

# Report on the Freetown Peninsula's Fishing Smoking Industry



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## Introduction

The artisanal fishing industry is a significant entity in Sierra Leone, providing large scale employment, while also impacting the health and environmental sectors of the country. A recent study reported that it employs around 30,000 full time and 200,000 part time workers, and contributes just under US\$75 million to the economy. Artisanal fishing is also the largest single and cheapest source of animal protein in Sierra Leone, and contributes about 80% of the animal protein that is consumed in the country.<sup>1</sup> The reliance on fuelwood in the smoking process is also believed to have large impacts on the forest and mangrove cover and environment of the country. Therefore improving fish preservation represents a key priority area in terms of the nation's economy, diet and environment.

One of the main methods of preservation in Sierra Leone is through the use of fish smoking ovens known, often referred to as *bandas*. While these are successful in preserving fish, they often consume high amounts of fuelwood, expose users to fire and smoke hazards and require frequent maintenance, meaning they are associated with different economic, health and environmental burdens. The fish smoking industry along the Freetown Peninsula is perhaps the largest in the country, with an estimated 4,000 people being directly involved in the fish smoking trade, selling their smoked fish throughout Sierra Leone and even in Liberia. This makes it an important and economically viable site to experiment with improved fish smoking methods.

This report examines the fish smoking industry in five villages along the Freetown Peninsula: Tombo Funkia (Goderich), Mama Beach, Tokeh and Compound. It provides a direct analysis of the individuals involved in the trade, their household incomes, the value chain of the industry and its fluctuations, the different oven designs and the fuelwood that they consume. The analysis is designed to directly inform interventions to disseminate improved fish smoking ovens, as well as providing baseline data from which to evaluate the longer-term impacts of the project. The research for this report was conducted in March and April 2012, by Mohamed Kebbay and Albert Thoronka of Energy For Opportunity, while this report was compiled in April 2012 by Mohamed Kebbay, Albert Thoronka and Paul Munro.

### Bandas

*Bandas* are locally made huts which contain fish smoking ovens, although the term is often used interchangeably to refer to the structure and the oven inside. *Bandas* vary in size considerably, some having one oven operating inside, with others having up to four. The ovens are often broken into smaller compartments, with oven sizes ranging from one to eleven compartments. The ovens in *bandas* along the Peninsula are generally constructed from mud, clay, cement, zinc or a stick/mud mixture, with each community having its own typical construction methods.

### Methodology

There are currently 804 *bandas* in operation across the five target communities. Tombo is the biggest fish smoking centre with 455 *bandas*, Goderich (Funkia) is the next biggest with 155, while Compound, Tokeh and Mama beach each have 71, 63 and 60 *bandas* respectively. Given the large quantity of *bandas* a random sampling approach was taken to gather information from each of the villages. Interview questionnaires were conducted with each of these samples, with a variety of questions relating to the economics of the trade, fuelwood used, *banda* construction and other important aspects. Two hundred and ninety-six people were interviewed across the five villages, 145 in Tombo, 55 in Goderich (Funkia), 35 in Compound, 31 in Tokek and 29 in Mama Beach. Such a sample size gives the answers present in this report 4.6% margin of error at a 95% confidence level. Tombo and Goderich (Funkia) are analysed individually due to the large size of the trade in these two villages, while Compound, Tokeh and Mama Beach are analysed as a cluster as the fish smoking industry is similar in size and nature in these villages.

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<sup>1</sup> A. Caramba-Coker, *Report on Artisanal Fishing Training in the Peninsula area of Freetown* (UNIDO 2009).



**Figure 1 - Different Fish Smoking Ovens in Use along the Peninsula.**



1: Large oven made out of mud and cement in Tombo; It can smoke a large quantity of fish at once but consumes a lot of fuelwood and produces a lot of heat and smoke. Users of this oven are more vulnerable to fire and smoke hazards.

2: Zinc oven in Funkia

3: Zinc and stick oven with weaker wire mesh and no iron rod, in Tokeh.

4: Stick oven ready to be filled with mud in the Tokeh community oven.

5: 100% mud oven in Mama Beach

6: Small clay oven in Compound.

