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**THE EFFECTS OF CHARCOAL AND WOOD FUEL  
PRODUCTION ON THE VEGETATION OF GHANA**

**A CASE STUDY OF VARIMPERE IN THE WA WEST DISTRICT.**

Master Thesis

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Brno 2015



## Declaration

I hereby declare that I carried out this Master's thesis "*The Effects of Charcoal and Wood Fuel*

*Production on the Vegetation of Ghana. ” (A Case Study of Varimpere in the Wa West District)*

Independently under the guidance of Ing. Alice Kozumplíková Ph.D., and only used sources and literature stated in the list of references. I agree that my work will be published in accordance with § 47b Act.No.111/1998 Coll. on Higher Education as amended thereafter and in accordance with valid *Directive of publishing university final thesis*.

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In Brno, 22.5.2015

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Signature

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Thanks to my parents for nurturing my passion for nature and the environment from an early age.

## **Dedication**

I dedicate this research work to my parents and all my loves ones who supported me through the completion of this work.

## **Abstract**

OSEI PRISCILLA. *THE EFFECTS OF CHARCOAL AND WOOD FUEL PRODUCTION ON THE VEGETATION OF GHANA. (A CASE STUDY OF VARIMPERE IN THE WEST DISTRICT)*. Master thesis, Brno: FRDIS in Brno, 2015.

Unrestrained population growth especially in the developing countries, the necessity for existence as well as the desire for comfort are the major causes of environmental resources depletion in the world with particular reference to Ghana. One of the most exploited environmental resources in Ghana which is mostly not replaced is vegetation specifically trees. This paper aims to look into the effect of charcoal and wood fuel on Ghana's vegetation. A combination of qualitative and quantitative methodological approaches were used in data collection and analysis. These methods include: questionnaire and interview. The findings show that charcoal and wood fuel is the means of revenue for the people of Varimpere village leading to desertification due to the source of domestic fire in use. Also other means of domestic fuel such as wind, solar, kerosene, electricity, coal and gas are not made available at affordable rates and therefore does not encourage the use of continuous and constant supply. Shea and Mahogany trees were the most preferred species due to the quality of charcoal and wood fuel products it produces. The findings also revealed that forestry services division whose role is to regulate the cutting of trees was not playing this role well due to inadequate personnel, logistics among others.

The study concluded that measures of mitigating desertification such as afforestation and planting trees programs. Also some mitigation measures included creation of other jobs such formation of women groups to encourage the expansion of the Shea butter processing industry.

**Keywords:** Charcoal, wood fuel, Varimpere community, vegetation

## **Abstraktní**

OSEI PRISCILLA. Dopady produkce dřevěného uhlí a palivového dřeva na vegetaci v Ghaně. (Případová studie pro Varimpere ve Wa West regionu). Diplomová práce. Brno: MENDELU, 2015.

Živelný populační růst, zejména v rozvojových zemích, nutnost existence, stejně jako touha po pohodlí, jsou hlavními příčinami vyčerpávání přírodních zdrojů ve světě i v Ghaně. Jedním z nejvíce využívaných přírodních zdrojů v Ghaně, která se většinou není nahrazována je vegetace, zejména stromy. Diplomová práce si klade za cíl identifikovat dopady produkce dřevěného uhlí a palivového dřeva na vegetaci Ghany. Byla použita kombinace kvalitativních a kvantitativních metodických přístupů pro sběr. Tyto metody zahrnují dotazník a pohovor. Výsledky ukazují, že uhlí a palivové dříví představují příjmy pro obyvatele obce Varimpere, ale současně jejich používání vede k desertifikaci. Jiné způsoby získávání energie jako větrná, solární, benzín, elektřina, uhlí a zemního plynu nejsou k dispozici za přijatelné ceny a nejsou dodávány pravidelně v potřebném množství. Máslovník africký a mahagonové stromy jsou nejvíce preferované druhy vzhledem ke kvalitě produkovaného dřevěného uhlí a palivového dříví. Výsledky také odhalily, že lesní správa, jejíž úkolem je regulace kácení stromů není efektivní z personálních a logistických důvodů.

V závěru práce byla navržena opatření na zmírnění desertifikace, jako je zalesňování a realizace programů pro výsadby stromů. Také byly zahrnuty návrhy k vytváření dalších pracovních míst, jako například vznik ženských skupin na podporu rozšíření zpracovatelského průmyslu bambuckého másla.

Keywords: dřevěné uhlí, palivové dříví, obec Varimpere, vegetace v Ghaně

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# **1. INTRODUCTION**

This chapter talks about the background, statement of the problem, justification of the Study and the scope of the study.

## **1.1 Background**

Recent FAO estimates suggest that in 1980 approximately three-fourths of the population of the developing world – 2000 million people - depended on traditional fuels for their domestic energy requirements, and that by the year 2000 this number could grow to 3000 million (FAO, 1981). Traditional fuels, a large portion of the overall energy consumption in most developing countries, are used extensively and often exclusively in meeting the household needs of people in both rural and urban areas. They are also used to a varying extent in the commercial, agricultural and industrial sectors, including some large-scale industrial uses. (Russell deLucia, 2000)

Energy is a vital role for the survival and improvement of ones quality of life. However, the most constructive, affordable, local and renewable sources of energy that could be produced on a sustainable platform for the development of the people of Varimpere , a less developed town in the Upper West region of Ghana is charcoal or wood fuel.

The rapid rate of forest resources depletion, especially across the humid tropics, has been the focus of much environmental concern in recent years. (Teye, 2008) Vegetation is an important part of the physical environment and helps to define the resources and the character of a place. It provides necessities to humanity such as food, shelter and medicine. Aside this vegetation also provides fuel for the survival of man. There are various forms of fuel that man derives from vegetation. Charcoal however is the most used fuel especially in the third world countries. Charcoal production and other relating activities are expanding in scope and magnitude in many tropical catchments especially in Sub-Saharan African countries (Oguntunde et al, 2004, Glaser et al, 2002, Matais-Sotera et al, 2002, Ajayi 2004)

Charcoal was the world's first industrial fuel and that it has been used in the United Kingdom over much of the last 5000 years. During this time, there had been huge pressure on timber supply and this has necessitated the production and management of the wood land resource. By around 1000 B.C, at least half of the natural wild wood had been already cleared and considerable pressure was now placed on local timber supply (English charcoal, 2000).

