin fruits, cooked yam and meat, are difficult to prepare on twigs. Using twigs, therefore, implies a change in composition of the diet. As a first step, women will use twigs for less important dishes such as fried maize/groundnuts, cooked bananas/mangoes and for short-time cooking dishes such as vegetable relish, fish and eggs, in order to keep the good quality wood for *nsima* and other fuel-consuming dishes. If only twigs are available, the less important dishes will be omitted and the preparation of long cooking dishes will be postponed.

Thirdly, especially the use of crop residues for food preparation causes smoke and ash. This ash may pollute the food that is prepared, contributing to a decrease in its quality. Furthermore, it causes health problems especially in those near the fire, including sore eyes, headache and coughing.

Fuel use and food consumption

Food and fuel are largely complementary goods: most foods, particularly whole grains and legumes, are inedible without cooking. This study also indicates that households using more fuelwood have a higher energy intake (Chapter 7). In both the rainy and the post-harvest season, a high fuel use was related with a higher intake of cooked foods made of cereals. The data on frequency of food preparation suggest that with a reduction in fuel use, the decrease in cereal intake is mainly due to a decrease in snacking and in the amount of cereals cooked per time. The frequency of preparation of

nsima during lunch and dinner was not related to the level of fuelwood use. Only in the post-harvest season, a high fuel use appeared to be related to a higher intake of other food groups, especially of beans. In the rainy season, the vegetable intake was increased with an increase in fuel use.

The association between fuel use and food intake in this study does not necessarily imply a causal relationship but rather reflects a reciprocal effect. Households with more food at their disposal will use more fuel and households that have less fuel will prepare less food. Comparison of the results of the rainy season, a period of relatively low food availability, and the post-harvest season, a period of adequate food availability, gives an indication of the direction of the causality. It was expected that with increasing fuel scarcity, the association between fuel use and food intake would become stronger. In the rainy season such a pattern was not found, whereas in the post-harvest season the association became stronger when fuelwood availability decreased. This suggests that in the rainy season food availability is a main determinant of food intake and this intake in its turn determines fuel use. However, in the post-harvest season, fuelwood availability seems to be a determinant for food intake.

The study on the relationship between fuel use and food intake (Chapter 7) and the more qualitative study on the consequences of the use of inferior fuels for dietary pattern and food preparation (Chapter 5) show important points of agreement. In both studies it was shown that *nsima*, the stiff maize flour porridge served for lunch and dinner, was never left out. Women would go to great lengths to find some fuel to prepare this mainstay of the diet. The preparation of *nsima* requires relatively little fuelwood but offers much food energy and has, therefore, a relatively high food energy/fuelwood ratio (Chapter 5). It was also observed that in case of a decrease in fuelwood use, the preparation of bean relish was omitted. With respect to fuel efficiency, this choice again is explainable. The preparation of beans needs a considerable amount of fuelwood but offers relatively little food energy, and the food energy/fuelwood ratio is rather low (Chapter 5). Therefore, it seems rather efficient to omit beans without affecting the food energy intake too much. Due to this efficiency, a decreasing fuelwood availability may be one of the reasons why *nsima* remained so popular in the research area. Furthermore, it may also be a reason why less households cultivate beans or why women are willing to exchange beans for maize flour with refugees . In any case, a decreasing fuelwood availability will work against any effort to change the overwhelming dependence on cereals for energy intake.

Especially the reduction of intake from food groups other than cereals forms a point of concern as the diet is already so dependent on cereals. The reduction of beans

in particular not only affects energy intake but also reduces the already marginal quality of the diet. Beans have a high protein content and are good sources of B vitamins and minerals (Aykroyd and Doughty 1982). Although beans formed a relatively small part of the diet in the research area (Chapter 7), simultaneous ingestion of beans with maize raises the protein quality, comparable to that of animal proteins (Aykroyd and Doughty 1982). Especially in the research area where animal proteins are not easily available, the replacement of vegetables for beans might endanger the fulfillment of the special protein needs of young children and pregnant and lactating women (WHO 1985; Cameron and Hofvander 1983).

Measurement of fuelwood shortage

Fuelwood scarcity or shortage is defined as the situation where fuelwood needs exceed the fuelwood supply (Chapter 1). There are numerous difficulties in measuring the needs as well as the supply of fuelwood. There is no agreement among the various authors whether or not the minimum needs should comprise factors such as the cooking method efficiency, climate and way of living. Conversion factors from minimum needs to amount of fuelwood are still inadequate. Estimation of fuelwood availability to the households occurs mostly by the measurement of existing woody biomass, but this biomass is usually not entirely available as fuelwood (Bradley 1988; De Gier 1989). Availability is determined by factors such as competing demands for wood (construction timber, fodder, wood for markets), physical and social access and cultural acceptability of wood species (Munslow *et al.* 1988; Soussan 1988; De Gier 1989).

In view of these difficulties, some authors suggest the use of indirect indicators of fuelwood shortage (ETC 1987b). Kumar and Hotchkiss (1988) used the time required to collect a standard bundle of fuelwood (20 kg) and the time per trip as proxies for the degree of deforestation. Meijs (1988/1989) used the ecology of the area that is forested, savanna area with scattered trees, or deforested savanna, as indicator of potential wood supply. Hosier (1985) used three measures: distance travelled to collect wood, time spent to gather 1 kg of wood and a scarcity index derived from dividing the available moisture index (representing rainfall minus evapotranspiration) by the population density. Bradley (1991) developed an index of woodfuel scarcity based on distance travelled, frequency of collection and stock of fuelwood.

In this study, the distance from woodlands was used as indicator of fuelwood availability; the further the distance, the lower the fuelwood availability. The use of this

indicator has advantages above those used by other authors. Distance from woodlands is relatively easy to measure, independent of responses and offers the possibility of comparing different situations within one agro-ecological area. Studying the responses of households to a decreasing fuelwood availability by comparing different agro-ecological zones, entails a possible confounding of results due to the differences in agro-ecological conditions rather than differences in fuelwood availability. The use of complex indices requires a thorough knowledge of the socio-cultural, economic and ecological characteristics of the area. The indication of fuelwood scarcity by distance travelled, frequency of collection or time spent on collection, which are responses in themselves, is, however, not appropriate to study the responses as a reaction to fuelwood shortages. Furthermore, these indicators assume a linear relationship with fuelwood availability, which does not apply to the research area (Chapter 4).

The distance from woodlands can serve as a general indicator of fuelwood availability. Several results of the study show that indeed distance from woodlands is related to fuelwood availability. Firstly, women prefer to use splitwood and branches because of their burning qualities (Chapter 5). These types of fuelwood are mainly available in surrounding woodlands; the further away these woodlands are, the more effort in terms of time the households have to make to obtain these particular types of fuelwood. Secondly, a first analysis of aerial photographs revealed that tree and shrub cover decreased in areas located further away from woodlands. There are also indications that the distance from woodlands reflects the extent to which households experience a decreasing fuelwood availability. Women in villages situated near woodlands did not really consider the inferior twigs as a fuel (Chapter 5). They only use twigs when they were really 'stranded'. The use of twigs was more common in villages at further distances from woodlands and here women considered twigs as an alternative fuelwood. Further, the number of households reporting to be unable to collect enough wood increased in villages situated at greater distances from woodlands (Chapter 4). However, caution should be taken with the interpretation of the ability to collect enough wood. This ability is the outcome of the efforts of households to collect fuelwood and women may be able to collect enough fuelwood only by making great sacrifices, for example regarding time allocation. The ability may also take into account a reduction in fuelwood use, of which the effects are not considered serious, unless for example the mainstay of the diet (nsima) remains unaffected.