## Tombo

The village of Tombo is located 53km from Freetown on the Southern Tip of the Western Area of Sierra Leone. The village was reportedly founded in 1812 and was originally inhabited by people from the Sherbro ethnic group. However the ethnic makeup of the village soon changed with the British using the village to settle freed slaves, who would later be known collectively as the Krio. Many other ethnic groups migrated to the village over the next century, with the village now being a Temne dominated settlement. The population of the village in 1981 was around 7,000, shrinking by around 25% during the non-fishing season (July to September).<sup>2</sup> The village has grown rapidly since this time, expanding to an approximate population of 15,000 in 2004, in particular the Sierra Leone civil war was a major driver of population growth in Tombo, as for the majority of the conflict the Freetown Peninsula was perceived to be somewhat of a safe haven.

Up to the early 1940s, fishing in the Tombo area was conducted predominantly as a subsistence activity, with some a small minority of people in the village travelling to Freetown to make sales. However the industry became increasingly commercialised and expanded rapidly over the next few decades, and in the 1980s the German Government (through GTZ) and the Sierra Leone Government collaborated on a large scale project entitled the 'Fisheries Pilot Project Tombo.' As a part of this project numerous studies, oven testing and other initiatives were implemented in the community. However the project came to a sudden halt with the outbreak of the Sierra Leone civil war in 1991.<sup>3</sup> Nevertheless, the presence of this previous extensive study in Tombo offers a timescale component for an analysis of the current fish smoking industry in the village.

### Bandas and Ovens

The number of bandas in Tombo has grown rapidly over the past couple of decades with there being reportedly 204 bandas in 1985, 293 bandas in 1986, 301 bandas in 1988,<sup>4</sup> and 455 bandas during the current study in 2012. The majority of banda operators (83%) owned their bandas, although there was still a reasonable banda rental market (17% of bandas in operation). Forty-eight percent of bandas have one oven inside, 42% have two ovens, 8% have three while 2% have four, meaning that approximately 746 ovens are in operation across Tombo's 455 bandas. Most of these ovens (68%) have two compartments, although some of the largest ovens had up to eight compartments, giving an estimated total of 1190 compartments, indicating a significant market for ovens. On average each oven had been in operation for just over five years, although some had just been built in the last few months, while the oldest oven was 32 years old (although it had been recently repaired). The bulk of ovens in Tombo are constructed out of mud (92%), while some were constructed from cement (8%). Just one of the banda operators interviewed had their oven constructed from clay. Overall the ovens were in fairly poor condition with only 12% having useable wire mesh plates, and only 14% having useable iron rods. Just 9% have *both* useable iron rods and wire mesh plates. This suggests there could be a good market for new and improved ovens in Tombo.

The major complaints surrounding the existing ovens are that they produce lots of heat and smoke in turn making working conditions difficult, while they also consume a lot of wood. Many operators also noted that they require regular maintenance, as they crack easily and the wire mesh and iron rods frequently need replacing. While the main advantage noted about the ovens was its ability to smoke a lot of fish at one time. Seventy-two percent of the fish smokers interviewed in Tombo claimed they want the

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<sup>2</sup> A Kotnik *A Demographic and Infrastructural Profile of the Tombo Fishing Village, Sierra Leone*, Fisheries Pilot Project Tombo (GTZ 1981);

<sup>3</sup> Morgan Elizabeth Simon, Franklin Mawendeh and Joseph Rahall *An Assessment of Tree Planting Activities and Opportunities in Sierra Leone*, Green Scenery Policy Paper Series 02/08 (Green Scenery 2004).

<sup>4</sup> K Wagner *Tombo Banda Survey 1986*, Fisheries Pilot Project Tombo (GTZ 1987); S E During *Tombo Banda Survey Report 1988*, Fisheries Pilot Project Tombo (GTZ 1988);

improved fish smoking oven to reduce smoke and heat, while only 19% of the fish smokers interviewed claimed they needed the improved fish smoking oven to reduce fuel wood consumption. Finally, 9% claimed they needed the improved fish smoking oven because it is strong and durable, as compared to the present ones they are using which according to them have to be broken down and rebuilt every six months to a year. With only one exception, all fish smokers stated that they would be willing to pay for an improved fish smoking oven, the one exception had just recently built her oven therefore was not in the market for a new oven.