## **1.2 Statement of the problem**

A gradually increasing population, majority of who are poor, together with weak energy policies as well as the high cost of LPG as compared to charcoal and wood could be an influential factor to the high demand of charcoal and wood fuel in the urban and pre-urban centres. A number of men, women and youth in Varimpere have gotten themselves in the activity which could be proposed that it pays much. In the community, charcoal production is high during the dry season, a period where all activity comes to a stop due to low or no rainfall. This leads to idleness among farmers who then resort to charcoal production because there is nothing much to do. The charcoal produced in this area is mostly taken to the urban consumers markets in Wa Municipality, Ashanti Region and Greater Accra Region. Charcoal production and exports have become growing activities and if not checked is likely to increase further. The cutting down of trees for charcoal exposes the soil to erosion. This reduces organic matter content and plant growth. Soils that decrease in organic matter cannot retain moisture, it take longer period if only there rain. When the tree cover is lost, the soil becomes weak to the pounding effects of rain drops thereby increasing the rate of erosion and ultimately leading to low crop production. As trees disappear in this community through charcoal production, so do parts of the culture. The community's artists no longer have enough wood to make sculptures, indigenous dishes are disappearing as well as certain fruits (Shea fruits, dawadawa) and vegetable becomes more rare and harder to grow. Moreover, the production charcoal and wood fuel has caused a respiratory infections. Women and children are usually exposed to the utmost levels of pollutants and it is children who suffer the greatest health risk respiratory infections.

Therefore, this study aims at assessing the implications of charcoal and wood fuel production on the vegetation of Varimpere.

## **1.3 Justification of the study**

This study has enormous significance that ranges from the global scale to the national. In view of the continuous global call to conserve the environment against the ever growing demand and supply of wood fuel with its ascending environmental threats, research of this sort is very crucial in achieving results that would inform the on-going discourse. The current efforts in combating global climate change are traceable to environmental shocks\imbalances. The study could contribute to the identification and formulation of global strategies, plans

and programs of action for the conservation and sustainable exploitation of biological diversity (Lurimuah, 2011).

Secondly, the research shows that the national forest of Ghana is rapidly depleting. Thus, in the last few decades, Ghana has lost close to 70% of its wildlife and about 75% of its 8.2 million hectares of forest (Resource Watch Agenda, 2010; Lurimuah, 2011). Factors accountable for this situation include unsustainable methods of charcoal burning, constant bushfires, deprived farming practices and logging. The research results and references could serve as significant data in handling the situation.

Moreover, charcoal production is a vital cross cutting subject and is never comprehensive over a particular survey. Consequently this study is intended at contributing to research on the minimization of the adverse environmental significances of charcoal production.

This study aims to contribute to the body of knowledge to academics and policy makers as well as rural communities in their bid to sustain their livelihood of maintain micro-economic stability at the local communities. The general hope is that, government agencies including the District Assemblies in the study area could also enact and enforce effective environmental and charcoal producing bye-laws based on the research findings and recommendations.

#### **1.4 The scope of the research**

The research was conducted in Varimpere Community in the Wa West District. It looked at the effects of charcoal production on the vegetation in Varimpere. The research also focused on the implications of charcoal production on the economic trees and again covered the involvement of relevant stakeholders such as EPA, Forestry Commission, District Assembly and the community at large in dealing with the activities of the cutting of trees for charcoal.

## **2. MAIN AIM AND MOTIVATION**

### **Main Aim**

The aim of this study is to look at the effect of charcoal and wood fuel production on Ghana's vegetation. A case study of Varimpere in the Wa West District.

### **Research Objectives**

- I. To examine the effects of charcoal and wood fuel production on economic trees.
- II. To identify the roles of stakeholders involved in the protection of the vegetation.
- III. To find out alternative energy sources for household consumption.
- IV. To analyse the environmental and legal features associated with production of charcoal and wood fuel.

### **Motivation**

Vegetation is the key components for ecosystem. It helps in the regulation of various biogeochemical cycles such as water and nitrogen. Destroying the vegetation has a great impact on the environment which needs attention, thus affect almost every species on the planet. Vegetation helps develop the soil over time by contributing more to productive soil. It releases oxygen and takes in carbon dioxide which is essential to human development. Humans take in oxygen released by the trees and the trees also absorb carbon dioxide from humans. This shows how important the vegetation is to humans since they depend on each other.

Cutting down of trees for charcoal and wood fuel has gone a long way to destroy the vegetation and has affected the development of humans. Also cutting down of trees destroys the habitat of most species which leads to species extinction. It would be difficult for trees to absorb rain fall and produce water vapour which is released into the atmosphere if the vegetation is being destroyed. This can cause increase of pollution in water. In Ghana, cutting down of trees for charcoal and wood fuel has caused the soil to erode which has lead silt to enter water sources. This has decreased the water quality in most communities and has also contributed to poor health among communities. In looking at the impact vegetation has on human development it has motivated me to research into the effect charcoal and wood fuel.

### **3. LITERATURE REVIEW**

This chapter mainly looks at works done by other scholars on the effects of charcoal and wood fuel production and usage on the savannah vegetation.

#### **3.1 Charcoal formation**

Charcoal is a black, porous material, containing 85% to 98% carbon, derived from wood or woody biomass. Although its first uses predate history, its controlled production can be traced back at least 3500 years. As the FAO wrote in 1987, and it remains true, “[t]hroughout the world wood is turned into charcoal by a surprising variety of systems.” Traditional charcoal-making involves heating biomass in an earthen mound to drive off moisture and some of the wood’s volatile matter. It is inexpensive, but yields are poor, typically 10% on a mass-balance basis, and large amounts of ground-level air pollution are released in the process. Improved traditional methods use small-scale steel or brick kilns, which provide more-consistent results and are less labour-intensive than the traditional method. Yields can be as high as 20% but are more typically around 15% (Stassen, 2002).

The making of charcoal, literally the distillation of wood to its carbon content, was an important process during the first half of the nineteenth century. Because it burned hotter and cleaner, charcoal was considered superior to wood. It provided fuel for both the furnaces which produced the iron and the forges of the blacksmiths who shaped it. The first person to discover the seemingly magical properties of charcoal has long since been lost to human memory. What is known is that it may have been used in Europe as early as 5,500 years ago and was the "smelting fuel of the bronze and iron ages." (Rensselear Resch, 2010)

Around the world, there is a growing interest in finding ways to use woody biomass to meet needs for energy and raw materials. There are many benefits associated with the utilization of woody biomass for bioenergy and bio-products, environmental, economic, and energy security related. Moreover, the utilization of woody biomass may benefit the forest ecosystem, the global environment, forest landowners, and society (Abt et al., 2010).

Wood fuel on the other hand is dominant in rural households: more than 2.2 million families depend on it for cooking and heating and at least 280,000 of them use it for small scale processing activities, such as pito brewing, fish smoking, gari making, oil extraction from palm fruit, groundnut, Shea butter thus making it a significant

contributor to food preservation, food security and cash earning for rural and urban people.

Poverty is one of the greatest moral challenges being faced today, with a sixth of the world's population living on less than \$1 a day (World Bank, 2006; Craster Herd, 2007). Over 90% of the 1.2 billion living in poverty worldwide rely on forests to some extent for subsistence needs (World Bank, 2002). Whilst forest resources provide a wide range of benefits to the rural poor, they also contribute significantly to the economies of developed and developing nations alike (Sengupta and Maginnis, 2005).

Charcoal is a very important energy source for households, its saturation ranges from 54 to 71% in urban areas and it is the main fuel for more than one million families. It is also a valuable commercial fuel, with an annual turnover of some US\$60 million at current market prices [Ghana Energy Commission, Renewable Energy Division 2005 report]. Charcoal production is an important economic activity in most rural areas of developing countries, and an important source of energy in developing countries. Figure 1 illustrates charcoal production in rural areas. Energy demand in Ghana has increased significantly in recent times as a result of population increase and urbanization, adding that, the increased demand is, however pronounced in the consumption of wood fuel, particularly wood charcoal.