In conclusion, the distance from woodlands is a reasonable indicator of fuelwood availability in the research area and can be used as a distinguishing factor for studying the responses of households to decreasing fuelwood availability in a cross-sectional type of study. The frequency of responses as indicator of fuelwood

availability should be used carefully, as the relationship between most of these responses and fuelwood availability are not as linear as they are taken to be. The frequency of responses is not useful when determining fuelwood availability in a rapid appraisal as interpretation needs a thorough knowledge of the area.

Conclusions and implications for research and development efforts

Already under conditions of moderate fuelwood scarcity in Malawi, households develop collection strategies particularly as regards distance and frequency of fuelwood collection. These strategies determine the time spent on collection and the amount and type of fuel used, and these outcomes are highly interdependent. The development of a strategy depends on the (female) labour availability in the household. Those with a labour deficit will economize on time spent on collection, reducing the amount of fuel used and switching over to inferior fuels which can be collected nearby.

There are several ways in which a decreasing fuelwood availability affects nutrition security, namely through the increased collection time, the increased use of inferior fuels and the reduction in fuel use. The following observations have emerged from this research:

- The impact of increased time spent on wood collection is seasonal and depends on the presence of other labour constraints. Women give priority to food production and labour input in agriculture is never reduced, but time of resting and food processing and, in the rainy season, of food preparation and food purchase is decreased.
- Women do not omit activities, spend longer working hours or receive more help from others during collection days, indicating that women are just more busy. The increase in wood collection at the expense of resting may imply an increase in energy requirements of women. Reduction in time spent on food processing, food preparation and food purchase may affect household food availability.
- The use of twigs prohibits women of doing other household chores during cooking as twigs need close attention to maintain the fire. Twigs cannot serve as fuel for dishes needing a long cooking time and these dishes are consequently dropped from the dietary pattern. Especially crop residues cause indoor air pollution when used for cooking, resulting in pollution of the food and health complaints of those residing near the cooking fire.
- A decrease in fuel use is associated with a reduction in the intake of cooked cereals by a decrease in snacking or in the amount of cereals cooked, and of

beans. This effect is mainly visible in the post-harvest season, where fuelwood forms a determinant of food intake. In the rainy season, this association is mainly determined by the relatively low food availability. Especially the reduction of beans intake is a point of concern in view of the already overwhelming dependence on cereals and the relatively marginal quality of the food.

The results clearly show that already under moderate conditions a decreasing fuelwood availability affects nutrition security. However, the impact is highly dependent on other factors such as food availability, labour availability and labour constraints emerging from other problems than fuelwood availability. In view of these results, the following suggestions for future research and implications for rural development efforts are described.

Suggestions for further research

The study was carried out in an area characterized by nutritional insecurity, an overwhelming dependence on cereals for energy intake and a moderate fuelwood shortage. To come to firm conclusions which can be safely used as the basis for rural development efforts and implementation, more research is needed, especially in areas with different agro-ecological, nutritional and dietary characteristics.

The study population of this research was selected from four villages situated at different distances from woodlands. The relative small numbers of households per village only allowed for a limited disaggregated analysis of groups of households developing different strategies. Although this study identified household size and, thus, household labour availability, as important determinants of the strategies developed, the contribution of other factors could not be examined. Therefore, it is suggested that larger populations within virtually the same fuelwood situations should be studied in order to learn more about the determinants of the strategies used. These determinants could serve as useful starting points for rural development efforts.

As emerging from the present study, research into the relationship between fuel and food is not straightforward, but asks an integrated approach using quantitative and qualitative methods (see Table 1 of this Chapter). For efficient data collection, two phases are proposed. During the first phase an assessment of fuelwood scarcity should be carried out based on the distance from the place where good-quality fuelwood can be collected. This assessment should be preceded by a qualitative study on wood preferences. As the assessment of fuelwood scarcity also requires a dynamic view, a

three generation study should be conducted in order to map out the changes in collection places.

In the second phase, the research should be divided into two groups of studies: *food and nutrition studies* and *fuel studies*. The food and nutrition studies should include a focused ethnographic study emphasizing fuel use in food preparation in the community. This in order to collect information on food system and food habits, and to generate hypotheses concerning the relationship between food and fuel. The studies should also include a food preparation and consumption study, carried out in periods of a relatively low and high food availability. Cooking experiments should be carried out to determine the amount of fuel and time needed to prepare dishes typical for the community under study. The fuel studies should comprise research into fuel supply and use, time allocation and labour division and, when applicable, income expenditure in the various seasons of the year. The study populations to whom these problems are applicable should be carefully selected; this is especially important for the studies on time allocation, labour division and income expenditure. Both groups of studies should be complemented with qualitative studies on attitude, opinion and perception of the rural population of the problem of fuelwood scarcity through focus group interviews.

Table 1

Components of a research into the relationship between fuelwood availability and nutrition

Phase I	Assessment:	Wood preferences
		Three generation study
		Places where good quality woods can be collected
Phase II	Fuel studies:	Fuel supply and use patterns
		Time allocation and labour division
		Income expenditure
	Food and Nutrition studies:	Focused food-ethnographic study
		Food preparation and food consumption
		Cooking experiments

However, most development programmes do not have the time and means to carry out such a comprehensive study. Simple assessment methods should therefore be developed, although simple indicators always have the danger of simplifying the problem. Especially a checklist with responses to a decreasing fuelwood availability should be handled with care since presence or absence of the responses do not always indicate a situation of scarcity. Based on this study it is advised to carry out the assessment as mentioned in Phase I (Table 1), including the study on wood preferences and the three generation study as these studies do not take much time. The fuel studies could be replaced by a short questionnaire on fuel supply and use, including questions concerning collection distance, collection frequency, purchase frequency, type of fuel used, weight of bundle collected, amount of fuel bought and persons responsible. The food and nutrition studies could be covered by a short questionnaire of a daily dietary pattern commonly prepared in the population under study.

Implications for rural development efforts

This study showed that already under conditions of moderate fuelwood scarcity nutrition security is affected in various ways. The interrelationship between decreasing fuelwood availability, labour availability, other labour constraints and food and nutrition appear to be more complex than has generally been acknowledged. This implies that the effects of a decreasing fuelwood availability should not only be a point of concern for nutrition and health projects but also for rural development efforts in general concerning reforestation, agriculture and labour.

An important aspect is that due to their central role in household fuel supply and use in Malawi, women should be the focal point of household fuel projects. They should be fully involved in the planning, development and implementation of such projects. For example, the nature of women's work needs to be considered in interventions that require their active participation (Cecelski 1985). The traditional expertise and knowledge of household fuel supply, cooking needs, habits, utensils, cooking fires and taste preferences of the family lie exclusively with women. Information on this expertise and knowledge is very relevant and offers starting points for development efforts. Building on existing knowledge and experience is preferred above introducing new ideas, since sustainable changes can never come from external resources.

Since fuelwood use is closely related to food preparation, nutrition and health projects should take full account of the growing shortage of fuelwood when certain food preparations, food types or hygiene-related activities are recommended. Ways of decreasing fuel consumption should be carefully looked into, such as the stimulation of

the use of aluminum cooking pots, the use of lids, decorticating and soaking of beans, improving the management of cooking fires (Cecelski 1985). A special point of concern is the overwhelming dependence on cereals for energy intake. Increasing fuelwood shortages will only enhance this one-sided reliance on cereals and therefore ways have to be found to stimulate variety in the diet without putting a large claim on fuel consumption and women's time.

