Agroforestry research program

National Agricultural Research Institute (NARI)

Fuel wood Project: Effects of consumption and production on the general population and natural resources of The Gambia

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A K Jarju
National Agricultural Research Institute

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Abstract

Increasing population, deforestation and changing climatic conditions have led to a decline in the availability of fuelwood in The Gambia. Present figures indicate that over 85% of the energy requirements come from forests and that fuelwood consumption surpasses forest volume increment by over 100,000 m^3 annually. To assess the current situation regarding fuelwood consumption and production for households, chop shops and schools, a survey was administered to collect data on; collection times and distances travelled; agroforestry and fuelwood production techniques practised; tree species favoured, and farmers' attitudes towards future sustainable fuelwood resources. Findings indicated that in general Gambians are not aware of a fuelwood crisis, nor do they worry about future supplies from the forest. The majority of respondents indicated that forests will continue to provide fuelwood, as a result of 'others' planting trees, regardless of the fact that collection time has increased, as has the distance traveled from their village to obtain fuelwood. Few farmers produce fuelwood on their farm, though one third indicated that family nutrition has been affected by the lack of fuelwood. The results showed that daily the per capita consumption rate, at present 1.05 kg, has remained steady over the years, but with the increasing population, the deficit between annual wood increment and fuelwood consumption has increased almost threefold.

1 Introduction

The Gambia, a small country within the Sahel region of West Africa, surrounded by Senegal on three sides and the Atlantic Ocean to the West, is suffering from the intense negative effects of desertification, due to a combination of climatic and population changes. More specifically, the Gambia is experiencing extreme forest degradation and a steady decrease in its natural resources.

Prior to 1968, approximately 60% of The Gambia was covered with forest of which 50% was of the closed Guinea-Savannah type. Though total forest coverage has reduced only slightly, to 46% (1998), only 1.1% is closed forest and overall density and species composition has decreased greatly.

The erratic rainfall patterns of the past few decades has led to a reduction in overall rainfall and a shorter rainy season characterised by sporadic dry spells during critical times of crop development. This changing rain pattern has created problems for crop and livestock production and has had a serious impact on forest structure and rejuvenation. Decreasing availability of fodder has caused the cattle herders to expand their grazing area, thereby entering and damaging the forests. The resulting decreases in forage and re-growth of the forests, further advanced by bush fires, has led to a decrease in the availability of dead wood, while greatly reducing the species composition (NARS1997[1]).

In 1973 The Gambia's population began to increase significantly and is currently estimated to stand at 1.25 million inhabitants with a growth rate of 4.1% overall (6% in the urban capital area)(NARS, 1997). This has increased the pressure on forest resources to provide fuelwood and timber for domestic use. Forest clearing, to convert the lands to agricultural production has increased, in order to meet the needs of this largely agricultural population, while the need for settlement areas making huge inroads into forest lands. All these factors have combined to negatively impact the density, area, and rejuvenation capacity of The Gambia's forest lands.

With forests providing 85% of The Gambia's domestic energy (NARS 1997) and the resources declining within the forests, the issue of fuelwood availability and consumption is of great concern. Previous studies estimated the average fuelwood consumption rates to be between 0.65kg and 0.97kg/ person/ day (Forester, 1983[2]; Von Kruedener, unpublished[3]). This they stated, surpassed wood production by 100,000 m^3 / year. Considering the dramatic increase in the population, the current situation regarding rural and urban household fuelwood consumption needs to be re-assessed and recommendations/ solutions offered on all levels to help alleviate future fuelwood shortages.

The objective of this survey is therefore to obtain current information regarding fuelwood consumption rates, document collection times and techniques and how this effects households of rural and urban origin, with respect to their budget and health. With such information, suggestions can be made as to how farmers and others can increase the fuelwood production (on rural farms) thus decreasing the pressure on forested lands, how to create a sustainable fuelwood supply.

[1] NARS of The gambia: Analysis and Strategy for the long term, FAO, Rome 1997

[2] Forester, H. 1983. Tree species plantation trials and silviculture studies in The Gambia, GGFP, The Gambia.

[3] Von Kruedener, B. Firewood Consumption in The Gambia, 1995, unpublished document.

2 Methodology

2.1 Introduction

A survey was conducted to assess the current situation regarding fuelwood consumption and production among farmers in The Gambia. As knowledge of what villages and individual farmers are doing to replenish the forest resource base / fuelwood supplies is limited at this point, the survey questionnaire set out to find out the current status of the fuelwood situation in homes, schools and restaurants. As previous surveys questioned only households, an accurate figure for per capita fuelwood consumption could not be obtained. For this reason, a selection of villages, schools and restaurants from urban and rural areas were surveyed from the 6 Agricultural Divisions of The Gambia.

2.2 Design and Implementation of the Survey

The survey questionnaire was refined and adapted from two surveys carried out in 1996 by Purcer, P[4], and Tarleton, M[5],. In order to take into account the differences between Kenyan and Gambian social and environmental conditions, the questions were altered accordingly. The new questionnaire was then tested on a number of farmers, urban, rural and semi-urban and modifications made where necessary

The survey questionnaire focused on the following subjects:

- General farm/compound information,
- Type of fuel use,
- Fuel consumption,
- Collection techniques,
- Effects of fuelwood on household budget, nutrition and income generation practices,

while the survey format consisted of the following types of questions:

- Yes/No (to get specific data relating to specific objectives),
- Pre-coded (with codes being verified by the pre-survey testing of the questionnaire),
- Open-ended (to allow for a general discussion relating to specific topics).