**Figure 1 Charcoal formation**

Source: [www.aaanet.org](http://www.aaanet.org)

Ghana is among the top two countries in West Africa in terms of charcoal consumption, and one of the countries with high per capita fuel wood demand in the sub-region indicating the importance of wood energy in the socio-economic development of the country (FAO, 2001; Yevich and Logan, 2003; Anang et al, 2011). Works done by the Ghana Energy Commission revealed that wood fuel accounts for about 78% of all primary energy consumption in the country, being the predominant source of energy for households and the commercial sectors. The bulk of the charcoal produced in Ghana is from the Savannah regions of the country and most especially among the Sissalas in the Upper West Region of Ghana (Songsore, 2003; Lurimuah, 2011). Coincidentally the charcoal producing areas of the northern part of Ghana are poverty endemic.

### **3.2 Consumption of charcoal and wood fuels**

Since fire was first harnessed, wood has been the primary fuel for it. Although most of the developed world now gets the majority of its energy for cooking and heating from fossil fuels like coal and petroleum, wood fuels are still a major source of energy for people in developing countries. Here, wood fuels account for between 50 and 90 percent of the fuel used (FAO, 2010) The figure 2 shows how some rural and urban dwellers in developing countries use charcoal and wood fuel in cooking.



**Figure 2 consumption of charcoal**

Source: [www.uenr.edu.gh](http://www.uenr.edu.gh)

Wood fuel is one of the main products of the forests. Approximately 60% of the World's total wood removals from forest and outside forests are used for energy purposes. Whilst the developed countries use only 30% of wood produced for energy, the developing countries use 80% for the same purpose (Energy Commission ). The extraction of timber for wood fuels accounts for 61% of the total wood removals (FAO, 2005; Craster Herd, 2007). Energy provision is a basic human need and consumption is closely related to the level of a country's development. Wood fuels and charcoal production serve as a source livelihood for most rural people and the increasing number of urban dwellers engaged in the charcoal and wood fuel trade (Anang et al, 2011). Woody biomass is part and parcel of rural livelihoods. According to Gelder and O'Keefe (1995) traditional economies can easily be defined as biomass economies. Rural livelihoods are intricately linked to the natural environment and this makes the charcoal problem a delicate one to solve (Anang et al, 2011). The Table 1 shows the consumption of charcoal and wood fuels in some selected countries. As we can see the highest consumption is in Uganda and lowest is in Malaysia.

**Table 1 Wood fuels and charcoal consumption in some selected countries**

<b>Country</b>	<b>Consumption per capita(m/ano)</b>
<b>Angola</b>	0.96
<b>Kenya</b>	1.48
<b>Madagascar</b>	0.59
<b>Malawi</b>	0.90
<b>Malaysia</b>	0.50
<b>Mali</b>	0.58
<b>Mozambique</b>	0.96
<b>Niger</b>	0.58
<b>Nigeria</b>	0.84
<b>Senegal</b>	0.55
<b>Sudan</b>	1.75
<b>Uganda</b>	1.77
<b>Zaire</b>	0.91
<b>Zimbabwe</b>	0.96

Source: Agarwal (1986), Brouwer and Falcao (2004).

The high incidence of poverty and food insecurity in the region is as a result of the single rainfall regime which supports one-season rain-fed agriculture. As a consequence of poverty, out-migration from the Upper West region is the highest in Ghana. The Statistical Service (2005) indicates that due to the high intensity of out-



migration, a third (about 31%) of the Upper West regions' population lives in other regions.

As a coping strategy, the households living in these poverty endemic areas have diversified their livelihood sources. Commercial charcoal production is thus a significant source of livelihood providing incomes to support households especially during the long dry seasons (Songsore, 2003; Guo, 2007; Ottu-Danquah, 2010; Agyeman et al, 2012).

Research conducted on the activities of charcoal producers in the Kintampo North district in 2005 by the Decentralized Environmental Action (DEAR) project revealed that charcoal provided an important supplementary income for many of these groups, which found agricultural production increasingly risky and prices for crops declining in real terms as markets were increasingly controlled by a monopoly of powerful traders.

Capital realized from charcoal was often reinvested in farming and used for family support and social welfare including the education of children and health provisions. Banning charcoal thus affects family welfare and hits the rural poor and the most vulnerable groups within society. It also undermines investment in agricultural production.

Another reason for the high patronage is the over-reliance on wood fuel and charcoal as household cooking fuel in the country. Over 90% of rural households depend on fuel wood for cooking. Charcoal on the other hand is the dominant cooking fuel used in the urban areas; about 61% of urban households use charcoal as their main fuel for cooking.

Liquefied Petroleum Gas (LPG) use in the country accounts for only four to six percent of the residential sector. This is concentrated in the urban areas among the middle and higher income groups. LPG is not widely used due to the unstable nature of its supply as well as its inaccessibility due to high costs and unavailability of LPG filling plants nationwide. There is also the issue of high costs of gas stoves and its accessories.

Other reasons include;

- Charcoal burns much hotter than cut wood and is lighter to transport.
- Charcoal lasts in storage without degradation many years longer than fuel wood.

- Charcoal and wood fuel production is the only energy sub sector where the cooking appliances and most production equipment are produced locally and are accessible to the rural poor in monetary terms.
- Availability of suitable wood is an important factor in determining the amount of charcoal produced. Previously most wood supply for charcoal production was from off-reserve sources. Increasingly, the forest reserves are also being exploited for illegal charcoal production.
- Increasing oil prices coupled with the relatively higher cost of cooking devices makes the use of LPG, kerosene and electricity less attractive.
- The supply and distribution of LPG, kerosene and electricity is also unreliable.
- Charcoal and wood fuel can be bought in small quantities making it suitable for the urban and rural poor.
- Inefficiencies of locally made devices implies that more charcoal and wood fuel is wasted in the process of preparing indigenous dishes, hence the increasing demand.
- Ineffective promotion and use of wood fuel-effective end-use devices. For example 'Ahibenso' charcoal stoves promotion could not be sustained because there was no coordination between implementing agency and the customs excise and preventive service (CEPS). The excise duty imposed on the stove increased the final price of the stove making it unaffordable to the targeted users.

One issue of concern is the ineffectiveness of stakeholders in the energy sector in fulfilling their respective roles in their bid to protect the natural vegetation. In the past, the government of Ghana promoted the substitution of charcoal for LPG, distributing gas cylinders free of charge, and also substituting gas prices.

This policy aimed to decrease the utilization of charcoal because of environmental concerns, led to a more pronounced increase in LPG consumption, which then had to be imported.

Since the country could not afford the expense of foreign currency, the subsidies were terminated and many users reverted to the use of charcoal and fuel wood as they were not

able to pay for LPG at real prices. The environmental impact of the substitution was not evaluated (Forest Energy, Forum No 9).