### **Fish Smoker Profiles**

The fish smoking industry in Tombo is highly dominated by women, with 90.3% of the banda operators being female. The operators tend to be older with families, with 90% being married, 9% being widows, and only 1% being single. On average each operator had 13 dependents that are reliant on them, although some have just one or two dependents, while others have up to 25. One operator reported that she had 52 dependents (children, grandchildren and other relatives). On average each smoker had been operating their business for 24 years, although some had been in the business for as little as two years, while one smoker had been operating her business for nearly sixty years. The exact number of people involved in the fish smoking process is hard to ascertain, as participants were often ambiguous with their answers (ie saying ‘many people’ worked in the banda). However from the data collected we can estimate that there are about six people working per banda and around 2,730 people working directly in the fish smoking business in Tombo. The people involved in the fish smoking process in the Tombo community have different roles in the process which include transporting fish from wharf to the banda, washing, laying, setting of fire, packing etc. The majority (94%) of the fish smokers in Tombo have their family members assisting them with labour in the fish smoking process. Twenty-five percent of the vendors hire external labour, either in addition to family members (19%) or as their only source of labour (6%).

### **Household Incomes and Labour inputs**

Most fish vendors do not know their monthly profit as no accounts are kept. Those that did keep some form of accounting stated that the range of profit was between Le 50,000 to 2.6 million per month, giving an average profit of about half million Leones a month.<sup>5</sup> The majority (67%) of fish smokers use their ovens seven days per week, 15% use their oven five to six times per week, while 18% use their ovens three to four times per week. There is certainly a seasonal fluctuation in the usage rates of the ovens but it was not possible to determine that through this limited study. In terms of commodity input, all fish smokers purchase their wood and fish, demonstrating the high commercial nature of the trade. Those that employed only family members do not pay labour costs. The 25% that do hire labour pay labourers between Le 6,000 to Le 50,000 per day, depending on the quantity of fish, distance from wharf to smoking site and distance to access fresh water to wash fish. All fish vendors pay truck drivers to transport their fish to markets all around Sierra Leone and even as far as Liberia.

### **Fuelwood Input**

One of the main inputs in the fish smoking process is firewood. On average, they use 13.3 dozen sticks of firewood per session, with a range of four dozen sticks per session up to 70 dozen sticks per session. From the data collected, it can therefore be estimated that Tombo’s 455 bandas are consuming around 995,249 dozen sticks of fuelwood per year. Around 28,857 dozen (3%) are farm fuelwood, around 278,670 dozen (28%) are forest fuelwood, and 686,722 dozen (69%) are mangrove wood. This differs slightly from the preferred fuelwood of fish smokers, where 3% stated they preferred farm fuelwood, 55% stated that they preferred forest fuelwood and 42% stated that they preferred mangrove fuelwood. This suggests that mangrove fuelwood is more readily available in Tombo than forest wood, probably due to increasing restrictions on harvesting forest wood from the Peninsula’s forests. They state that the price is always changing and attribute this to high demand which has caused scarcity, as well as transport costs.

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<sup>5</sup> Given the limited responses on this question this amount has a very high margin of error.



There are also seasonal fluctuations, with greater scarcity in the rainy season. Most stated that there has been a reduction in supply within the last couple of years, the majority attributed this to the WAPFoR ban, while others attributed this due to scarcity and low production of fuelwood around the country in general. Firewood generally cost Le 5,000 per dozen sticks in Tombo, although some of the respondents reported getting the firewood occasionally cheaper for around Le 3,000 to Le 4,000. Thus the previously calculated 995,249 dozens of fuelwood sold in Tombo, sold at the current rate of Le 5,000 would have gross sales in excess of Le 4.9 billion Leones a year (US\$1.1 million). It is important to note the scale of the fuelwood industry as the individuals and organisations involved will be negatively impacted by improved efficiency and may pose a risk to the dissemination of the technology.