A stratified random sample of 95 respondents throughout The Gambia was then developed and the questionnaire administered.

2.3 Implementation of Questionnaire

To carry out the survey using time and financial resources effectively, a number of US Peace Corps volunteers were drafted to administer the questionnaire. The questionnaire was directed to compound heads where possible, failing this the oldest and most responsible family member was questioned. However, on questions pertaining to the women's role on the farm, cooking or fuelwood consumption, women were specifically addressed. The survey took place between October and December 1998.

During the questionnaire, farmers were asked to estimate the weight in kilograms and number of bundles collected and used per day. To assess the weight of fuelwood bundles, both in rural villages and on roadsides, the survey weighed a total of 175 samples using a calibrated weighing scale. Those figures could then be correlated with the answers given by farmers as to their daily consumption rates. All sample areas, rural, urban and semi-urban were randomly selected.

[4] Purcer, P. MSc. Thesis, "Farm and Village Level Fuelwood Issues in Three Contrasting Agro-Ecological Zones in Embu District, Eastern Province, Kenya" UCD, Ireland 1996

[5] Tarleton, M., MSc. Thesis, "On-Farm Fuel Dynamics in Three Contrasting Agro-Ecological Zones in Embu District, Eastern Province, Kenya"UCD, Ireland 1996

3 Results and Discussion

3.1 Survey Statistics

A total of 95 fuelwood surveys were administered to both rural and urban farmers/compounds, chop shops, and schools, see Table 1. Of the surveys undertaken, 46 covered private residences in rural, urban and semi-urban locations, 20 covered chop shops and 29 covered schools. With regard to household surveys 10 were conducted in North Bank Division, 15 in Western Division, 7 in Central River Division, 7 in Upper River Division and 7 in Lower River Division. Of the household surveys, 22 were conducted with rural farmers (48%), 14 in urban compounds (30%) and 10, 22%, in semi-urban households.

Table 1 Breakdown of survey respondents by agriculture divisions

Survey respondent	NBD	WD	LRD	CRD	URD	Totals
Private						
Urban household	0	14	0	0	0	**14**
Semi-urban household	3	0	3	2	2	**10**
Rural household	7	1	4	5	5	**22**
Chop shop	2	12	4	1	1	**20**
Schools						**6**
Urban	0	6	0	0	0	
Semi-urban	2	0	0	1	1	**4**
Rural	4	2	1	7	5	**19**
Totals	**18**	**35**	**12**	**16**	**14**	**95**

NBD, North Bank Division, WD, Western Division, LRD, Lower River Division, CRD, Central River Division, URD, Upper River Division

The average family size of the 46 compounds surveyed was 15 persons, indicating that the survey covered the fuelwood consumption rates of a population of almost 600 people, excluding the chop shops and the schools.

3.2 Farm Background

Of the private residences surveyed, 42 out of the 46 (91.3%) were farmers with an average farm size of 3.5 ha. The maximum amount of land farmed by any one farmer was 11 ha, while the smallest farm was less than 1 ha. Over 47% (20) of the farmers stated that they owned the land they farmed (Table 2). An interesting point is that more than 95% of farmers surveyed farmed more than 1 plot of land, with the average being 4 plots. The majority of farmers, over 75%, farmed between 2 and 5 ha. This would imply that an average farmer's field is approximately 1 ha in size.

Table 2: Breakdown of who owned the farmed land

Farmer owned land	47.6% (20)
Family owned land	23.8% (10)
Alkalo owned land	11.9% (5)
Communal land	9.5% (4)
NARI land	7.2% (3)
Total	100% (42)

Out of the 42 farmers surveyed, 43% owned cattle, of which 50%, had fewer than 5 cattle, 3 farmers (16.7%) with between 6 and 10 cows and 2 farmers with 15 cattle. Over one fifth of farmers had a livestock herd of greater than 30 cows, with one farmer indicating he owned a herd of 175! Almost 90% of farmers with cattle acknowledged that their cattle grazed extensively on the surrounding lands while 2 farmers fed their cattle fodder from their farm holdings.

Only 43% of farmers surveyed had been exposed to agroforestry via extension services. The main sources of agroforestry information were the Department of Forestry, the National Agriculture Research Institution (NARI), the Department of Agricultural Services (DAS), US Peace Corps, Action Aid, the Methodist Mission and other Non-governmental Organizations (fig.1).