This experience shows that in the absence of a comprehensive knowledge of the demand, a fuels substitution policy may lead to undesirable consequences for the national economy. On the other hand, since neither the environmental impact of charcoal use nor the potential for other mitigation policies were assessed, the chance to develop other more cost-efficient alternatives was lost (ibid).

In Ghana numerous studies and draft policies are being conducted on fuel wood and charcoal harvesting but with limited targeted interventions and actual implementation in the country. This makes it practically difficult to regulate activities within the industry, hence the incidence of severe pressure on both the natural environment and biodiversity (Energy Commission, 2010; Lurimuah, 2011).

The lack of transparency and consistency in policies on charcoal has led to district administrations empowering or allowing chiefs to ban and control charcoal production. In the Kintampo North district, several village chiefs had introduced bans against charcoal production and in other settlements bans were imposed from time to time or threats of introducing bans were introduced. This was used by chiefs to extract revenues from farmers (Amanor et al., 2005).

One of the stakeholders responsible for charcoal and wood fuel production regulation is the Forestry Commission.

The Forestry Commission was established by law in 1984. It was assigned the responsibility among other things to;

- Review practices relating to forestry resources and formulate recommendations of national policy on forest resources
- Ensure that forests are maintained and protected as economic resources; and
- Ensure that waste and destruction of the forest and associated natural resources are minimized (Ghana Forestry Commission).

Similarly, the Energy Commission established by an ACT of Parliament in 1997, was given the statutory mandate to regulate, develop and manage the efficient utilization of energy resources including wood fuels in Ghana and to coordinate policies relating to them.

The Energy Commission, in its present national efforts is to develop sustainable national energy policies for the production and utilization of indigenous energy resources, has identified wood fuel resource management as an area that needs immediate attention. Both the forestry commission and the energy commission are currently building the personnel planning capacity and developing programmes for the creation of comprehensive database on wood fuel resources, production and consumption (Ghana Energy Commission, Renewable Energy Division Report, 2005).

The government has become increasingly concerned with the need for concerted action to preserve the country's wood fuel resources. Its stated objectives are;

- To manage the wood fuel resources by methods ensuring improved productivity and efficiency in transportation and distribution
- Efficient use of these resources through the production of improved end use devices and best practices (Ministry of Energy/ Energy Commission 2002, National Wood fuel policy paper).
- However, data on wood fuels are very scarce and where available, not very reliable , thus making it very difficult to undertake relevant planning activities and environmental impact assessment activities on wood fuel use;
- Develop institutional capacities for both the forestry and the energy commission through the provision of adequate resources, personnel development and joint or collaborative programmes .

Prepare a wood fuel resource development plan as part of a land use plan, based on;

- i. Realistic assumptions about productive potential and future demand
- ii. Selective inventories of wood fuel resources within a reasonable distance from the major consumption centres;

Evaluation of options to increase wood species that can be used for charcoal production

Evaluation of options to increase the production of wood fuel resources

Wood fuel consumption survey in major consumption centres for the purposes of preparing a wood fuel policy (Ghana Energy Commission 2005, Strategic National Energy Plan 2000-2025).

The 1994 forest and wildlife policy, the forestry development master plan and current policy reform aims to reverse the loss of environmental resources through conservation of biodiversity, high sanctuaries, environmentally sensitive areas, water shed, among others for protection against logging, sustainable utilization, and conservation of forest resources for the socio-economic benefit of all segments of the society, wildlife management in fire prone areas to reduce the incidence of bush fires; collaborative management and protection of forest resources with active involvement of local communities.

Environmental stability and climate stability-forest resource habitation and development, the benefit sharing formula for community based plantation is as follows; farmers 40%, forestry commission 40%, traditional authority's 15% and community 15%.

The Forest Commission is thereby powerless when confronted with these communal lands with regards to enforcing policy regulation in off-reserve areas. Lands under the state in the form of state forest and wildlife reserves are quite well managed, but those outside the reserves need more efforts and the collaboration of traditional authorities and communities to manage (National REDD Strategy Ghana-presentation transcript, Robert K. Bamfo head of climate change unit, Forestry Commission Accra, Ghana, 2008).

### **3.3 Effects of charcoal and wood fuel production on the natural environment**

However, the pace of interventions slowed when it became clear that forest degradation and loss could not be stopped by handing out new cookstoves (Arnold et al., 2003; Leach & Mearns, 1988; Masera, Ghilardi, Drigo, & Trossero, 2006).

More than 2 billion people use wood, charcoal, dung or agricultural residues as the primary fuel for their cooking and heating needs, leading to significant health, economic and environmental consequences. Burning wood or agricultural residues produces smoke with a

variety of irritant pollutants, some of which are known carcinogens. More than 1.5 million deaths a year are caused by acute respiratory infections from breathing smoke from indoor cooking fires. Women and children are generally exposed to the greatest levels of pollutants and it is children who suffer the greatest health risk – respiratory infections are the leading cause of death of young children worldwide (Amy Smith, 2000). Figure 3 illustrates the effect of wood fuel on the vegetation.



**Figure 3 Effects of charcoal and wood fuel production on the natural environment**

Source: [www.opinion.myjoyonline.com](http://www.opinion.myjoyonline.com)

Charcoal is the general term for a range of carbon materials, with varying combustion and dark properties (Amanor et al., 2002; Lurimuah, 2011). It is usually produced by raising the temperature of wood beyond the point at which many of its organic components become chemically unstable and begin to break down. The details of this process, called pyrolysis, are still incompletely understood.

Most of the newly formed material is vaporized. The material left behind is a black, porous charcoal that retains the original form of the wood but has just one fifth the weight, one half the volumes, and about one third of the original energy content (Amanor et al, 2002; Lurimuah, 2011).

To prevent most of the wood from igniting during production, charcoal must be made in an environment of restricted air flow.

Charcoal producers obtain the trees and logs used for charcoal production from the natural forest. A research conducted by Agyeman et al (2012) on commercial charcoal production and sustainable community development of the Upper West region revealed that about 88% of the charcoal producers use live trees taken from the natural forest. A probe further revealed that charcoal producers used live trees because dead ones were almost depleted from the natural forest. Furthermore, the live trees are easier to fell and process than the dead ones.

The researchers observed that the harvesters of the trees cut about 40 centimetres above the ground level with tools such as axes, cutlasses and at times chainsaws with the hope of enabling the forest to rejuvenate. This method of harvesting from the natural forest inhibits replenishment commensurate with the rate of extraction. There is the likelihood that trees would be harvested in Varimpere using this method, meaning that natural forest replenishment could be inhibited.

It was further revealed that about 48% and 22% of the charcoal producers had strong preferences for Shea trees and mahogany for charcoal production. The remaining 30% were indifferent and used any tree they chanced upon in their search for raw materials for commercial charcoal production. The Shea tree which has numerous economic benefits but have between 20 and 25 years of gestation are under threat of depletion from the research communities. There is also the likelihood that the Shea tree would be the most preferred for charcoal production in the study area which could lead to its extinction given its long gestation period.