It is important to find ways to ensure an adequate fuel supply to households and to increase the efficiency of fuel use. The majority of the rural population in Malawi will continue to rely on fuelwood and other biomass fuels for food preparation. Furthermore, the more sophisticated fuels will be out of reach of most households and the new sources of renewable energy are only expected to make a limited contribution. Households, however, face many problems during their life. These problems are usually solved in a multiple way: households look for solutions that solve more problems at the time instead of finding solutions for each and every problem separately. Therefore, this study agrees with Munslow (1988), that tackling the fuelwood problem with ready-made, narrowly defined "fuelwood" solutions is not useful.

Wood production outside forests should be strongly encouraged. As most of the rural population collect fuelwood within 4-5 km from their village, large fuelwood plantations are less appropriate. These plantations normally aim to serve a larger area and are therefore out of reach of most villages. Tree planting along roadsides, boundaries and compounds should therefore be stimulated (Mung'ala and Openshaw 1984). However, fuelwood production will hardly be the reason for rural households to plant trees, also because fuelwood has no economic value in the research area (French 1986). Appropriate species should be selected which produce a number of products such as hedges, shade, fruit, animal fodder and building timber. A mixture of different species should be encouraged rather than introducing single species as happens so often with eucalyptus trees even in areas unsuitable for their cultivation (Cecelski 1985). Existing knowledge on the multipurpose of both indigenous and exotic trees is still limited and needs more research.

Finally, when introducing a new crop to increase food production and to improve soil fertility, agricultural projects should take into consideration the consequences for fuel use and women's work load. A shortage of fuelwood means that a compromise has to be made between agricultural, ecological, nutritional and women's aims.

Final remarks

The present research is one of the first specifically addressing the consequences of a decreasing fuelwood availability for nutrition security. The concept of nutrition security and the model depicting the relationship between fuelwood shortages and nutrition security through household coping strategies appeared to offer a useful analytical framework. The quantitative and qualitative methodologies used and the key-variables identified in the present research could serve as a basis for further studies. More studies in urban areas, and in rural areas with agro-ecological, nutritional and dietary characteristics other than in the present research area are needed to sharpen the findings which can then be safely used as the basis for development efforts.

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APPENDIX 1

Food ethnography of the Ngoni in Ntcheu District[1]

Executive Summary

As part of the comprehensive research on the relationship between a decreasing fuelwood availability and nutrition security, a food ethnographic study of the Ngoni in Ntcheu District in Central Malawi was carried out. This food ethnographic study aimed to describe elements of the food system such as supply, preservation, storage, preparation, distribution and consumption and to describe cultural norms and values concerning food (food habits). The study was especially focused on the role of fuelwood herein. Knowledge of the food system and food habits was considered to be essential for interpretation of the quantitative results of the comprehensive research.

Data for the food ethnographic study were collected using methodologies suggested in the systematic approach as developed by the Department of Human Nutrition, Wageningen Agricultural University (Van Liere *et al.* 1993). This approach comprised three phases. During the first phase, a census was made of all foods produced and consumed in the research area by means of interviews with key-informants, regular market visits and observations in the fields. Next, food-related activities were placed in a time frame and calendars of agricultural activities, gathering and hunting and food availability were determined through interviews. In a third phase, detailed descriptions of how people use and consume their foods were obtained, including food supply activities such as cultivation, hunting, collection of wild foods, preparation of specific dishes and daily meals, distribution and consumption of meals and eating habits (meal patterns and eating groups). Interviews with village women provided information on norms and values concerning food (food habits). Special emphasis was put on the role of fuelwood in food preparation, on cooking facilities and on the consequences of fuelwood shortages. The study population consisted of women older than 18 years originating from the four villages involved in the comprehensive research project.

A list of vegetable and animal products consumed by the Ngoni in Ntcheu District is given in Table I and II. The daily meal pattern in the research area consists of at least two meals: lunch at noon and dinner in the evening. These meals consist of a thick porridge of maize flour, *nsima*, served with a small amount of relish consisting of leaf vegetables sometimes with groundnuts, tomatoes or onions. Approximately once a week the relish contains beans and occasionally fish. Meat is rarely eaten; only for

[1] Based on Heldens (1992)

Table I

List of vegetable products consumed by the Ngoni in Central Malawi

English name	Scientific name	Chichewa name	harvest season	period of consumption
Cereals				
Maize	Zea Mays	Chimanga	Apr-May	whole year**
Wheat*	Triticum aestivum	-	-	whole year**
Millet	Pennisetum spp	Mchewere/Mawele	May-Jun	whole year**
Sorghum	Sorghum vulgare	Mapira	Jun-Jul	dry season**
Rice	Oryza sativa	Mpunga	Apr May	occasionally
Roots, tubers				
Sweet potatoe	Ipomea batatas	Mbatata	Apr-Aug	dry season**
Cassava	Manihot esculenta	Chinangwa	Feb-Oct	dry season
Yam	Dioscorea bulbifera	Chilazi	Apr-Aug	dry season
Legumes				
Groundnut	Arachis hypogea	Mtedza	Apr-Aug	whole year**
Field pea	Pisum sativum	Sawawa	Apr-Jul	whole year**
Beans	Phaseolus vulgaris	Chimbamba, Kaera, Tyolo nanyati, Kaulesi	Jan-Mar	whole year**
Cowpea	Vigna unguiculata	Khobwe	Mar-May	whole year **
Vegetables				
Chinese cabbage	Brassica chinensis	Tanaposi	Jun-Jul	dry season
Turnip	Brassica juncea	Mpiru/turnip	Apr-Jun	dry season
Swede and rape	Brassica napus	Rape	Aug-Sep	dry season
Cabbage	Brassica oleracea	Kabitchi	Feb-Jul	dry season
Pumpkin leaves	Cucurbita maxima	Mkhwani	Jan-Apr	whole year**
Green leaves				
Okra	Hibiscus esculenta	Therere	Jan-Feb	rainy season
Sweet potatoe	Ipomea batates	Kholowa	Sep-Oct	dry season
Cassava	Manihot esculenta	Ntapasya	Jun-Jul	dry season
Bean	Phaseolus vulgaris	Khwanya	Jan-Feb	whole year**
Cowpea	Vigna unguiculata	Mtambe	Jan-Feb	whole year**
-	Amaranthus spp.	Bonongwe	Nov-Mar	rainy season
-	Andenia cissumpeloides	Mlozi	Nov-Dec	rainy season
Black jack	Bidens pilosa	Chisoso	Nov-Dec	whole year**
-	Corchorus olitorius	Chilenzi	-	whole year**
-	Corchorus trilocularis	Denje	Oct-Jan	whole year**
-	Hibiscus acetosella	Limanda	Oct-Dec	whole year**
Sugar cane	Saccharum officinarum	Misale	Apr-Sep	dry season
Prickly cucumber	Cucunis dipsaceus	Zikanyanya	Jan-Mar	whole year**
	Cucumis spp.	Chimpwete	Jan-Mar	whole year**
Pumpkin	Cucurbita maxima	Maungu	Feb-Mar	whole year**
Okra	Hibiscus esculenta	Therere	Jan-Apr	whole year**
Gourd	Lagenaria vulgaris	Mphonda	Jan-May	whole year**
Tomato	Lycopersicum esculentum	Tomato	whole year	whole year
Fruits				
Mango	Mangifera indica	Mango	Jan-Feb	rainy season
Bananas	Musa paradisiaca	Nthochi	whole year	whole year
Guave	Psidium guajava	Gwafa	Mar-May	rainy season
-	Bridelia micrantha	Maposa	Feb-Mar	rainy season
-	Canthium crassum	Mbilima	Aug-Sep	rainy season
-	Flacourtia indica	Mthudza/Mthucha	Jun-Jul	dry season

* wheat does not grow in the area but the flour is used to make bread and snacks

** these products can be consumed the whole year because they are dried

special occasions an animal is slaughtered. A meal in the morning is less common, especially in the rainy season when food availability is relatively low. If prepared, it consists of a thin porridge of maize flour, *phala*, or tea with bread. Snacks include boiled or roasted maize kernels, boiled sweet potatoes, cassava and pumpkins, sugar cane and fresh fruits. Food preparation takes place in an indoor kitchen using a three-stone fire. Women use either clay or metal pots for cooking; to fry maize a kind of frying pan which is made of a flat piece of metal with raised edges and a wooden stick fastened at one side is used. Girls start learning to cook around the age of five to six years. At the age of ten they are expected to cook for the whole family and at this age mother and daughter divide tasks in cooking. Gradually the daughter obtains more responsibilities.