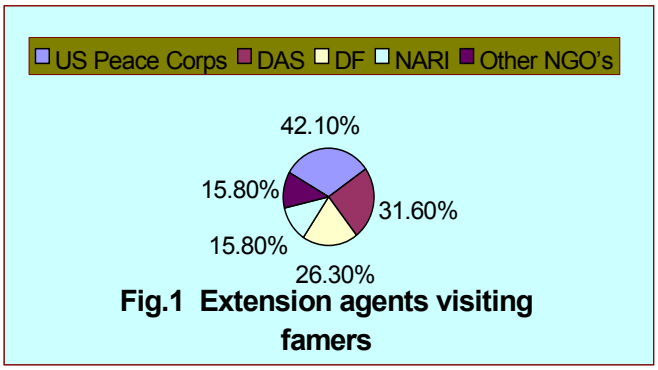

Fig.1 Extension agents visiting famers

With regards to off-farm income, 61% of the survey respondents stated that they had other means of generating a cash income. Of those respondents with alternative income generating activities, renting out rooms and skilled labourers (carpenters, masons, and tailors) were most frequently stated at 13% each, and having jobs as government employees (teachers, extensionists, and civil servants) at 10%.

3.3 Fuelwood Statistics

Throughout the survey, many fuel types were documented, including wood, gas, charcoal, electricity, and kerosene. It was noted that the fuel types differ slightly depending on the economic standing of the household. Although many respondents stated that they used different forms of fuel energy at different times, wood was the primary source of fuel for 97.8% of those households surveyed. The breakdown of fuel used throughout the country along with their main uses can be seen in Table 3. It is interesting to note that over 88% of survey respondents use charcoal (the production of which is banned in The Gambia). However, the quantity used is very small with over 53% of respondents using less than 10 cup fulls/month. Charcoal was generally used in producing the traditional local hot tea, attaya, and for ironing. Many respondents, over 54.3%, also used kerosene for lighting, of which the majority, 52%, were in urban and semi-urban areas. Gas was used by 34% of the private respondents, of which 69% were urban. Its use was restricted to re-heating food and

producing attaya. Electricity, found only in the urban and semi-urban areas was used by 21.7% of all surveyed, again for lighting only. The majority of respondents paying for alternative fuel sources, i.e., electricity, gas, kerosene live in urban areas while the fuelwood users are throughout The Gambia.

In chop shops, in over 85% of cases, fuelwood was the primary source of energy, while gas was used in 40% and in 3.4% of school. Charcoal was generally not used in either chop shops or schools.

Table 3: Household fuel types and uses

Fuel type	Main uses	Rural household usage % n=22	Urban household usage % n=14	Semi-urban household usage % n=10	School usage % n=29	Chop shop usage % n=20
Wood	cooking	100% (22)	93% (13)	90% (9)	86.2% (25)	90% (18)
Charcoal	attaya* and ironing	77.2% (17)	93% (13)	90% (9)	3.4% (1)	10% (2)
Kerosene	lighting	45.5% (10)	57% (8)	70% (7)	0%	0%
Gas	attaya*	18.1% (4)	64% (9)	33% (3)	3.4% (1)	40% (8)
Electricity	lighting	0%	100.%(14)	0%	0%	0%

*traditionally brewed tea

3.3.1 Type of Fuel Stove Used

Of the 46 household respondents, 97.8% were using wood as an energy source, the majority, 71.7%, used the traditional 3-stone fire for cooking, while 40%, stated they used a 'sinkiri kutoo', the newer more efficient metal structure designed to have 3 sticks burning at once, pushing the heat upwards thus increasing heat intensity and decreasing cooking time and therefore fuel consumption. Of the household respondents, no one was found using the highly efficient Kumba Gaye mud stove or other alternatives (Table 4).

Table 4: Types of stoves used

	3 stone	Sinkiri kutoo	Gas burner	Charcoal burner	Kumba Gaye	Community Development	FIOH*
Schools	41.4%	6.9%	0%	0%	31%	3.4%	13.8%
Chop shops	35%	55%	40%	10%	0%	0%	0%
Households	71.7%	39.1%	34.7%	78.2%	0%	0%	0%

∗Future in Our Hands

With regard to the 29 primary and secondary schools surveyed, 55.2% used fuel efficient stoves (i.e. sinkiri kutoo, Kumba Gaye, community development and Future In Our Hands {FIOH}). Of the schools using fuel-efficient stoves, the majority 56% used the Kumba Gaye model while 25% have stoves built by (FIOH) that also conserve fuelwood. Of the 18 chop shops using wood to cook with, 61.1% (11), use the 'sinkiri kutoo' metal stove where as 7, 38.8%, traditionally cook over the 3-stone fire. Of the chop shops surveyed the wood was

bought in bulk from firewood dealers in 74% of the cases. It was also stated that the firewood dealers imported the wood from Senegal and/or from up-country.

3.3.2 Fuelwood Consumption Rates

Table 5 illustrates the annual fuelwood consumption rates of households, chop shops, and schools. Average consumption rates in the three categories combine to reveal that an estimated 714,784 m^3 of fuelwood is used annually in The Gambia. Furthermore, This indicates that the average per capita fuelwood consumption is 1.05 kg/day.