### **Fish Input**

Two main types of fish are smoked in Tombo: bonga (*Ethmalosa fimbriata*) and herring (*Sardinella maderensis*). Bonga is a more expensive fish, which 87% of fish smokers purchase, while herring is a cheaper fish which 93% of fish smokers purchase. The price for one dozen raw bonga ranges between Le 4,500 and Le 9,500, however it can sometimes be as cheap as Le 500 or as expensive as Le 15,000 depending on the size, quality and availability of fish. The price for one dozen herring fish is usually between Le 1,500 and Le 2,500, however it can sometimes be as cheap as Le 200 or as expensive as Le 3,000 once again depending on the size, quality and availability of fish.

Bonga is usually sold for between Le 8,000 to Le 13,500 per dozen. Although it can be sold for as little as Le 2,000 and as high as Le 40,000 per dozen depending on the market, the availability, the size and the quality of fish. Meaning from the raw fish purchasing price they usually have a mark-up of around Le 3,500 to Le 4,000 per dozen bonga fish. Herring is usually sold for between Le 2,500 and Le 3,500 per dozen. Although it can be sold for as little as Le 1,000 and as high as Le 9,000 per dozen once again depending on a variety of factors. Meaning from the raw fish purchasing price they usually have a mark-up of around Le 1,000 per dozen herring fish.

Most of the smokers sell their fish in multiple markets, some up to five different markets. Freetown is the most popular market with 51% of fish smokers selling their produce there, followed by Waterloo (47%), Makeni (25%), Kenema (19%), Bo (19%), Kono (8%), Lunsar (6%), Kailahun (3%), Liberia (2%), Moyamba (1%) and Port Loko (1%). Transportation costs vary depending on distance to market and size of basket but usually one basket to close markets (ie Freetown and Waterloo) is around Le 10,000, while for the more distant markets such as Liberia and Kono it can cost more than Le 100,000 per basket. Seventy-two percent of the fish smokers interviewed have the fish smoking trade as their only source of livelihood activity, while 28% of the fish smokers/vendors have other sources of livelihood activities including petty trading, timber selling and running cinemas.

## **Funkia (Goderich)**

While once an isolated village, Goderich has now been met by the western urban expansion of Freetown, essentially becoming a suburb on the edge of the city. The town had a population of 19,209 in the 2004 census, a number that has likely grown dramatically due to the recent rapid urban expansion in the area. Goderich is a bustling town with a variety of economic activities, however the fishing industry is still very important, with the section of Goderich where the fishing boats and bandas are located being known as Funkia.

### **Bandas and Ovens**

The majority of banda operators (96%) in Funkia owned their bandas with a very small banda rental market (4% of bandas in operation) existing. Thirty-two percent of the bandas have five ovens inside, 16% have four ovens inside, 5% have two ovens inside, 21% have six ovens inside, 9% have seven ovens inside, 5% have eight ovens inside and 2% have eleven ovens inside. Meaning that there are approximately 578 ovens are in operation across Funkia's 155 bandas. Most of these ovens (32%) have five compartments, although some of the largest ovens had up to eleven compartments, giving and estimated total of 800 compartments. On average each oven had been in operation for just over three years, although some had just been built in the last few months, while the oldest oven was 12 years old. The bulk of bandas in Funkia are constructed from zinc sheets (80.1%), while a minority were constructed from mud (19.9%). There were no ovens constructed with cement or clay. Overall the ovens were in fairly poor condition with no ovens surveyed having usable wire mesh or iron rods, in fact some smokers' used sticks instead of iron rods which sometimes catch fire during fish smoking process. This suggests there could be a good market for new and improved ovens in the Funkia community. The larger oven sizes, as compared to Tombo, indicates that there will need to be differences in the marketing materials between the various communities

Similar to Tombo, the major complaints surrounding the existing ovens is that they produce lots of heat and smoke, making working conditions difficult, while they also consume a lot of wood. Many operators also noted that they required regular maintenance, as they crack easily and the wire mesh and iron rods frequently needs replacing. Sixty-one percent of the fish smokers interviewed in Funkia claimed they want the improved fish smoking oven to reduce smoke and heat from the old ovens, while only 23% of the fish smokers interviewed claimed they needed the improved fish smoking oven to reduce fuel wood consumption. Finally, 16% claimed they wanted the improved fish smoking oven because it is strong and durable, as compared to the present ones which have to be rebuilt every six to twelve months. All fish smokers interviewed stated that they would be willing to pay for an improved fish smoking oven.