Table II

List of animal products consumed by the Ngoni in Central Malawi*

English name	Scientific name	Chichewa
Domestic animals		
Beef	Bos sp.	Nyama ya ng'ombe
Goat meat	Capra sp.	Nyama ya Mbuzi
Pork	Sus sp.	Nyama ya Nkumba
Chicken meat	Gallus gallus	Nyama ya Nkhuku
Animal products		
Eggs		Dzira
Wild animals**		
Mouse	Micropus sp.	Mbewa
Partridge	Perdix perdix	Nkhwala
-	-	Hkhawena
Fish		
-	-	Utaka
-	Tilapia sp.	Chambo
-	-	Usipa
Catfish	Clarias sp.	Mlamba
-	-	Ncheni
-	-	Kampango/Matemba
Insects		
Flying ant	Macrotermes sp.	Inswa/Mbulika (Nov-Dec)
Flying ant (small)	Macrotermes sp.	Mbereswa (Feb-Mar)
Large green bush cricket	Homorocroryphus vicinus	Bwamwoni (Apr-May
Grasshopper	Acanthacris ruficornis	
	Cyrtacanthacris aeriginosa	Dziwala (Sep-Oct)

* Animal products are not eaten frequently; only those consumed occasionally are mentioned
** Big game was not hunted anymore, the animals mentioned are mainly caught by small boys.

Wood from different trees are used as fuelwood. Table III lists these trees with their English, Chichewa and scientific names. Women preferred to cook on wood of the *tsamba* tree, but also used wood from the *mthethe*, *sederela*, *mwanga*, *blue gum* and *mango* trees. These trees are widespread in the woodlands present in the research area.

Comparison with earlier descriptions of the dietary pattern, dating from 1903, indicate that there are no major changes in the dietary pattern over the last 90 years. Hunting hardly takes place anymore. Only small boys sometimes kill rodents and birds fro consumption. The number of wild leaves collected and their variety has also declined. Besides, women cultivate a sufficient number of leaves themselves and do not take much effort to collect wild leaves. Environmental changes influenced changes in food system and food habits. Soil erosion is an important environmental problem and results in lower yields and, consequently, in a lower food availability of households. Deforestation resulted in a decline in flora and fauna contributing to a reduced consumption of wild leaves and game meat. In former days Ngoni people were real cattle holders, but due to increased population, more land was cultivated and less land was available for grazing. As cattle destroyed many crops during grazing, people were forced to slaughter their animals and as a result people only keep few animals nowadays and only rarely consume animal products. The growing importance of money resulted in a higher consumption of bread which was formerly an unknown product but was introduced during the arrival of Europeans in the area. Alternative ways of paying such as by animals or sweet beer, have nearly disappeared.

Farmers in Ntcheu District are more or less self sufficient in staple food. However, in years of drought such as 1992, most households do not manage to produce enough staple food. Strategies to overcome periods of food scarcity are finding sources of income (casual or regular work) and sale of own produce or home-made products. Other strategies are to work for food, to exchange fuelwood with Mozambican refugees, receiving gifts from relatives and changes in the dietary pattern (e.g. use of brown maize flour or mixtures of flour). Drying is used to preserve foods for future use, such as leaves (pumpkin leaves, cowpea leaves and wild leaves), pumpkin fruits, prickly cucumbers and okra fruits.

In times of fuelwood shortage women reported to replace fuelwood consuming dishes such as beans by dishes that need less fuelwood, such as leaf vegetables. They will also drop breakfast easily. *Nsima* with relish, however, forms an essential meal in the research area and will hardly be omitted from the dietary patter. Women will try their best to prepare nsima with relish at least once a day, even in times of food or fuelwood scarcity.

People in the research area sometimes avoid certain foods temporarily because of traditional beliefs, such as the avoidance of eggs during pregnancy and of adding a certain ingredient during the menstruation period. Other foods are avoided permanently because of religion (such as pork and alcohol) or because of their clan (avoidance of certain animals). However, most people do not strongly keep to these avoidances anymore and rather avoid food because of individual reasons

Table III

List of trees used for fuelwood

English name	Scientific name	Chichewa name
African Cachechu Tree/ White Torn	Acasia polyacantha	Mthethe*
-	Acanthus montanus	Msangu
Albizia Tree	Albizia spp.	Mtangatanga
Mountain Bamboo/ Golden Bamboo/ Common Bamboo	Arundinaria alpina Bambusa vulgaris Oxythenanthera abyssinca	Nsungwi
Yellow flowered Bauhinia	Bauhinia tomentosa	Mphando
-	Brachistegia floribuna	Tsamba*
-	Burkea Africana	Kalinguti
-	Choristylis Rhamnoides	Nsolo
Octopus Cabbage Tree/ Deadman's Tree	Cordia abyssinica Cussonia arborea	M'gbwabwa
Rhodesian Rubber Tree	Diplorrhyrcus spp.	Mthombozi
Blue Gum	Eucalyptus globulus	Eucalyptus*
Wild Fig	Ficus spp.	Kachere
Gmelina	Gmelina arborea	Gmelina
Red Mahogony	Khaya nyasica/Whalteria indica	M'bawa
Sausage Tree	Kigelia aethiopia/K. Africana	Mvunguti
-	Lonchocarpus capassa	Mswamswa
Mango	Mangifera indica	Mango*
Indiya	Melia azedarach	Indyia
African Locust Bean	Parkia filicoidea	Mkundi
Elephant Grass Napier Fodder	Pennisisetum purpurum	Senjele
Afrormosia Wood	Pericopsis angolensis	Mwanga*
Camelfoot	Piliostigma thonningii	Chitimbe
African Teak/Bloodwood/ Sealing Wax Tree	Pterocarpus angolensis	Mlomba
Druce	P. rotondifolius	Balitsa
Silver Terminalia	Terminalia sericea	Mnalinsi
Toon Tree, Cedrela	Toona ciliata	Sindiyela/sederela*
-	Uapaca nitida/Uapaca sansibarica	Kasolokolowe
-	-	Mbululukutu

* commonly used as fuelwood

APPENDIX 2

Three-generation study on fuelwood shortage in Ntcheu District[1]

Executive Summary

As part of the comprehensive research on the relationship between a decreasing fuelwood availability and nutrition security, a three-generation study on fuelwood shortages in Ntcheu District was carried out. This three-generation study aimed to reveal the extent of the downward trend in fuelwood availability over the past 50 years and to describe how women adapted to the situation of decreasing fuelwood availability in relation to activity pattern and nutritional situation of households. In this study qualitative historical data were collected in order to achieve a better understanding of the cross-sectional quantitative data collected in the comprehensive research.