Table 5 Fuelwood Consumption Chart

	Chop shops	Schools	Households
Average daily fuelwood (kg)	14 kg	14 kg	1.044 kg/ person*
Days cooked / year (Approx.)	300	180	365
Annual consumption	420,000 kg	731,000 kg	476,325,000 kg
Total kg Used per year			477,476,000 kg
Converted to cubic meters (App. 4)			714,784 m^3/yr
Per Capita consumption on a daily basis			1.05 kg / day

*this is an average from the weighed and the estimated responses

3.4 Tree Parts Used

During the survey it was observed that all parts of the tree were used as fuelwood throughout the country, everything from the tree branches, to the trunk and cut timber. However, in the urban areas cut timber is what is predominately sold at the marketplace and is therefore the more commonly used fuelwood source. There appears to be a distinct division between urban and rural users and the parts of the tree used for fuelwood. In rural locations, the majority of respondents (91%) used the trunk and branches of trees whereas less than 41% used cut fuelwood (Table 6). However, in urban areas, over 70% used cut timber (i.e., purchased) with the remainder coming from branches and the tree trunk. However, 'cut timber' may be seen in this survey to be high in the rural areas because the precise definition was not always conveyed. 'Cut timber' refers to the wood split for purchase. This is not available widely in the rural areas and therefore rural farmers who answered this may be referring to wood from the bush that they themselves have split.

Table 6: Tree parts used

Tree Part	Urban		Semi-urban		Rural	
	%	n=14	%	n=10	%	n=22
Stem	35.7%	(5)	40.0%	(4)	54.5%	(12)
Branch	42.9%	(6)	90.0%	(9)	90.9%	(20)
Cut timber	78.6%	(11)	60.0%	(6)	50.0%	(11)

3.4.1 Characteristics of Good Fuelwood Trees

When respondents were asked about the characteristics sought in fuelwood tree species, the vast majority (77.3%) said that calorific value was the single most important attribute necessary in fuelwood species. In accordance with the cooking habits of The Gambia, 50% of the respondents cited that they preferred burning smokeless fuelwood. Other attributes,

which were of interest to respondents whether urban, semi-urban, or rural, included wood density and long-lasting flame, both 9.1% (4), followed by the effect of the tree on the food while cooking. Interestingly, only 2 respondents stated the importance of fuelwood to be able to produce charcoal as a key attribute.

*3.4.2 **Most Common Trees***

The most common trees used for fuel as a result of the survey were *Pterocarpus erinaceus*, 54.5%, *Combretum glutinosum* 34.1%, *Terminalia albida* 29.5%, and *Mangifera indica* 18.2% (Appendix 2). However, when respondents were asked why the above species were favoured for fuelwood, other interesting attributes were noted along with the aforementioned calorific value, smokiness and long-lasting flame. Of the respondents, 17% noted that brittle branches, the production of good charcoal, a fast drying time and flammability were important characteristics of fuelwood tree species.

3.4.3 Fuelwood Shortages and Seasonal Variations

Both fuelwood shortages and seasonal variations had affected the majority of respondents, in particular the rural farmers, over the last number of years. Of the respondents surveyed, 45.7% stated that they had suffered fuelwood shortages over the past 5 years, while 56.5% agreed that they had suffered fuelwood shortages over the past year alone (1998), thus documenting an increase in fuelwood shortages over the past year.

Seasonal variations affecting the availability of fuelwood occurred in 61% of the respondents' households. The number one reason for this variation was the use of fuel during the cold season, when more wood was burned for heating purposes. Larger logs were burned to keep the compound warm after sundown. These logs are kept burning while the family stays up and were re-ignited in the morning until the sun has warmed. The extra use of fuel continued throughout the cold season, which ranges anywhere from 8-10 weeks. Other seasonal variations include an increase in fuel used during the rainy season in compounds that farm rice. In this situation, the women were in haste to get to the rice field, and thus they used more wood to cook the lunch faster. However, in the dry season, others stated that they used more wood, as more was available in the bush.

3.5 Collection Techniques

3.5.1 Who Collects

Fuelwood collection was an important and time-consuming activity whether done at daily or weekly intervals for the majority of urban and rural Gambians. However, the people involved in fuelwood collection varied with regards to the household's economic standing, though in general it was the males of the compound that collect the fuelwood. Survey results indicated that in 65% of the cases it is either the adult or child males who collected fuelwood, while females (old and young) accounted for 35% of the fuelwood collection. However it was shown that in rural areas female adults were equally responsible along with adult males for fuelwood collection. The female child was seen to collect, according to survey respondents, in less than 7% cases overall (Table 7).

Table 7 Who collects the fuelwood

	Rural	Urban	Semi-urban	Total
Male adult	45.5%	64.3%	11.1%	33.3%
Female adult	45.5%	21.4%	44.4%	28.3%
Male child	50.0%	14.2%	66.6%	31.6%
Female child	18.1%	0	0	6.6%
Collective effort	0	14.2%	0	0

The high percentage of adult males in urban areas can be accounted for because most of the fuelwood is bought from a vendor or at the market and children do not have the financial capacity to purchase the wood. However in the rural areas, wood is collected from the bush or forest and therefore children, in particular male children are required to assist. Over 30 of the farmers surveyed, 61%, collected their fuelwood directly from the bush or forest. Only 1 farmer, actually collected fuelwood from his farm. A total of 34.7% (17 farmers) collect or buy their fuelwood directly from the market or roadside.

3.5.2 Time Spent Collecting

It is indicated in Table 8 that the time spent collecting fuelwood is not excessive, with 63.6% of rural dwellers collecting their fuelwood requirements in less that 2 hours, over 71.4% of urban dwellers collecting (presumably purchasing) fuelwood in less than 1 hour, and 44.4% of semi-urban households collecting in under 2 hours. However, for rural and semi-urban dwellers, the proportion of farmers whose collection time exceeded 2 hours is over 55.5% while 36.4% of rural dwellers spending between 2 and 5 hours collecting.