Without the need for permits, the identified trees are harvested from the natural forest because it is seen as a common property resource.

Apart from the loss of food and livelihoods as a result of the cutting down of the Shea tree and other important economic trees, the earth mould method of charcoal production inflicts damage to the vegetation. The process often causes bush fires which has implications for the sustenance of flora and fauna in the communities. The traditional earth mould method of charcoal production leads to the loss of vegetation around the production site. Grasses or soils are heaped on the earth mould to aid its processing. In doing this, the grasses are lost. The heat from the earth moulds kill off micro bacterial organisms in the soils rendering the soil

infertile for a long time. Harvesting of the trees for solid fuels also destroys the ecosystem and the habitat of the animal species in our forest. It also exposes water bodies to the risk of drying up which is gradually affecting the rainfall pattern and climatic conditions of the country.

The research conducted by Agyeman et al estimated that the sample population could use about 24,000 mature trees preferably Shea and mahogany in a year for charcoal production. Commercial charcoal producers were able to harvest the trees and the logs with the aid of chainsaws. The known gestation period for the Shea tree, however was ten to fifteen years and this implies that the natural rejuvenation process would not be able to catch up with the rate of extraction.

This finding supports the claim that commercial charcoal production causes severe environmental degradation in terms of deforestation and denudation (Friends of the Earth, 2002; Makhabane,2002; Nsuya et al., 2011; Ottu-Danquah,2010; Songsore, 2003; Agyeman et al...,2012).

The use of firewood and charcoal is cumbersome, drudgery and can affect the health of women and children through the inhaling of smoke in burning wood or lighting the fire. Amy Smith reports that acute respiratory infection from indoor cooking fires is the number one cause of death in children under five in the third world. This represents nearly two million deaths per year. In addition, carbon monoxide (CO<sub>3</sub>) is a combustion product which contributes to outside air pollution. This causes lungs and eye infection among women. Even though there is an interventional program dubbed ‘a world fit for children’ which aims at reducing by one-third the deaths of children due to acute respiratory infections by 2015, the use of solid fuel for cooking in our homes may defeat the objective if not discouraged.

In the Kintampo North district, local chiefs issue threats of banning charcoal production or ban the activity out rightly because there were fears that the youth are abandoning food production to take up charcoal production and this could result in hunger and lack of food in the areas (Amanor et al., 2005). The issue of food insecurity could be replicated in Varimpere community if the youth especially, are encouraged to produce charcoal and wood fuel in order to make quick money as opposed to taking up farming which does not only provide incomes from the sale of farm left over but more importantly provides food for sustenance.



Charcoal use in developing countries affects global warming in several interrelated ways. First, a significant portion of charcoal production wood is unsustainably harvested. Although forestry management is improving and projects in countries like Malawi have encouraged use of plantation wood, the bulk of charcoal wood is clear cut from secondary and in some cases, primary forests. This is very different from small-scale rural forestry practices, where wood is often less intensively and more sustainably harvested (Bradley, 1991; Kammen and Lew, 2005).

Second, emissions during charcoal production are significant compared to those from charcoal burning. Charcoal is produced via pyrolysis, or thermal degradation of biomass. This partial combustion in an oxygen-poor environment results in formation of products of incomplete combustion (PICs), such as CH<sub>4</sub>, CO, alkanes, oxygenated compounds and particulate matter.

In ideal biomass combustion only CO<sub>2</sub> and H<sub>2</sub>O would be formed; in practice, however, various amounts of PICs are produced, depending upon operating conditions (Kammen and Lew, 2005).

### **3.4 Alternative energy sources for the household consumption and commercial purposes.**

From the foregone reviews, fuel wood and charcoal are very essential and will continue to be essential components of the energy supplies of most third world economies in the foreseeable future. Charcoal will continue to remain a key source of domestic and commercial cooking energy source for most rural families in developing countries (Lurimuah, 2011).

Any attempts at banning the use of charcoal will be out of place. However, deforestation in part is due to fuel wood use, seriously threatens the environment and for that matter future supplies of fuel wood in many developing nations. The situation is being aggravated by the traditional methods of charcoal production. It is technically inefficient and promotes waste of natural resources, particularly in the case and Ethiopia. As it stands, the environment is at risk of depletion. Underpinned by the industry's economic importance, it is recommended that the government of Ghana should subsidize the cost of the improved kilns to enable the charcoal producers obtain them to cut down wastage.

The wastage could reduce the charcoal producers' reluctance to invest money in charcoal production. The Energy Commission should also undertake intensive education to enable commercial charcoal producers get used to the improved kilns. The adoption of the improved kilns could introduce efficiency into commercial charcoal production and slow down the rate of deforestation and curtail its multiplier effects within and outside the districts.

In Ghana biomass is the most dominant source of energy and is used significantly in the domestic sector for cooking and many other heat appliances. Wood fuels in the form of forest wood, charcoal and wood processing residues are the most dominant biomass forms of energy in use in Ghana although crop residue and other non-woody materials also find some usage (KITE,1999 ;Atakora, no year).

The agricultural and forest product sectors in Ghana are major foreign exchange earners for the country. The contribution of agriculture to Ghana's GDP is currently rated at about 40% and this is a decline from 42.6% in 1992. The crops grown include such cash crops as cocoa, cashew nuts, palm nuts and seasonal crops like rice, maize and others, which yield a lot of residue. In recent years about one million cubic meters of logs have been harvested in the country annually for the wood processing industry alone. The logging activities yield a lot of residues which are used at varying efficiencies for energy purposes (Atakora, Brew-Hammond, 1999; Atakora).

Also available in the country are considerable amounts of non-woody biomass in the form of animal and human waste. Livestock rearing is a major activity in some parts of the country especially the north and the number of herds of cattle, sheep, goats, pigs and other animals is quite substantial. The waste produced is enormous and there have been a number of projects and studies aimed at improving biogas technologies in the country. All kinds of tropical crops are in cultivation and residues such as maize cobs, rice husks, palm branches, shells and nuts are major potential fuel used in many parts of the country. They are normally popular fuels that burn rapidly and well and are usually used in relatively small quantities to supplement or augment ignition when the main fuel is forest wood or charcoal (Atakora, no year).

Another form of energy that can be derived from agricultural waste in the form of animal and human waste is biogas. Biogas is the product (mainly methane) of the biological action of certain bacteria on organic matter such as dung. The resulting combustible gaseous product

could be used like LPG in stoves for cooking, gas lamps for lighting and be used to provide motive power for water pumping and grain milling application.

Improved technologies for cooking and heating have been introduced over the years. These include improved charcoal stoves, saw dust stoves, as well as the introduction of briquetting technologies.

All these technologies would go a long way to finally shift the attention from mainly wood fuel and charcoal patronage to sustainable energy sources.

## 4. PROFILE OF THE STUDY AREA

This chapter describes among other things the physical, socio-demographic and economic characteristics of Varimpere community in the Wa West District.

### 4.1 Geophysical setting

#### 4.1.1 Geographic location

The location of Wa is in the Upper West region of Ghana which is illustrated in figure 4. Varimpere is a farming community in the Wa west district .The Wa West District is one of the nine districts that make up the Upper West Region created in 2004 by legislative instrument 1751.