In the comprehensive research project, four villages were selected at different distances from woodlands. For the three-generation study, in each of these villages, three women were selected in each of the age categories 60-69, 40-49 and 20-29. These women were involved in an individual oral history interview going back to the time they had their first child, in order to study the changes over the past 50 years in fuelwood collection habits and types of fuelwood used for food preparation. In the village situated at the longest distance from woodlands and thus experiencing a severe fuelwood shortage, two group interviews were held in order to get a better understanding of the effects of a fuelwood scarcity on activity pattern and nutrition situation. The participants in the group interviews were the same women selected for the individual interviews. Two extra group interviews were held in another village in Ntcheu District, where fuelwood scarcity was even more severe than in the four research villages.

In general, in all villages women indicated that in former days, fuelwood was only collected at places surrounding their villages. Comparing the collection places in 1992 with those in former days, three important observations were made:

- collection places nearby disappeared or became smaller and were slowly depleted from their trees;
- the number of places where women could collect fuelwood became more limited;
- new places were situated at increasing distances from the villages.

[1] Based on Temmink (1993)

Women preferred to use branches and splitwood when performing fuelwood consuming activities such as food preparation, because of the superior burning qualities of these types of wood. Therefore, as long as possible women tried to collect branches and splitwood at places in the neighbourhood of the village or their farm. When fuelwood availability decreased, branches and splitwood became more difficult to find and women were therefore going to other places, mostly further away, in order to collect good quality wood. However, there seemed to be a limit to the distance that could be covered by the women. The absolute limit will probably be determined by the length of day: women will only collect at those places where they can go, collect and return by daylight. Many women, however, will not reach this absolute limit, and they will search for other options such as (i) collection of fuelwood, often of inferior quality, at nearby places, (ii) collection of fuelwood at their farms or (iii) purchasing of fuelwood.

Factors that play a role in the decision whether to collect at far away places or switch to the alternative options, are determined by *physical* reasons and whether a woman thinks it *worthwhile* to cover a great distance.

Which distance a woman can physically cover depends on several factors:

- physical condition, which is often related to age;
- how many times she has to cover the distance, which is dependent on household size and number of grown -up daughters that are present in the household to assist her in her activities;
- difficulty of covering the distance, which is dependent on steepness of hills, number of rivers and difficulty in crossing them;
- other activities that have to be carried out apart from fuelwood collection.

Factors mentioned by the women that determine the distance a woman thinks is worthwhile to cover are:

- tree cover at this distance: if there are not enough trees left even at a far distance, women have to invest time in traveling as well as in searching for wood;
- possibility to collect fuelwood (of a lower quality) at nearby places, which depends on the presence of communal lands nearby. However, most of the time only twigs can be collected here, as trees had already been cut down in the past. As an interim solution women may alternate twig collection at nearby places and collection of good quality wood at places further away;
- possibility of purchasing fuelwood, which depends on the economic situation of the household;
- presence of trees at own farm or around the house.

Finally, a woman's decision on where to collect fuelwood is also influenced by her personality, for example her motivation to comply with the decisions other women make and her own evaluation of the different options that are available to her.

In group interviews, the consequences of these changes were discussed. Women reported that as a first response to decreasing fuelwood availability, excessive use of fuelwood was avoided. Secondly, they started to use twigs for the preparation of dishes that asked a short cooking time. With an increasing scarcity, they started to use twigs supplemented with splitwood and branches for long-cooking dishes. In case only twigs were available, long-cooking dishes such as beans and pumpkin fruits were omitted from the diet, and women indicated even to drop breakfast or lunch sometimes. The women also reported that they needed more time to collect fuelwood and that the use of twigs increased the time they had to spend on food preparation. They all admitted that they had less time to carry out all other daily activities but none of them said she dropped one of these activities. They were just more busy now than in former days.

During the interviews it became clear that conclusions on the effects of decreasing fuelwood availability on activity pattern and nutrition should be taken with care due to many confounding factors. In general, the task of fuelwood collection is disliked and apart from the decrease in fuelwood availability, this dislike may also be an important reason why women started to omit excessive use. Changes in the meal pattern such as the omission of beans or breakfast, might also be caused by a decline in bean or food availability for example through season. The general lack of time which causes changes in time allocation, may be due to other time consuming activities such as field work during the agricultural season. Finally, lack of time may also cause fuelwood shortage in the household: the exchange of fuelwood for maize flour with Mozambican refugees put an extra burden on women's time and endanger the supply of good quality wood for personal use as this wood is preserved for exchanging.

SUMMARY

Fuelwood is the main source of energy for rural households in developing countries and is predominantly used for food preparation and processing. Due to rapid deforestation, the supply of fuelwood is threatened. Many factors influence household food and nutrition security, but so far the role of fuelwood shortages has received little attention. Nutrition security has three main aspects (food security, care and health conditions); it is a prerequisite to the nutritional security of the individual, that these are favourable. The relationship between fuelwood availability and nutrition security is determined by the coping strategies chosen. These may comprise increase in collection time, reduction in amount of fuelwood used and switch to alternative fuels (Chapter 1). These strategies may affect food supply, food preservation, preparation and distribution, income generation and food consumption, all of which may result in a decrease in quality and quantity of the food consumed (Chapter 2). However, most of the existing literature is based on limited research or anecdotal evidence, and scientific evidence for these propositions is still scarce.

The purpose of this research was to describe and analyse the relationship between fuelwood availability and nutrition. The study was a joint project of the Department of Human Nutrition, Wageningen Agricultural University, and the African Studies Centre, Leiden, and was affiliated with the Centre for Social Research, Zomba. Field work was carried out among the Ngoni population in Ntcheu District, Central Region of Malawi, from 1990 to 1992. Study households originated from four villages selected on distance from woodlands, being less than 1.5 km (Muuso), 2.5-3 km (Kachinjika), 4-6 km (Chimpuza) and more than 6 km (Magola). The area was characterized by nutrition insecurity (Chapter 3), overwhelming dependence on cereals for energy intake (Chapter 7) and moderate fuelwood scarcity (Chapter 4).

With increasing distance from woodlands, households initially collected further away, spending more time on collection (Chapter 4). When woodlands had to be reached much further away, they returned to nearby places needing less time and switched to lower-quality wood. Households within the same village differed in collection strategies particularly as regards collection distance and collection frequency. These strategies determined collection time, type of fuel used and amount of wood collected, which factors were highly interdependent. Female labour availability was a strong determinant of the strategy that was followed and especially households with a labour deficit economized on collection time, reduced the amount of wood collected and switched to inferior fuels.

In the following chapters, studies on the relationship between the three main strategies (switch to alternative fuels, increase in collection time, reduction in fuel use) and nutrition are described. Chapter 5 reports on a study of wood quality and preferences for types of wood in relation to food preparation and diet composition. Women preferred splitwood and branches and were reluctant to use twigs and maize stalks because, among others, the former yield more charcoal of better quality with a longer burning time. Preparing dishes with splitwood and branches require less time and fuel. Time studies, however, showed that the use of twigs did not prolong cooking time. However, the use of twigs prohibited women from doing other household chores as twigs need close attention to maintain the fire. Twigs cannot serve as fuel for dishes needing long cooking times (such as beans) so that, as a consequence, these are dropped from the dietary pattern. The dish nsima accompanied with relish was the mainstay of the diet, and was hardly left out.