Table 8 Hours spent collecting fuelwood

Hours	Overall	Urban	Rural	Semi-urban
< 1	42.2%	71.4%	31.8%	22.2%
1-2	20.0%	0%	31.8%	22.2%
2-3	11.2%	7.1%	12.5%	14.3%
3-4	13.3%	14.3%	8.3%	28.6%
4-5	13.3%	7.1%	12.5%	28.6%

These calculations were based on single collection times, the frequency of which, in rural, urban and semi-urban areas can be seen in Table 9. When averaged out how many hours per day are spent collecting, 93.3% collected wood in under 2 hours with only 3 farmers spending from 2-5 hours daily on fuelwood collection.

Table 9 Frequency of fuelwood collection

When collected	Rural	Urban	Semi-urban
Daily	31.8%	30.8%	22.2%
3 times a week	18.2%	23.1%	0%
Twice a week	27.3%	15.4%	33.3%
Once a week	18.2%	53.8%	88.9%
Once every 2 weeks	4.5%	7.7%	0%
Once every 3 weeks	4.5%	0%	0%
Once a month	9.1%	0%	50%

3.5.3 Changes in Collection Times and Distance Travelled

Regardless of the time spent collecting fuelwood, according to 71.1% of the survey's respondents, the time spent collecting fuelwood increased, with only 6.7% indicating that collection time decreased (Table 10). Almost 23% or 10 farmers, stated collection time has remained the same. However, of those that said the time had stayed the same, 90% were urban dwellers that buy their fuelwood in the market. At the market level, a fuelwood crisis

has yet to be felt as the vendors are still capable of supplying fuelwood for consumers, thus from the consumer's perspective it appears that there is no decrease in fuelwood supplies.

Table 10 Time change in fuelwood collection

Time Collecting	Rural	Urban	Semi-urban	Total
Increased	90.9% (20)	11.1% (5)	70.0% (5)	71.1% (32)
Remained same	4.5% (1)	15.6% (7)	20.0% (2)	22.2% (10)
Decreased	4.5% (1)	2.2% (1)	10.0% (1)	6.7% (3)

Nearly all of the respondents, 95.7% stated that they had to travel beyond the resources of their farm to obtain fuelwood. Furthermore, 82.6%, had to travel out of their village to fetch the required amount of fuelwood. When asked why the distance or time increased, the following reasons were given (Table 11).

Table 11 Reasons given for an increase or a decrease in fuelwood supplies

Increasing or Not Decreasing	% of respondents
Always available	7.5%
Plenty still in the bush	2.5%
More trees are dying	2.5%
People are replanting	2.5%
Demarcating Community Forests for future	2.5%
More trees are growing	2.5%

Decrease	% of respondents
Increase in population	20.0%
People are not replanting	17.5%
Trees are being cut down	12.5%
The bush is vanishing	12.5%
No management of trees	5.0%
Increase in bush fires	5.0%
Amount per bundle is decreasing	5.0%
Rainy season is shorter	2.5%

3.6 On-Farm Wood Production

Considering the high percentage of fuelwood users, the survey included a section on what farmers were doing in an effort to supply themselves with fuelwood or to protect the natural resources about them. The results, which follow, clearly indicate a lack of awareness of the need to manage ones own fuelwood supply and to protect the environment. Over 76% of respondents, when asked whether they practised some form of fuelwood production on their farm or compound replied in the negative. They simply stated that whatever trees were left on the farm, whether boundary or in inner fields, would be cut now and then for fuelwood use. No other active management of trees was undertaken. The location of trees on the farm varied with half of the farmers interviewed stating that trees are left on the boundary of their farms while 63% confirmed that their farm contains trees within the boundaries.

3.6.1 Trees Left on the Farm

Of the farmers with trees along the boundaries of their farms, the most prevalent species are *Anacardium occidentale* (cashew) and *Gmelina arborea* (gmelina) 31.8%, followed by *Mangifera indica* (mango) and *Pterocarpus erinaceaus* (rosewood) at 18.2%. Those with non-boundary trees on their farms have mostly mango, 44.8%, followed by *Cordyla africana* (bush mango) and *Khaya senegalensis* (african mahogany) at 20.7% each. See Appendix 3 for full list of species found on farmers' lands.

As stated above, the only trees to be managed by farmers were fruit and nut species. Here 41.3% of respondents acknowledged that they actively planted and managed trees on their farm. Mango was listed as the number one managed species for 36.8% of respondents, followed by cashew at 21.1% and *Citrus limon* (orange) at 18.4%. These trees are mostly planted within the compound rather than in the fields although they are listed as on the farm.

When asked about future plans to plant or manage trees on their farms specifically for fuelwood production almost 48% replied that they would use whatever means possible to increase their own supply. However, todate only one farmer (2.2%) replied that he actually produced a surplus fuelwood supply on his farm, thus overwhelmingly indicating that fuelwood, particularly in the rural and semi-urban area's is taken straight from the bush.