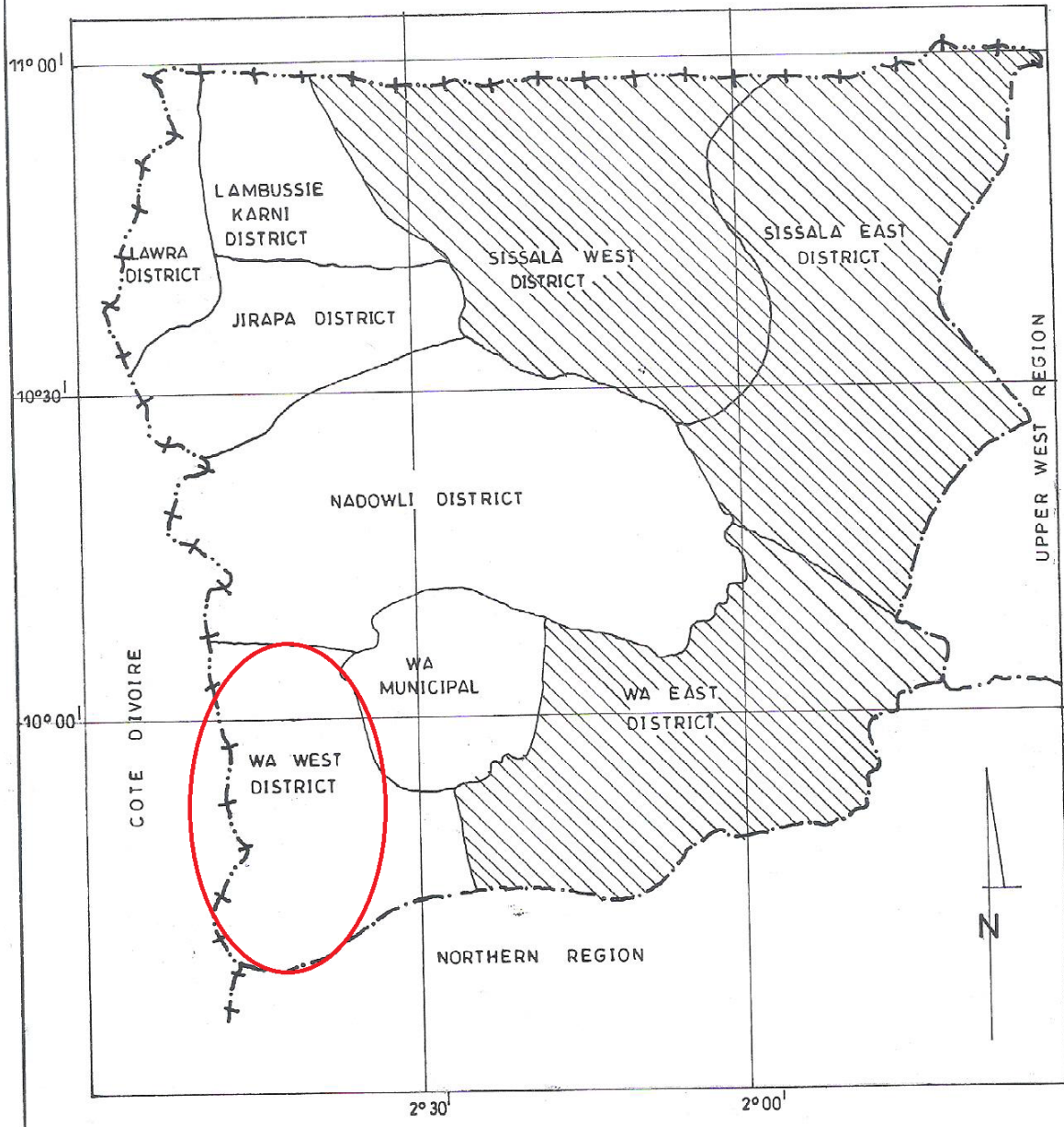


**Figure 4 Location of Wa in the Upper West Region in Ghana**

Source: [www.moledagbon.blogspot.cz](http://www.moledagbon.blogspot.cz)

The figure 5 shows the District is located in the western part of the Upper West Region, approximately between Longitudes 9°40'N and 10°10'N and also between latitudes 2°20'W and 2°50'W. It shares borders to the south with Northern Region, North-West by Nadowli District, East by Wa Municipal and to the West by Cote D'ivoire. The total area of the district is approximately 1,856 square km.

## DISTRICT MAP OF UPPER WEST REGION SHOWING THE STUDY DISTRICTS



**Figure 5 Location of Wa West District**

Source: Wa municipal assembly

### 4.1.2 Topography

Varimpere lies in the savannah high plains ranging between 180 and 300 meters above sea level. (Wa west district assembly)

### **4.1.3 Drainage**

The district is drained by one main river, the Black Volta, to the west marking the boundary between the district and the Cote D'ivoire. The Black Volta and its tributaries is the main drainage system in the District. The Black Volta and its several feeder tributaries present opportunities for irrigation in the district that can promote all year round farming. Most of the tributary streams are seasonal, thus disrupting communication during the rainy season along all the major roads to the District capital. Varimpere has three boreholes which serve as their source of water for both domestic and commercial purposes.

### **4.1.4 Soil**

The soils in the district are mostly Leptosols, Lixisols and Vertisols. There are also strips of Fluvisols along the flood plains of the Black Volta as well as sandy loams along some of its tributaries. The general nature of the soils, coupled with the traditional land use practices and limited rainfall, tend to have adverse effect on crop production. This forces the youth to look for sustenance elsewhere at the expense of their lives or health (Wa west district assembly)

### **4.1.5 Vegetation**

The Wa West District lies within the Guinea Savannah Zone which is characterized mainly by short grasses and only few woody shrubs and trees. Common trees in the District consist of drought and fire resistant trees such as baobab, dawadawa, Shea trees and kapok. Commercial trees such as Cashew and Mangoes are also found in the district. The vegetation is very congenial for livestock production, which contributes significantly to household incomes in the District. The greatest influence on the vegetation is the prolonged dry season. During this period, the grass becomes dry and the subsequent bush burning leaves the area patched and mostly bare off vegetation. Consequently, the torrential early rains cause soil erosion. Bush burning reduces the vegetative cover and adversely affects rainfall. Transpiration is reduced considerably and this affects average annual rainfall totals.

### **4.1.6 Climate**

The climate of the district is tropical continental type with the mean annual temperature ranging between 22.5°C to 45°C. The Wa West District, like most of the other districts of the three northern regions have the comparative advantage during the months of November to February (the harmattan period) of having relatively cool night temperatures of between 18°C to 22°C and rather hot day temperatures of as high as 38°C to 40°C. The relatively cool

nights are very suitable for stimulating good flowering in fruits and vegetables, heavy fruit setting and good ripening and colour turning in fruits. This gives the northern part of Ghana that comparative advantage of this type of less known climatic resource for generating other economic benefits; and Wa West District should not hesitate to take full advantage of this. The period between February and April is the hottest. Between April and October, the Tropical Maritime air mass blows over the area which gives the only wet season in the year.