Chapter 6 shows that the impact of an increase in time spent on fuelwood collection is seasonal and depends on the presence of other labour constraints. Women gave priority to food production and labour input in agriculture was never reduced, but time for resting, food processing, and, during the rainy season, for food preparation and food purchase was decreased. No evidence was found that women spent more working hours, omitted activities from their daily pattern or received more help from others during fuelwood collection days. This suggests that women were just more busy during fuelwood collection days. The increase in wood collection at the expense of resting may imply an increase in energy requirements of women. A reduction in time spent on food-related activities may affect household food availability.

Chapter 7 deals with the relationship between fuel use and food consumption. A decrease in fuel use is associated with a reduced intake of cooked cereals in the form of a decrease in snacking or in the amount of cereals cooked, and with a reduced bean intake. This effect is mainly visible in the post-harvest season, when fuelwood forms a determinant for food intake. In the rainy season, this association is mainly determined by the relatively low food availability. Especially the reduction of bean intake is a point of concern in view of the already overwhelming dependence on cereal and the relatively marginal quality of the food.

In Chapter 8 the relationship found between a decreasing fuelwood availability and nutrition security are discussed according to the different aspects mentioned in the model introduced in Chapter 1. The results clearly show that already under conditions of moderate fuelwood scarcity a decreasing fuelwood availability affects nutrition security. The impact is highly dependent on other factors such as food availability, labour availability and labour constraints emerging from other problems than fuelwood

shortage. The results of the present study give several starting points for methodologies to be used in future research and for development efforts intended to promote both fuelwood supply and nutrition security. More information is needed on the relationship between food and fuel in urban areas and in rural areas with different agro-ecological, dietary and anthropometric characteristics. Methodologies to be used in such studies are suggested. In view of the interrelationship between fuelwood, food and labour the effects of a decreasing fuelwood availability should not only be a point of concern for nutrition and health projects but also for rural development efforts in general concerning reforestation, agriculture and labour. Fuelwood shortage means that a compromise has to be made between agricultural, ecological, nutritional and women's aims.

SAMENVATTING

Brandhout vormt de belangrijkste energie bron voor plattelandshuishoudens in ontwikkelingslanden en wordt vooral gebruikt voor de voedselbereiding en verwerking. Door de optredende ontbossing komt de brandhout voorziening echter in gevaar. Veel faktoren beinvloeden de voedsel- en voedingszekerheid van huishoudens, maar de rol van brandhout tekorten heeft tot nu toe weinig aandacht gekregen. Voedingszekerheid omvat drie elementen (voedselzekerheid, zorg en gezondheid) die voldoende gewaarborgd moeten zijn om een individu voedingszeker te laten zijn. Het verband tussen brandhout beschikbaarheid en voedingszekerheid wordt bepaald door de gekozen aanpassingsstrategieen. Deze kunnen een toename in verzameltijd, een afname in de hoeveelheid hout die gebruikt wordt en een overstap naar alternatieve brandstoffen omvatten (Hoofdstuk 1). Deze strategieen kunnen de voedselvoorziening, voedsel verwerking, bereiding en verdeling, het verwerven van een inkomen en de consumptie van voedsel in gevaar brengen. Dit kan resulteren in een afname van hoeveelheid en kwaliteit van de voeding (Hoofstuk 2). De bestaande literatuur hieromtrent is echter voornamelijk gebaseerd op beperkt onderzoek en is anekdotisch van aard. Wetenschappelijke bewijzen voor de veronderstellingen zijn nog niet geleverd.

Het doel van deze studie was het beschrijven en analyseren van de relatie tussen brandhout beschikbaarheid en voeding. De studie is een gemeeschappelijk projekt van de vakgroep Humane Voeding van de Landbouwuniversiteit Wageningen en het Afrika Studie Centrum, Leiden, en de onderzoeker was verbonden aan het Centre for Social Research in Zomba, Malawi. Het onderzoek werd uitgevoerd in Malawi, in Ntcheu District, van 1990 tot 1992. De onderzoekshuishoudens waren afkomstig uit vier dorpen die geselecteerd waren op basis van de afstand tot het bos, te weten minder dan 1.5 km (Muuso), 2.5-3 km (Kachinjika), 4-6 km (Chimpuza) en meer dan 6 km (Magola). Het onderzoeksgebied is gekenmerkt door een hoge mate van voedingsonzekerheid (Hoofdstuk 3), een grote afhankelijkheid van granen voor energie opname (Hoofdstuk 7) en een gematigde brandhout schaarste (Hoofdstuk 4).

Bij toenemende afstand tot het bos verzamelden de huishoudens in eerste instantie verder weg, en staken meer tijd in het verzamelen van brandhout (Hoofdstuk 4). Wanneer het bos nog verder weg kwam te liggen, keerden de huishoudens terug naar dichterbij gelegen plaatsen, gebruikten minder tijd maar schakelden over op het gebruik van hout van een lagere kwaliteit. Huishoudens in hetzelfde dorp verschilden in strategieen met name wat betreft afstand tot verzamelplaats en frekwentie van verzamelen. Deze strategieen bepaalden de totale verzameltijd, het soort hout dat werd

gebruikt en de hoeveelheid hout verzameld, welke onderling sterk afhankelijk waren. De beschikbaarheid aan arbeid, met name dat van vrouwen, bepaalde in hoge mate welke strategie gekozen werd en met name huishoudens met een arbeidstekort bezuinigden op verzameltijd, verminderde de hoeveel hout verzameld en stapten over naar het gebruik van inferieure brandstoffen.

In de daarop volgende hoofstukken werd gekeken naar de relatie van de drie strategieen (overstap op alternatieve brandstoffen, toename van verzameltijd en afname van hoeveelheid hout) met voeding. In Hoofdstuk 5 wordt een studie naar hout kwaliteiten en preferenties van vrouwen in relatie tot de voedselbereiding en dieet samenstelling beschreven. Vrouwen hadden de voorkeur voor het gebruik van takken en kloofhout boven dunne takjes en maisstengels omdat, onder andere, de eerst genoemden in een betere kwaliteit houtskool werden omgezet dat langer brandde en omdat deze minder tijd en brandhout vroegen bij de bereiding van voedsel. Tijdsstudies wezen echter uit dat het koken met dunne takjes niet meer tijd kost, maar dat vrouwen geen andere aktiviteiten konden uitvoeren tijdens het koken omdat zij bij het kookvuur moesten blijven. Dunne takjes konden niet gebruikt worden voor het bereiden van gerechten die een lange kooktijd vragen (zoals bonen) en deze gerechten werden dan ook weggelaten uit het dieet. Het gerecht *nsima* geserveerd met een saus was het belangrijkste onderdeel van het dieet en werd bijna nooit weggelaten.

Hoofdstuk 6 laat zien dat de gevolgen van een toename in verzameltijd afhankelijk zijn van seizoen en van de aanwezigheid van andere arbeidsverplichtingen. Vrouwen gaven de prioriteit aan landbouwaktiviteiten en op landarbeid werd dan ook nooit bezuinigd. Tijd besteed aan rusten en voedselverwerking en, in het regenseizoen, aan voedselbereiding en aankoop van voedsel nam af. Er werd geen bewijs gevonden dat vrouwen langere dagen maakten, aktiviteiten uit hun dagelijks patroon weg lieten of dat ze meer hulp van andere huishoudleden ontvingen op dagen dat ze hout verzamelden. Dit geeft aan dat vrouwen drukker waren op verzamel dagen. De toename van verzameltijd ten koste van tijd besteed aan rusten zou een stijging in energie behoefte van vrouwen tot gevolg kunnen hebben. Een afname in tijd besteed aan voedsel gerelateerde aktiviteiten kan de voedselbeschikbaarheid van het huishouden beinvloeden.