### **Fish Smoker Profiles**

The fish smoking industry in Funkia is exclusively occupied by women, with 100% of the banda operators interviewed being female. The operators tend to be older women with families, with 82% being married, 11% being widows, and only 7% being single. On average each operator had seven dependents, although some had just one or two dependents, while others had up to 17. On average each fish smoker had been operating their business for 27 years, although some had been in the business for as little as two years, while two of the smokers had been operating their businesses for nearly fifty-five years. Like with Tombo, the exact number of people involved in the fish smoking process is hard to ascertain, as participants were often ambiguous with their answers. However from the data collected we can roughly say there are about five people working per banda and around 835 people working directly in the fish smoking business in Funkia. The people involved in the fish smoking process in the Funkia community have different roles in the process which includes transporting from wharf to the oven, washing, laying, setting of fire, packing and so forth. The majority (93%) of the fish smokers in Funkia have their family members assisting them with labour in the fish smoking process. Four percent of the vendors hire



external labour in addition to family members and 7% exclusively hire external labour to help with the smoking process.

### **Household Incomes and Labour inputs**

Most fish vendors do not know their monthly profit as no accounts are kept. From those that keep accounts, the range of incomes is between Le 20,000 to 750,000 per month. The majority (65.5%) of fish smokers use their ovens seven days per week. 6.5% use their oven five to six times per week, while 28% use their ovens three to four times per week. In terms of commodity input all fish smokers purchase their wood and fish. Eighty-nine percent of the fish vendors in Funkia do not pay any labour cost in the fish smoking process as they have their family members and other dependants involved in the smoking process, while 11% have to pay labour cost at almost fixed rate of Le 20,000 per session. All fish vendors pay truck drivers to transport their fish to markets.

### **Fuelwood Input**

One of the main inputs in the fish smoking process is firewood. On the average, they use 12.3 dozen sticks of firewood per session. Some use as little as two dozen sticks per session while others use up to 20 dozen sticks per session. From the data collected, it can therefore be estimated that Funkia's 155 bandas are consuming around 310,577 dozens of fuelwood per year. Around 27,951 dozen (9%) are forest fuelwood, and around 282,625 dozen (91%) are farm firewood with no mangrove wood recorded. This differs dramatically from the preferred fuelwood of fish smokers, where 24% stated they preferred farm fuelwood, 74% stated that they preferred forest fuelwood and 2% stated that they preferred mangrove fuelwood. This suggests that farm fuelwood is more readily available in Funkia than forest wood, probably due to the proximity to Freetown and the up-country fuelwood supply chain, rapid urbanisation of the area (reducing local gathering) and increasing restrictions on harvesting forest wood from the Peninsula's forests. They state that the price is always changing and attribute this to high demand which has caused scarcity, as well as transport costs. Also there are seasonal fluctuations, with greater scarcity in the rainy season. Most stated that there has been a reduction in supply within the last couple of years, generally linking this to the WAPFoR ban. Firewood generally costs between Le 3,000 and Le 5,000 per dozen sticks (an average of Le 4,000). Thus the previously calculated 587,136 dozens of fuelwood sold in Funkia at the average rate of Le 4,000 would have gross sales in excess of Le 2.3 billion Leones a year (US\$546,000).

### **Fish Input**

As in Tombo, the same two main types of fish are smoked in Funkia: bonga (*Ethmalosa fimbriata*) and herring (*Sardinella maderensis*). Eighteen percent of fish smokers purchased bonga, while all of the fish smokers in Funkia purchased herring. The price for one dozen raw bonga ranges between Le 5,000 and Le 12,000. However it can sometimes be as cheap as Le 4,000 or as expensive as Le 13,000 depending on the size, quality and availability of fish. The price for one dozen herring is usually around Le 2,000. Bonga is usually sold for between Le 11,000 to Le 17,000 per dozen. Meaning from the raw purchasing price they usually have a mark-up of around Le 5,000 to Le 6,000 per dozen bonga fish. Herring is usually sold for about Le 2,500. Meaning from the raw purchasing price they usually have a mark-up of around Le 500 per dozen herring fish.