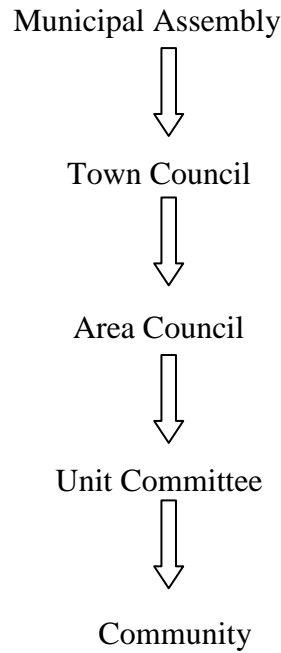
## **4.2 Landscape**

The environment consists of the natural and the built. The natural consists of the existing land areas, which is made up of farm lands, grazing land and the natural flora and fauna. . Traditional practices such as slash and burn, shifting cultivation, road construction, sand and gravel winning degrades the land in the district. Farming along water courses has led to the silting of many streams and other water bodies. The built environment on the other hand describes towns and villages with substantial conglomeration of residential, education, roads and others.

## **4.3 Socio political issues**

### **4.3.1 Modern political system**

The modern political system is established by the government of Ghana through the local government Act 1993 (article 462, section 11). The importance of this political system is to bring decision making process to the door steps of the community, hence an essential tool for political and socio-economic development. The modern political system of Varimpere is not different from that of any other community in Ghana. The modern structure in Varimpere is illustrated in figure 6 below.

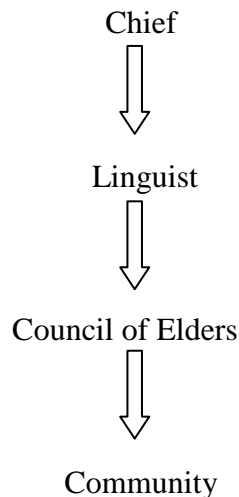


**Figure 6 Modern structure in Varimpere**

Source: Wa West District Assembly

### 4.3.2 Traditional political system

Figure 2 represents Traditionally Varimpere is headed by a chief or the community leader with the support of the linguist and his council of elders. Administratively, the family, the clan's heads also help the chief and the council of elders in decision making in the community. The traditional structure is illustrated in the figure 7 below;



**Figure 7 Traditional structure in Varimpere**

Source: Field Survey



### **4.3.3 Marriage**

Marriage is a legitimate union between a man and a woman where children born to the woman become legitimate children of both. Religiously; marriage is contracted in the traditional, Islamic, and Christian way in Ghana. The people of Varimpere are no exception. Traditionally, polygamous marriage is dominant and this is where a man is obliged to marry more than one wife. This marriage system has to do with the situation where a spouse is selected either through the child betrothal or an agreement between a man and a woman. The marriage rites usually commence with knocking where kola and drinks are presented to woman's family for approval. After the confirmation depending on the individual religion, the marriage then proceeds in that aspect.

### **4.3.4 Religion**

There are three main religious groups in Varimpere namely Christianity, Islamic and the traditional worshippers. Islam is practiced mainly by the indigenous walas followed by Christianity and traditional worshippers.

### **4.3.5 Ethnicity**

The most predominant tribe in the District is the Brefor with dialectical variations, followed by Waalas and Dagaabas. There are other minor tribes such as the Hausa, Asantes, etc. They Co-exist peacefully and inter-marry. The major ethnic groups in the community are the walas who form more than half the population. Other ethnic groups who are in the minority are the Dagaabas, Sissalas, Frafras and the Fulanis (Field Survey).

### **4.3.6 Kinship**

The indigenous people in the community practice the patrilineal system of inheritance with the few minor groups such as the Akans practicing the matrilineal system. The extended family system is also upheld in the community.

## **4.4 Economic activities**

### **4.4.1 Agriculture**

Agriculture accounts for 80% of the Wa West District economy. Most farmers undertake a combination of crops and animal production. The main crops grown by the farmers are maize, millet, maize, cowpea and groundnut. Of these the District has comparative

advantage in groundnuts and cowpea production. However, productivity of crops is low due to a combination of factors such as inadequate rainfall, low fertility, poor cultural practices and low technology application. For example rainfall distribution and amount in the district are concentrated in within the second and third quarters of the year. Since the district is dependent on rainfall agriculture, the implication of such rainfall pattern is low crop productivity and inability to produce all year round, hence there is a high risk of food insecurity. Low crop productivity is one of the major causes of poverty in the District.

#### **4.4.2 Industry (small-scale industry)**

The major industries in the area are pito brewing, Shea butter and groundnut extraction which women are mostly the dominant producers. Most of the women engage in pito brewing, petty trading and Shea butter extraction

#### **4.4.3 Services**

There are no banking and non-banking services in the district. This has made access to credit very difficult thereby adversely affecting all aspects of economic activities. Thus all workers receive their salaries in Wa. This has implication for absenteeism. The police service, military and the prison posts located in Wa Township provides security to the people coupled with easy access to transport services.

#### **4.4.4 Spatial organisation of the community**

The community has its settlement quite nucleated but dispersed towards its outskirts. In spite of the nucleated pattern of arrangement, most of the populace lives in enclosed compound `houses.

#### **4.4.5 Infrastructural development**

The community has basic infrastructures like educational institutions, health centre, bore holes and road networks. Due to the proximity of the community to the Wa municipality, the inhabitants find it very easy in attending second cycle institutions, tertiary and vocational institutions in Wa. Although the community has a health centre, extreme cases of illnesses are referred to Wa regional hospital due mainly to the fact that it serves as a referral centre to its various communities and the rest of the towns and villages in the region.

There is no standardized rural market to exchange goods and services in the community but their nearness to the Wa municipality have served as a ready market to their produce and other items like the charcoal and the wood fuel.

## **5. RESEARCH METHODOLOGY**

Primary and secondary sources of data were relied on for data collection. The secondary data sources included information from books, journals, documents from the forestry commission, web reference. Primary data sources were charcoal and wood fuel producers and consumers in and other communities.

Probability and non- probability sampling techniques was used to select interviewees. Due to the large population of the community it was difficult administering questionnaires to everybody, hence the need for probability sampling. In the case of contacting resource personnel, the non-probability sampling became effective and appropriate.

The non-probability sampling technique include

- Snowball technique was used to identify the charcoal and wood fuel producers in the community. The technique was used due to the fact that there is no charcoal producers association. Therefore a respondent selected recommends another respondent who was also involved in the production and consumption of charcoal and wood fuel.
- Purposive technique was used to identify charcoal producers and respondents from relevant institutions such as the forestry commission, the environmental protection agency, district assembly among others.

The probability sampling technique used included the following;

- Simple random sampling technique was used to select user households of charcoal, wood fuel, LPG and electric stoves in the community. The target population was the consumers of charcoal and wood fuel.

The techniques used for the data collection included observation, questionnaires and interviews as show in appendix A, B and C.