3.6.2 The Decision of Tree Planting

The farmers surveyed indicated that the decision-maker in planting trees on the farm or in the forest is the husband in 60.5% of cases, while 23.3% said that it is a family decision and 14.0% agreed that it is a husband and wife joint decision. In no instances were women the sole decision-makers when it came to tree planting.

3.6.3 Agroforestry Practised

In the survey, those with a farm were asked a number of questions about their knowledge of fuelwood production and how or what agroforestry techniques they apply to their farms. Table 12 lists the different types of agroforestry techniques practised and the percentage of farmers using them. However, few of these practices are specifically for fuelwood production, with fuelwood mainly resulting as a by-product of tree/crop interaction, boundary planting, and alley cropping techniques. Table 12 clearly shows that farmers are not practising extensive agroforestry techniques on their farms. The reasons for this may be as a result of the inadequate agroforestry extension services available in The Gambia.

Table 12 Agroforestry techniques practised by surveyed farmers

Agroforestry technique	% of farmers
Fruit tree planting	70.3%
Boundary planting	43.2%
Soil fertility maintenance	27.0%
Tree/Crop Interaction	24.3%
Contour planting	18.9%
Fuelwood production	13.5%
Live fencing	13.5%
Orchard plantations	8.1%
Alley cropping	8.1%
Fodder production	5.4%

Table 13 lists the number of farmers surveyed that were visited by agents extending agroforestry techniques over the past few years. It is interesting to note that of the farmers surveyed, less than 39% were visited by extension agents.

Table 13 Percentage of farmers visited by extension services

Region	Farmers receiving extension # n=46 (%)
North Bank Division	5 (10.8)
Western Division	5 (10.8)
Lower River Division	3 (6.5)
Central River Division	2 (4.3)
Upper River Division	3 (6.5)
Total receiving extension	**18 (39)**

Agroforestry techniques have been extended by a number of agencies and departments in The Gambia. Table 14 shows that of the majority of farmers received agroforestry extension agents, from existing government extension services. This figure is disproportionately high for as yet there is no true agroforestry extension services within the government services. However, limited knowledge is available and can be obtained from the Department of Forestry and the Department of Agricultural Services along with NGO's. The US Peace Corps was shown to have visited many of the farmers surveyed who claimed agroforestry extension. This figure again could be misleading as the survey itself was carried out with the help of Peace Corps Volunteers in the field, many of which are actively extending agroforestry techniques to those villages surveyed.

Table 14 Agencies extending agroforestry practices to surveyed farmers

Extension Agent	Agency distribution among farmers receiving extension
US Peace Corps	8 17%
Dept. Agric. Services	6 13%
Dept. of Forestry	5 11%
NARI	3 7%
Other NGO's	3 7%
Total	**25**

3.6.4 Community Efforts in Tree Planting

Of the farmers surveyed, 41.3% said they were involved with tree nurseries. Of those involved with tree nurseries, 36.8%, are individual nurseries, 47.4% are for the Community Forest Project supported by the Department of Forestry, and 15.8% are from outside non-government organizations. Only 8.7% of respondents acknowledged involvement in community woodlot projects.

3.7 Farmers Opinion /Attitude to Future Fuelwood Supplies

The survey results show that virtually no farmer produces surplus fuelwood and less than 25% produce any fuelwood on their farms, thus indicating that most farmers get their fuelwood supplies from the natural vegetation around them or from the market. A further indication of this fact, is that from the survey, the majority of respondents, (57.8%), stated that the forest and bush will continue to supply their needs without any intervention over the coming years. Over 40.0% of respondents said that the forest would not be able to continually produce enough fuelwood for local consumption. One farmer stated that is was up to the merciful and almighty Allah!

The 57.8% of farmers who stated that the bush would continue to supply fuelwood in the future cited the following reasons. Almost 42.3% indicated that the forest is plentiful, and that there is no shortage of fuelwood as yet. A further 15.4% believe that there is no shortage as trees are always growing and others, especially the government, are continually planting. However, for the 40% of farmers who believe the forest will not produce enough fuelwood for the future, the following reasons were given: an increase in demand for fuelwood (13.3%,) and a lack of replanting efforts (13.3%). Six farmers, 13.3% also stated that the bush would soon disappear for various reasons.

Because of the traditional farming practices of The Gambia, over 80-85% of agricultural and forest lands are burnt each year due to bush fires. This is practised particularly by rural farmers and in the survey over 88% agreed that bush fires were one of the major constraints affecting fuelwood availability in the forest.

3.8 Effect of Fuelwood Supplies on Household Budget and Nutrition

The survey further questioned respondents to see if the decrease in fuelwood supplies had an effect on family nutrition and on household budgets. Over 37% of the respondents spent money on fuelwood, the rest gathered it from the bush or traded for it in kind in the village. Of the respondents spending cash on fuelwood, the average spent was D17.3 a week ($1.54, $1= 11.2D). Those purchasing fuelwood were all from urban and semi-urban areas (15 households). When asked if the purchase of fuelwood limits the purchase of other necessary goods 71.1% of respondents said that it did not.