Freetown is the most popular market with 94.6% of fish smokers selling their produce there. This is unsurprising given Funkia's close proximity to Freetown. Some vendors also sold their fish to markets in Kono (3.6%) and Bo (1.8%). Transportation costs vary depending on distance to market and the size of basket but usually to transport one basket of fish to Freetown is around Le 6,000, while for the more distant markets such as Kono it can cost more than Le 100,000 per basket. Fifty percent of the fish smokers interviewed have the fish smoking trade as their only source of livelihood activity, while the other half had other sources of income through petty trading activities.

## **Compound, Mama Beach and Tokeh Communities**

Compound, Mama Beach and Tokeh are fishing communities located along the Peninsula. While all of the communities are Temne dominated they are also home to Sherbro, Susu, Loko, Mende and Limba populations. Compound is a very small community that is very close to Tombo and is dominated by the fishing industry. Mama Beach and Tokeh were both once thriving tourist destinations prior to the civil war, being home to French hotel resorts. Hotels are now being reconstructed at both of these locations, however the fishing industry is still the main source of livelihood. Tokeh is the most bustling of the settlements and has inhabitants involved in woodcutting, coal burning, harvesting sea cucumber, driving taxis and selling vegetables.

### **Bandas and Ovens**

The majority of banda operators (98%) owned their bandas, although there was still a very small scale banda rental market (2% of bandas in operation). Eighty-five percent of bandas have one oven inside, while 15% have two ovens inside, with no three or four ovens recorded; meaning that there are approximately 221 ovens in operation across these communities' 193 bandas. Most of the ovens (85%) have one compartment although very few of the larger ovens had up to four compartments, giving and estimated total of 375 compartments. On average each oven had been in operation for just over 2.5 years, although some had just been built in the last few months, while the oldest oven was 20 years old. All of the ovens in these communities are constructed from mud and sticks with no good wire mesh and iron rods. This indicates that the fish smoking industry is less established in these communities and there may be opportunities for market expansion.

Like Tombo and Funkia, the major complaints surrounding the existing ovens, is that they produce lots of heat and smoke, making working conditions difficult, while they also consume a lot of wood. Many operators also noted that they required regular maintenance, as they crack easily with wire mesh and iron rods frequently needing to be replaced. While the main advantage noted about the ovens was its ability to smoke a lot of fish at one time. Seventy-four percent of the fish smokers interviewed in these communities claimed they wanted the improved fish smoking ovens to reduce smoke and heat from the old ovens, while only 13% of the fish smokers interviewed claimed they wanted the improved fish smoking oven to reduce fuel wood consumption. Finally, 13% claimed they needed the improved fish smoking oven because it is stronger and durable, and therefore has less maintenance costs.

### **Fish Smoker Profiles**

The fish smoking industry in these communities is highly dominated by women, with 91% of the banda operators being female. The operators tend to be older with families, with 85% being married, 10% being widows, and only 5% being single. On average each operator had 9 dependents, although some have just one or two dependents, while others have up to 17. One operator recorded that she had 35 dependents (children, grandchildren and other relatives). On average each smoker had been operating their business for 19 years, although some had been in the business for as little as two years, while one smoker had been operating her business for nearly 45 years. From the data collected it can be roughly calculated that there are about 2.4 people working per banda and therefore around 470 people working directly in the fish smoking business in these communities. The people involved in the fish smoking industry in these communities have different roles in the process which include transporting from wharf to the oven, washing, laying, setting of fire, packing etc. By far the majority (99%) of the fish smokers in these communities have their family members assisting them with labour in the fish smoking process. Eleven percent of the vendors hire external labour either in addition to family members. Only 1% employs pure labour in the fish smoking process in these communities.

## Household Incomes and Labour inputs

Most fish vendors do not know their monthly profit as no accounts are kept. Of those that did maintain some form of accounting the range of income was between Le 25,000 and Le 1.5 million per month; the average profit being half million Leones a month. The majority (60%) of fish smokers use their ovens seven days per week. 20% use their oven five to six times per week, 15% use their ovens three to four times per week, while 3% only use their ovens two times per week. In terms of commodity input all fish smokers purchase their wood and fish, demonstrating the high commercial nature of the trade. Eighty-nine percent of the fish vendors in these communities do not pay any labour cost in the fish smoking process as they have their family members and other dependants involved in the smoking process, while 11% have to pay labour cost ranging from Le 10,000 to Le 30,000 per session, depending on the quantity of fish, distance from wharf to smoking oven site and distance to access fresh water to wash fish. All fish vendors pay truck drivers to transport their fish to market all around Sierra Leone and even as far as Liberia.