Hoofdstuk 7 beschrijft de relatie tussen het gebruik van brandhout en de voedsel consumptie. Een afname in brandhout gebruik was geassocieerd met een reduktie in inname van gekookte granen (door afname in snacks of in de hoeveelheid granen per keer gekookt) en met een reduktie in inname van bonen. Dit effekt was met name zichtbaar in het seizoen na de oogst wanneer brandhout in belangrijke mate de voedsel inname bepaalt. In het regen seizoen werd deze relatie vooral bepaald door de

relatief lage voedselbeschikbaarheid. Vooral de reduktie in de consumptie van bonen is een punt van zorg vanwege de al grote afhankelijkheid van granen en de relatief marginale kwaliteit van het bestaande dieet.

In Hoofstuk 8 worden de gevonden resultaten met betrekking tot de relatie tussen brandhout beschikbaarheid en voedingszekerheid besproken volgens het model dat in Hoofdstuk 1 werd geintroduceerd. De resultaten tonen duidelijk aan dat al in een situatie van gematigde brandhoutschaarste de voedingszekerheid beinvloed wordt door de afnemende brandhout beschikbaarheid. De grootte van het effekt wordt bepaald door andere factoren zoals de voedsel beschikbaarheid, de beschikbaarheid aan arbeid en arbeidsverplichtingen die voortkomen uit andere problemen dan brandhout tekorten. De resultaten van deze studie bieden suggesties voor methodologieen te gebruiken in verder onderzoek en aanknopingspunten voor ontwikkelingsprojekten gericht op een verbetering van zowel de voedingszekerheid als de brandhoutvoorziening. Er zijn meer studies nodig naar de relatie tussen brandhout en voeding in stedelijke gebieden, en in plattelands gebieden met andere agro-ecologische, voedingskundige en anthropometrische karakteristieken dan het onderzoeksgebied. Gezien de onderlinge afhankelijkheid van brandhout, voeding en arbeid, zouden de effekten van een afnemende brandhout beschikbaarheid niet alleen een punt van zorg voor voedings- en gezondheidsprojekten moeten zijn, maar voor alle ontwikkelingsprojekten met betrekking tot ontbossing, landbouw en arbeid. Een tekort aan brandhout betekent dat er een compromis gezocht moet worden tussen lanbouwkundige, ecologische, voedingskundige en vrouwen doelstellingen.

NDONDOMEKO[1]

M'madera a mmidzi, a maiko amene akungokwera kumene, maanja amadalira nkhuni ngati mphamvu yophikira ndi kukonzera chakudya. Kutha kwa mitengo m'nkhalango kwadzetsa vuto losowa nkhuni. Pali zinthu zambiri zomwe zimathandizira kasungidwe ndi katetezedwe ka chakudya m'maanja koma kusowa kwa nkhuni kwakhala kusakuganiziridwa kwenikweni. Matetezedwe a chakudya ali ndi zigawo zenizeni zitatu (kuteteza chakudyacho, kasamalidwe kake ndi umoyo) zomwe zili zoyenera kumpanga munthu kukhala wodzidalira pa chakudya. Umodzi umene ulipo pakati pa kapezedwe ka nkhuni ndi katetezedwe ka chakudya, ukudalira pa njira zosankhidwa ndi maanja zomwe ndizo kuchuluka kwa nthawi yotolera nkhuni, kuchepetsa nkhuni zogwiritsira ntchito kapena kugwiritsa ntchito nkhuni za mtundu wina (Mutu woyamba). Njira zimenezi zingathe kukhudza kapezedwe kachakudya, kasungidwe kachakudya, kakonzedwe ndi kagawidwe, mapezedwe a ndalama ndi kadyedwe; zomwe zotsatira zake zingakhale kuchepa kwa chakudya chodyedwa ndi ubwino wake (Mutu Wachiwiri). Komabe zolembera zopezeka zimachokera mu kufufuza kochepa kapena m'maumboni ochepa koma umboni weniweni wochokera m'kafukufuku wakuya, okhudza mavutowa akusowabe.

Cholinga cha kafukufuku ameneyu chinali kufufuza ndi kufotokoza mgwirizano umene ulipo pakati pa kapezekedwe ka nkhuni ndi kadyedwe. Maphunziro amenewa anachitika mogwirizana ndi a Bungwe loona za kadyedwe ka anthu (Department of Human Nutrition) lochokera kusukulu yapamwamba ya zamalimidwe ku Wageningen ndi a African Studies Centre, Leiden ndipo anali kuthandizidwa ndi a Bungwe lofufuza zachikhalidwe cha anthu (Centre for Social Research) lomwe liri lu Zomba. Ntchito ya mmidziyi inali kuchitika pakati pa anthu a mtundi wa Chingoni m'boma la Ntcheu, lomwe liri m'chigawo chapakati ku Malawi, kuyambira mchaka cha 1990 mpaka 1992. Maanja omwe amakhudzidwa ndi maphunzirowa anali kuchokera mmdizi inayi yomwe inasankhidwa malinga ndi utali womwe ulipo kuchokera ku midziyi ndi kukafika kumalo otolera nkhuni, monga: Mudzi wa Muuso womwe uli pa mtundu wochepera 1.5; Mudzi wa Kachinjika uli pa mtunda wapakati pa 2.5 ndi 3.0; Mudzi wa Chimpuza uli pa mtunda wapakati pa 4.0 ndi 6.0 ndi mudzi wa Magola womwe uli pa mtunda woposa 6.0. Delali linali lodziwika ndi kusoweka kwa katetezedwe kachakudya (Mutu wachitatu), kudzidalira kwakukulu pa chakudya chopatsa mphamvu chokha (Mutu wachisanu ndi chiwiri) ndi wokhala ndi malire nkapezekedwe ka nkhuni (Mutut wachinayi).

[1] Wotanthauzira: Mandaaliza Kamwendo, Paul Damiano

Mtunda ukatalika kuchokera kunyumba kukafika kotolera nkhuni, maanja amakatolerabe kutaliko ngakhale amataya nthawi yambiri akutolera. Koma pamene malo otolera nkhuniwa anali kutali kwambiri, iwo amatolera nkhuni m'nkhutu momwe amatolera matsatsa ndipo potero amaononga nthawi yochepa. Maanja a mmudzi umodzi anali nazo njira zosiyana makamaka poganizira za mtundu waku malo otolera nkhuni komanso masiku otolera nkhunizo. Njira zimenezi ndi zomwe zimazindikiritsa za kuchuluka kapena kuchepa kwa nthawi yottolera, mtundu wa nkhuni ndi kuchuluka kapena kuchepa kwa khuni zotoleredwa, mfundo zomwe zili zodalirana. Ntchito zomwe akazi amakhala nazo panyumba ndi zomwe zimapangitisa iwo kuganizira za njira yakatoleredwe kankhuni makamaka iwo okhala ndi owathandiza ochepa amayesetsa kuononga nthawi yochepa, amatolera nkhuni zochepa ndi kugwiritsa ntchito nkhuni zosazidalira.