3.8.1 Priority of Expenditure

When asked to list in order of priority, what available cash would be spent on, respondents indicated food first at 19%, school fees at 18%, followed by clothes (17%), fuel (16%), livestock (13%), agriculture inputs (9%) and health care (6%). It is evident that from the above data, the future decreasing amounts of fuelwood in urban areas resulting from the

dwindling forest resources will cause considerable hardship to the urban dwellers. Since fuelwood is collected freely in most rural areas rather than bought, monetary constraints may not be as evident, however collection times undoubtedly will increase causing many other hardships.

3.8.2 Family Health

Further consideration was taken into account, regarding the health of the family as a result of dwindling fuelwood supplies. Over 98% of households surveyed in The Gambia used fuelwood as their primary cooking fuel. The lack of fuelwood thus implies cooking fewer meals per day. In light of this, 35% of survey respondents indicated that the lack of fuelwood did, between moderately and heavily, affect family nutrition as a result of fewer cooked meals a day.

3.8.3 Lack of Fuelwood Affecting Other Income Generating Activities

Besides family health and necessary household purchases, 23.9% of survey respondents indicated that the lack of fuelwood affected other income generation activities. The main activity affected by the lack of fuelwood was fishing (10%); however, other activities like carpentry (20%) were affected though more so by lack of wood, not fuelwood.

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4 Conclusion

Survey results indicated that all households, whether urban, rural, or semi-urban used fuelwood as their main source of energy for cooking and heating. Although other forms of fuel (i.e., charcoal, kerosene, gas and electricity) were used, their use was generally limited to lighting, ironing, and brewing attaya. Fuelwood was also the main source of energy for both chop shops and schools, indicating a complete reliance on fuelwood throughout The Gambia. The majority of these fuelwood users still use the inefficient 3 stone stoves (77% of households, 41% of schools) although alternate stoves are available. This clearly indicates the general publics' lack of awareness of fuel-efficient stoves and the importance of conserving The Gambia's natural resources.

When respondents were asked about fuelwood supplies, 57% claimed that the bush, as it stands, would continue to supply them with the fuelwood resources they need. In light of recent publications indicating that the forest resources of The Gambia have reduced from 30% closed canopy coverage alone in 1968 to 1.1% closed canopy today (with a huge decline in species diversity, density and regeneration), farmers clearly are not aware of the fuelwood issues and possible impending crisis. Coupled with this are the figures for fuelwood consumption and forest volume output. Survey results have shown that combined, (households, schools and chop shops) the per capita fuelwood consumption rate in The Gambia is 1.05 kg per person per day, equivalent to approximately 477,476,000 kg a year. When these figures are converted to cubic meters, using an average weighted density of 668 kg/m^3, (appendix 4), fuelwood consumption in The Gambia is equivalent to 714,784 m^3 per year. Total standing volume at present, as stated in the National Forest Resource Inventory

of 1998[6], is approximately 16,032,044 m^3. The average annual volume increment is 0.6m^3 per hectare. Given that over 877,200 hectares are considered to be covered by woody vegetation, the sustainable harvest of wood products is approximately 526,320 m^3. However, over 21% of this annual increment is considered to be of sawlog standard timber, the remainder being of fuelwood quality. Thus, only 415,792 of fuelwood is added to the forests annually. This implies an annual deficit of 298,992 m^3 of fuelwood supplies. Given these figures it is unlikely that the forest can continue, as 57% of farmers claim, to supply the 85% of The Gambia's energy requirement into the next millennium.

Almost all respondents claimed to collect their fuelwood directly from the bush or buy it from the local market (which also comes from the bush). Very few farmers actively plant and manage fuelwood species on their farms. Although many stated they practised agroforestry, less than 14% actually managed trees specifically for fuelwood consumption and only 4 were involved in woodlot development. These figures are suprisingly low given the fact that on average respondents spend between 1-2 hours/day in the process of collecting fuelwood. In recent years, time spent collecting has increased for over 70% of all respondents and likewise, the distance travelled to collect the fuelwood has also increased. This indicates that available fuelwood is dwindling, thereby forcing farmers to spend more time and travel farther to collect sufficient supplies.

The decreasing amounts of fuelwood have also affected the health and nutrition of families. Over one third of respondents stated that the lack of fuelwood caused the reduction in number of hot meals served a day. These figures support recent FAO publications that state that over one third of Gambians receive less than the daily nutrient requirements necessary to maintain a balanced diet. It is therefore evident that efforts have to be made to inform farmers of fuel-efficient stoves, to conserve fuelwood, and of other ways to develop on-farm fuelwood production. Reviewed and increased extension services are urgent as of the respondents surveyed less than half were visited by agriculture or forestry extension services (either governmental department extension or NGO's).

Agroforestry research currently underway in The Gambia is focusing on live fencing, fodder production, fuelwood species and alley cropping geared toward small-scale rural farms. Given that the average farm size surveyed was 3.5 hectares divided between 4 plots, it is calculated that the average field size is less than 1 hectare. This area is small enough to manage agroforestry techniques without serious time constraints. The implementation of small-scale agroforestry on a rural farm level is a feasible and efficient way to increase local fuelwood production thus alleviating previously mentioned health constraints, workload and pressures currently on The Gambia's people and resources.

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[6] Ludwig, R. and Bojang, L., 1998, Results and Analysis of The National Forest Resource Inventory, The Gambia, 1997/98 GTZ

5 Recommendations

These recommendations are made following the results of the fuelwood survey.