## Fuelwood Input

On the average, each banda uses seven dozen sticks of firewood per day with some use as little as 2 dozen sticks per day while others use up to 18 sticks per day. From the data collected, it can therefore be estimated that these three communities' 193 bandas are consuming around 218,776 dozen of fuelwood per year. Around 66,726 dozen (30.5%) are farm fuelwood, around 147,455 dozen (67.4%) are forest fuelwood, and 4,594 dozen (2.1%) are mangrove wood. This differs slightly from the preferred fuelwood of fish smokers, where 25% stated they preferred farm fuelwood, 48% stated that they preferred forest fuelwood and 27% stated that they preferred mangrove fuelwood. This suggests that forest fuelwood is more readily available in these communities than mangrove wood, probably due to their locations at the edge of the peninsula forest and low supply of mangrove wood and farmwood into these communities. They state that the price is always changing and attribute this to high demand which has caused scarcity, as well as transport costs. Also there are seasonal fluctuations, with greater scarcity in the rainy season. Most stated that there has been a reduction in supply within the last couple of years, most attribute this to the WAPFoR ban, while others attribute this due to scarcity and low production of fuelwood. Firewood generally costs Le 3,000 to 5,000 per dozen sticks (an average of Le 4,000). Thus the previously calculated 218,776 dozens of fuelwood sold in these communities, sold at the average rate of Le 4,000 would have gross sales in excess Le 875 million a year (US\$198,000).

## Fish Input

Two main types of fish are smoked in these communities: bonga (*Ethmalosa fimbriata*) and herring (*Sardinella maderensis*). Seventy-four percent of fish smokers in these communities purchased bonga, while 100% purchased herring. The price for one dozen raw bonga ranges between Le 4,500 and Le 12,500. However it can sometimes be as cheap as Le 3,000 or as expensive as Le 16,000 depending on the size, quality and availability of fish. The price for one dozen herring is usually between Le 1,100 and Le 2,700. However it can sometimes be as cheap as Le 600 or as expensive as Le 1,800 once again depending on the size, quality and availability of fish.

Bonga is usually sold for between Le 7,500 to Le 16,500 per dozen. Although it can be sold for as little as Le 6,000 and as high as Le 25,000 per dozen depending on the market, the availability, the size and the quality of fish. Meaning from the raw fish purchasing price they usually have a mark-up of around Le 3,000 to Le 4,000 per dozen bonga fish. Herring is usually sold for between Le 1,000 and Le 3,500 per dozen. Although it can be sold for as little as Le 1,400 and as high as Le 3,200 per dozen. Meaning from the raw fish purchasing price they usually have a mark-up of around Le 300 to Le 500 per dozen herring fish.

Most of the smokers sell their fish in multiple markets, some up to five different markets. Freetown is the most popular market with 46% of fish smokers selling their produce there, followed by Waterloo (32%),

Makeni (5%), Kenema (2%), Bo (5%), Kono (4%), Kailahun (4%), Liberia (2%). Transportation costs vary depending on distance to market and size of basket but usually one basket to close markets (ie Freetown and Waterloo) is around Le 6,000 to Le 10,000, while for the more distant markets such as Liberia and Kono it can cost more than Le 100,000 per basket. Sixty-six percent of the fish smokers interviewed in these communities have the fish smoking trade as their only source of livelihood activity, while 34% of the fish smokers/vendors have other source of livelihood activities as some are engaged in petty trading.