M'mitu yotsatirayi, maphunziro okhudza mgwirizano wapakati pa njira zenizeni zitatu zomwe zili (kugwiritsa ntchito nkhuni za mtundu wina, kuonjezera nthawi yotolera nkhuni ndi kuchepetsa nkhuni zogwiritsa ntchito) ndi zakadyedwe zafotokozedwa. Mutu wachisanu ukulongosola za maphunziro a ubwino wa mitundu ya nkhuni ndi magulu a chakudya. Amayi amakonda nkhuni zowaza ndi zamatunthu koma sanali olola kugwiritsa ntchito nkhuni za matsatsa ndi mapesi chifukwa zokondedwazo zimapereka makala abwino ndi kuyaka nthawi yayitali komanso zimachepetsa nthawi ndi khuni zophikira. Komabe maphunziro a nthawi yophikira, anatiululira poyera kuti nkhuni za matsatsa sizinali kuchulutsa nthawi yophikira. Kusakonda kwa nkhuni zamatsatsa kunali kuchokera pa mfundo yoti iwo samalimba pamoto ndipo moto wake umasokoneza ntchito zomwe amayiwa amayenera kuzigwira panyumba pawo popeza moto wa matsatsa ufunika kuuona pafupipafupi. Matsatsa sangagwiritsidwe ntchito ngati nkhuni zophikira zakudya zomwe zimafuna nthawi yophikira yayitali monga nyemba ndipo zakudya zoterezi sizimakhala nawo mgulu la zakudya zawo. Koma chakudya monga nsima ndi ndiwo zomwe zima psa m'nthawi yochepa, sizimasiyidwa popeza ndicho chakudya chodalirika.

Mutu wachisanu ndi chimodzi ukufotokoza kuti zotsatira zakuonjezereka kwa nthawi yotolera nkhuni zili ndi nyengo yake ndipo zimadalira pa kusowa kwa anthu owathandiza. Amayi anali kutsogoza ntchito ya ulimi koma anali kuchepetsa nthawi yopumula, yokonzera chakudya komanso yophikira ndi kugula chakudya m'nthawi ya dzinja. Panalibe umboni wopozekeratu kuti amayi amaononga maola ambiri akugwira ntchito ya kumunda, kusiya ntchito zina zomwe zimayenera kugwiridwa pa tsiku kapena kuthandizidwa ntchito m'masiku otolera nkhuni, lzi zikutanthanza kuti amayi amakhala otanganidwa m'masiku otolera nkhuni. Chifukwa cha kutanganidwa kotereku m'masiku otolera nkhuni mmalo moti adzipumula, kungatanthanze kuti kunayene ra

amayiwa adzidya zhakudya chambiri cowapatsa mphamvu. Kuchepetsa kwa nthawi yogwirira ntchito zopezera chakudya, zingathe kukhudza mapezekedwe a chakudya m'maanja.

Mutu wachisanu ndi chiwiri ukufotokoza za mgirizano umene ulipo pakati pa magwiritsidwe a nkhuni ndi kadyedwe a chakudya. Kugwiritsa ntchito nkhuni zochepa kukugwirizana ndi kuchepetsa zakudya zopatsa mphamvu monga: kuchepetsa zakudya zomwe zimadyedwa pakati pa kadzutsa ndi nkhomaliro komanso zapakati pa nkhomaliro ndi mgonero kapena kuchepetsa maphikidwe a chakudya chopatsa mphamvu ndi nyemba. Izi zimaoneka m'nthawi yoti mbeu zakololedwa popeza iyi ndiyo nthawi yomwe kudya kumadalira pankhuni. Ngwirizano uwu m'nthawi ya dzinja umadalira pa chakudya chochepa chomwe chimapezeka. Makamaka kuchepa kwa nyemba zodyedwa ndi mfundo yopatsa chidwi poganizira za kudzidalira kwakukulu pa chakudya chopatsa mphamvu mderali komanso chakudya chomwe ubwino wake ndi wocheperapo.

Mutu wachisanu ndi chitatu, ubale womwe wapezeka kale wapakati pa kusoweka kwa nkhuni ndi katetezedwe ka chakudya uli kufotokozedwa mogwirizana ndi mfundo zosiyanasiyana zomwe zatchulidwa mu ndondomeko yomwe yalembedwa m'mutu woyamba. Zotsatira zakafukufukuyu zikuonetseratu poyera kuti pamene nkhuni zili zosowerapo, kusoweka kotereku kuma khudza kwambiri katetezedwe ka chakudya. Zotsatirazi zikudalira kwambiri pa mfundo zina monga: kupezeka kwa chakudya, kupezeka kwa othandiza amayi kugwira ntchito zina ndi mavuto osoweka othandiza amayiwa ntchito zomwe zimacho kera ku zovuto zina m'malo mwa kusoweka kwa nkhuni. Zotsatira zamaphunzirowa zikupereka chiyambi cha njira zina, zomwe zingadzagwiritsidwe ntchito m'kafukufuku wa mtsogolo komanso nkuyesayesa kwathu pa ntchito zachitukuko, zomwe cholinga chake ndi kukweza mapezekedwe a nkhuni ndi kuteteza chakudya. Chidziwitso chambiri chikufunika chokhudza ubale womwe ulipo pakati pachakudya ndi nkhuni mmizinda komanso mmidzi yomwe ili ndi malo osiyanasiyana, kadyedwe, miyambo ndi zikhulupiriro zosiyanasiyana. Njira zomwe zingadzagwiritsidwe ntchito m'kafukufuku wamtsogoloyu zaganiziridwa m'maphunziro awa. Poganizira za ubale wodalirana womwe ulipo pakati pa nkhuni, chakudya ndi ntchito, zotsatira zakusoweka kwa nkhuniku sizili zoti zingagwiritsidwe ntchito pa kafukufuku wa kadyedwe ndi umoyo yekha komanso m'chitukuko cha malo akumidzi pokhudza kudzala mitengo, ulimi ndi ntchito zina. Kusoweka kwa nkhuni kukutanthauza kuti mgwirizano uyenera kupezeka pakati pa zauchikumbe, zachilengedwe, zamadyedwe ndi zolinga za amayi.

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CURRICULUM VITAE

Inge Dorothé Brouwer was born on the 5th of March 1961 in Rheden, the Netherlands. In 1979 she graduated from secondary school with a 'Gymnasium-beta' orientation, at the "Thorbecke Scholengemeenschap" in Arnhem. In September of the same year, she started her studies in Human Nutrition at the Wageningen Agricultural University. During her studies she spent a 6-months period of practical work at the Langbensi Agricultural Station, Ghana, and 3-months period in Kaolack, Senegal, for her MSc research. In 1986, she obtained her Master's degree, with Human Nutrition and Public Health as major topics, and Teacher Training and Education as minor topic.

From 1986 to 1988 she worked at the Department of Teacher Training and Education of the Wageningen Agricultural University. In September 1988, she started as PhD-fellow in the Postgraduate Programme in Human Nutrition at the Department of Human Nutrition of the Wageningen Agricultural University. The subject of research was the relationship between fuelwood availability and nutrition in rural areas in Malawi. In November 1988, she attended a postgraduate course in data collection methods in social-scientific research, Free University of Amsterdam, the Netherlands. In July 1989, she participated in the Postgraduate Summer Course on Epidemiology in Human Nutrition and Public Health, University of Southampton, Southampton, UK. From September 1990 till May 1992 she carried out field work for the study described in this thesis, in Ntcheu District of Malawi. During the final phase of the project, she was also involved in supervising of a comparable study carried out in Ethiopia by the Ethiopian Nutrition Institute, in the development of a teaching module on Food and Nutrition Security for Health and Development, as part of an EC-funded NATURA-Nectar programme, and in the writing of a joint research proposal on Fuel and Health involving the WHO Division of Environmental Health, WHO Division of Food and Nutrition and the Department of Human Nutrition. In June 1993 she stayed in Malawi as an UN-observer during the national referendum.


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