1. Increase awareness of the benefits of woodlots as a renewable fuelwood resource through existing extension services and NGO's,

2. Increase research on multi-purpose tree species in The Gambia specifically for the production of fuelwood but with the ability to increase soil fertility, fodder production and establish live fencing,

3. Increase extension on agroforestry practices such as woodlot management on an individual basis, live fencing, fodder production, boundary planting, orchard and fruit tree management,

4. Increase research on practical fuel efficient stoves and alternatives to fuelwood

5. Increase dissemination of information regarding the decline in forest resources via NGO and government extension to farmers, thereby increasing farmers incentive to establish woodlots,

6. Increase awareness in schools of impending fuelwood shortage and encourage woodlot production for their future consumption

7. Increase the promotion of alternate fuels, i.e.: kerosene and natural gas, until fuelwood production becomes sustainable

8. Review the charcoal regulations and investigate charcoal production in The Gambia

9. Increase the promotion of the Department of Forestry, Gambia German Forestry Project and of NGO's involved in woodlot establishment

Appendix 1 Methods of Income Generation of Farmers and Households Surveyed

	%
Manual labourer	13.2
Letting rooms out	13.2
Government worker	10.5
Taxi or car driver	7.9
Making tie and dye	7.9
Selling small essentials (sugar, oil)	7.9
Working a tractor	5.6
Fishing	5.3
Owning a bitiko	5.3
Juice/Fruit vendor	5.3
Night watchman/ Care taker	5.3
Baking	2.6
Making brooms	2.6
Grinding grain	2.6
Canoe ferry	2.6
Court scribe	0.6

Appendix 2 Tree species used for fuelwood by farmers

	%
Pterocarpus erinaceus	54.5
Combretum glutinosum	34.1
Terminalia albida	29.5
Mangifera indica	18.2
Khaya senegalensis	15.9
Gmelina arborea	11.4
Prosopis africana	10.8
Cassia spp.	6.8
Avicennia spp.	6.8
Cordyla africana	4.5
Azadirachta indica	4.5
Combretum nigricans	4.5
Anacardium occidentale	4.5
Mitragyna inermis	4.5
Mallotus oppositifolius	2.3
Guieria senegalensis	2.3
Combretum spp.	2.3
Leucena leucocephala	2.3
Parkia biglobosa	2.3

Appendix 3: Trees found on farmers fields

Boundary Tree Species	**%**
Gmelina arborea	31.8
Anacardium occidentale	31.8
Mangifera indica	18.2
Pterocarpus erinaceus	18.2
Eucalyptus camaldulensis	13.6
Terminalia albida	13.6
Citrus limon	13.6
Cordyla africana	9.1
Prosopis africana	9.1
Parkinsonia aculeata	9.1
Combretum glutinosum	9.1
Ficus platyphylla	4.5
Avicennia spp.	4.5
Parkia biglobosa	4.5
Daniella oliveri	4.5
Morenga olifera	4.5
Cassia spp.	4.5

Non-boundary Tree Species	**%**
Mangifera indica	44.8
Cordyla africana	20.7
Khaya senegalenses	20.7
Citrus limon	17.2
Adansonia digitata	13.8
Parkia biglobosa	10.3
Anacardium occidentale	10.3
Ficus platyphylla	10.3
Morenga olifera	10.3
Terminalia albida	10.3
Combretum glutinosum	10.3
Eucalyptus camaldulenses	3.4
Psidium guajava	3.4
Azadirachta indica	3.4
Prosopis africana	3.4

Appendix 4 Calculations for the average weighted density of Fuelwood species

Fuelwood species	% of people using each species (/100)	Specific Density† Kg / m^3	Weighted Average (Kg/m^3 x % users)
Pterocarpus erinaceus	0.231	680	157.1
Combretum glutinosum	0.144	900	129.6
Terminalia albida	0.125	590	73.8
Khaya senegalensis	0.067	650	43.6
Gmelina arborea	0.048	530	25.4
Prosopis africana	0.038	1025	38.95
Cassia spp.	0.029	700	20.3
Avicennia spp.	0.029	900	26.1
Cordyla africana	0.019	700	13.3
Leucena leucocephala	0.01	700	7.0
Parkia biglobosa	0.01	610	6.1
Azadirachta indica	0.019	700	13.3
**Mangifera indica*	0.077	690	53.13
**Combretum nigricans*	0.019	690	13.1
**Anacardium occidentale*	0.019	690	13.1
**Mitragyna inermis*	0.019	690	13.1
**Mallotus oppositifolius*	0.01	690	6.9
**Guieria senegalensis*	0.01	690	6.9
**Combretum spp.*	0.01	690	6.9

Weighted average density **667.98 Kg/m^3**

* For species of unknown density, (16.4%), they were assigned the value of the median density of the other species.

† The specific densities of the above tree species were taken from the following publications:

1. Von Maydell, H.J., 1990, Trees and shrubs of the Sahel: their characteristics and uses, Weikersheim, Margraf.
2. Gotz, E. 1983, Timber trees of The Gambia,
3. Little, E. L.. Common Fuelwood Crops, Communi-Tech Associations, Unknown publishing date.