## Conclusions

A direct comparison of the consumption of fish and firewood across the five different villages produces some interesting results (see Figure 2). There is great heterogeneity, particularly in regards to firewood consumption, between the different villages and it appears that geography plays a major part in influencing consumption habits. Funkia (Goderich) uses predominantly farm wood, as it linked to the Freetown firewood market, which principally sources its firewood from farms in the Provinces. Tombo has a high consumption of mangrove firewood as boats harvesting mangrove from the coasts of Port Loko and Bonthe Districts stop in Tombo to sell mangrove firewood. The other villages have much smaller fish smoking markets and therefore the mangrove harvesting boats rarely stop there, although there is some consumption of mangrove firewood at Mama Beach, which is likely sourced from the nearby Tombo market. Tokeh exclusively consumes forest firewood, this is likely due to its isolated location, far from the Freetown farm firewood market and far from the Tombo mangrove wood market, meaning it is reliant on forest firewood harvested from nearby forested areas. Compound is also heavily reliant on firewood consumed from nearby forested areas, although interestingly it does have a sizeable consumption of farm fuelwood, where this is sourced from is not entirely clear, quite possibly from Waterloo. Similarly the nearby village of Mama Beach has a high consumption of farm firewood, which also is probably sourced from Waterloo. Overall it is interesting that there can be such diverse consumption of firewood across such a small geographical area.

		Tombo	Funkia	Compound	Tokeh	Mama Beach	Total
<b>No of Bandas</b>		455	155	71	63	60	804
<b>No of Ovens</b>		747	222	86	63	75	1,193
<b>No of Compartments</b>		1190	800	132	139	104	2,365
<b>Used</b>	Farm wood	3%	91%	23%	0%	79%	25.34%
	Forest wood	28%	9%	77%	100%	14%	29.27%
	Mangrove wood	69%	0%	0%	0%	7%	45.39%
<b>Preference</b>	Farm wood	3%	24%	20%	58%	0%	12.64%
	Forest wood	55%	74%	51%	42%	55%	57.29%
	Mangrove wood	42%	2%	29%	0%	45%	30.07%
<b>Firewood (Annual)</b>	Volume (bundle)	995,249	310,577	60,432	82,427	75,917	1,524,602
	Cost (US\$)	1,107,508	258,814	53,147	88,314	82,435	1,590,218
<b>Fish</b>	Bonga	87%	18%	100%	100%	14%	70.42%
	Herring	93%	100%	100%	100%	100%	96.04%

Figure 2 - Comparison of data across the five villages

In terms of firewood preference, generally forest firewood is the most popular choice, with the notable and interesting exception of Tokeh, which prefers farm firewood. Seeing as Tokeh exclusively consumes forest firewood, the high preference for farm firewood might be a case of desiring what one cannot obtain. Mangrove firewood is also fairly popular, but only in the village of Tombo, Compound and Mama Beach. These villages are clustered fairly close together and therefore have exposure to the Tombo mangrove firewood market, while Funkia and Tokeh are much further away and quite probably have very limited exposure or knowledge of mangrove wood.

All of the villages smoke high amounts of herring fish. There is a bit more of a variety with bonga fish, with Funkia and Mama Beach only smoking this fish on a fairly limited scale.

From the data collected it is apparent that there is a good potential market for improved fish smoking ovens across the five communities. Almost all of the ovens in operation were in bad condition and people from the communities almost universally responded positively to the idea of paying for an improved oven. Already the five communities spend in excess of US\$1.6 million per year on fuelwood consumption, meaning, given the 50% increased efficiency that improved ovens offer, US\$0.8 million on fuelwood savings could potentially be made across the five villages. Further savings would also be made due to reduced maintenance and repair of ovens, indeed many respondents indicated they want an improved oven due to maintenance issues with their previous ovens. Previous research suggests that this amount could be substantial. Overall the trade is highly commercialised, with banda operators having a constant

cash flow, meaning that their ability to finance the building of an improved oven is high. Most also noted that the trade is growing, meaning such an economy is likely to expand in future.



Figure 3 – Smoke filled banda in Mama Beach

In terms of promoting the improved ovens, interestingly health and safety issues appear to be stronger than economic or environmental ones. This has perhaps been a flaw of previous initiatives to introduce improved ovens which have focussed promotions on the savings they offer in fuelwood consumptions. Most banda operators do not keep accounts and such fiscal benefits would not be realised immediately or clearly. Only a small minority of people in the communities stated they wanted an improved oven to reduce firewood use. The majority instead stated that they wanted an improve oven in order to reduce heat and smoke in their work place. Such benefits can be witnessed immediately and overall can reduce serious health hazards for banda operators and their families.