Quantitative and qualitative techniques were used for the analysis and presentation. Qualitative data was analysed using descriptive and content analysis. Quantitative data was presented by the use of figures and tables.

The research was confronted with

- Language barrier; getting information from respondents was difficult and the use of interpreters distorted information as well, thereby affecting the quality of the work.
- Inadequate financial resources; I faced the problem of inadequate financial resources. Finances for transportation to the study area was a challenge.

## **6. RESULTS**

This chapter focuses on the production of charcoal, fuel wood collection, their usage and effects on the vegetation and health of the people of Varimpere. It captures the data and information gathered by the researcher and the analysis on the causes of charcoal and fuel wood collection. It also gives a vivid description of why people go into such activities and possibly the quantity of charcoal, fuel wood and their related income effects.

### **6.1 Background information of respondents**

During the research, 60 producers were interviewed, of which 23 constituting 38.3% were males and the remaining 37 representing 61.7% were also females. On the other hand an equal number of 40 consumers were interviewed. Out of this number 28 females representing 70% were interviewed whilst 12 males representing 30% of the total figure were also interviewed.

The dominance of women in both the production and consumption of charcoal and wood fuel is a signal that women have nothing else to do apart from small scale farming which does not earn much and as such they undertake charcoal and wood fuel production as a matter of necessity and not as a choice. A majority of the respondents, women included, are illiterates who have little livelihood options. The study also revealed that men in the community have negative perceptions about the production of charcoal and wood fuel as such, people are considered lazy if they engaged in it.

The hitherto assertion that men are the bread winners of the family is challenged in this analysis since there was a greater integration of the efforts of women in production activities to generate enough incomes for their family. This implies that there is the need to ensure that women are more integrated in activities that aim at protecting the environment. This will ensure the success and sustainability of such projects.

The table 2 below illustrate the occupational distribution of charcoal and wood fuel.

**Table 2 occupational distribution of charcoal and wood fuel.**

SEX	CHARCOAL	WOOD FUEL	WOOD FUEL AND CHARCOAL	TOTAL	PERCENTAGE
<b>MALE</b>	8	3	11	23	38.3%
<b>FEMALE</b>	23	4	10	37	61.7%
<b>TOTAL</b>	31	7	21	60	
<b>TOTAL IN PERCENTAGES</b>	51.67%	11.67%	35%	100	100

Source: Field data

### 6.1.1 The age structure of respondents

The age structure of the respondents ranged from a class of 20 to 60 and above for the purpose of the work.

$$\begin{aligned} \text{Mean} &= \sum fx / \sum f \\ &= 2497.5 / 75 \\ &= 33.3 \\ &= 33 \end{aligned}$$

This suggests that the average age of respondents was 33 and the modal class was between 20 and 29 with a corresponding number of 34 interviewees constituting 45%. This means that the community has an economically active population involved in the charcoal and wood fuel production since it has its majority of the populace within the youthful age.

The production activity serves as a source of employment. They are forced to make a living due to the limited livelihood options available in the community. Charcoal and wood fuel production engages them so they do not migrate to the southern parts of the country. The involvement of the youthful populace in the activity due to its lucrativeness as compared with farming implies that food production is abandoned and this has negative implications for food security in the community.

The table 3 below illustrates the age structure of the respondents.

**Table 3 age structure of the respondents**

AGE	NUMBER OF PEOPLE (f)	CLASS MID POINT (x)	F (x)	PERCENTAGE (%)
<b>20-29</b>	34	24.5	833	45.3
<b>30-39</b>	25	34.5	862.5	33.3
<b>40-49</b>	10	44.5	445	13.3
<b>50-59</b>	3	54.5	163.5	4
<b>60 and above</b>	3	64.5	193.5	4
<b>TOTAL</b>	75	222.5	2497.5	100

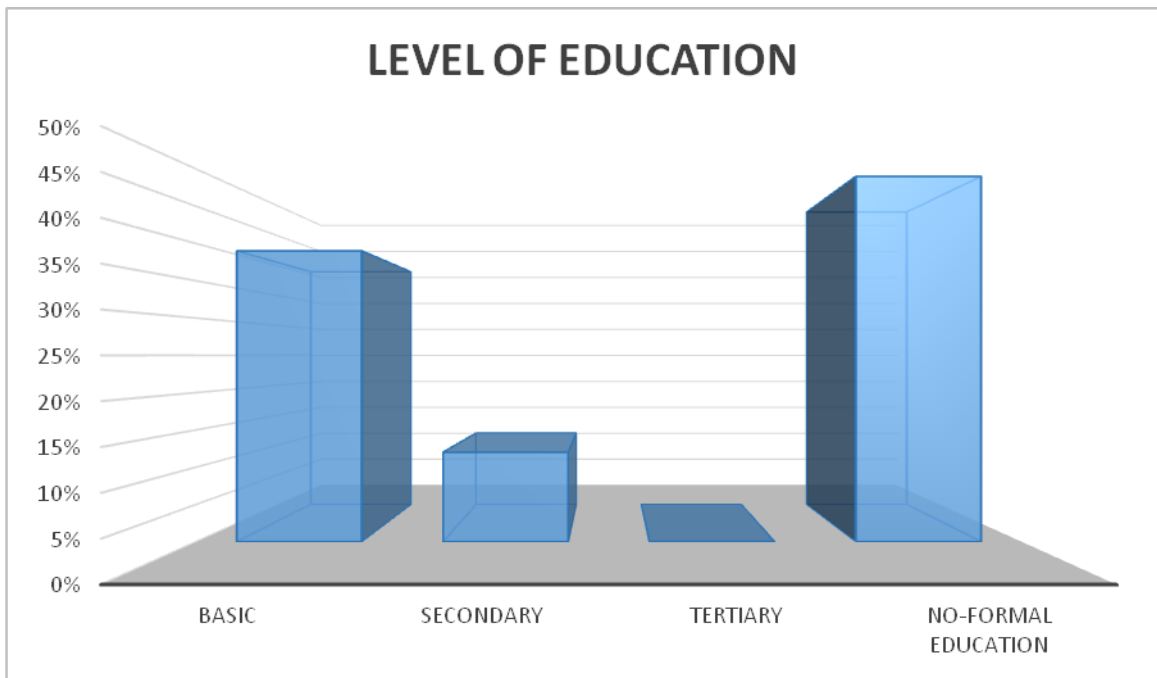
Source: Field data

### **6.1.2 Educational background of respondents**

The educational background of respondents ranged from the basic level, secondary, tertiary and those who have had no formal education. It was realised that, a total of 37 respondents constituting 49% of the sample size have had no formal education whilst the accumulated data of basic and secondary amounted to 38 constituting 50%.

From the study, 66 respondents have little or no education. This leaves them with limited employment avenues due to no or little skills. Therefore they have no other option than to depend on the environment for survival. Farming is not viable in this part of the country because of climatic conditions as well as poor soil fertility coupled with limited livelihood opportunities. In their bid to survive, the environment is degraded in the process.

The figure 8 below illustrates the educational background of respondents.

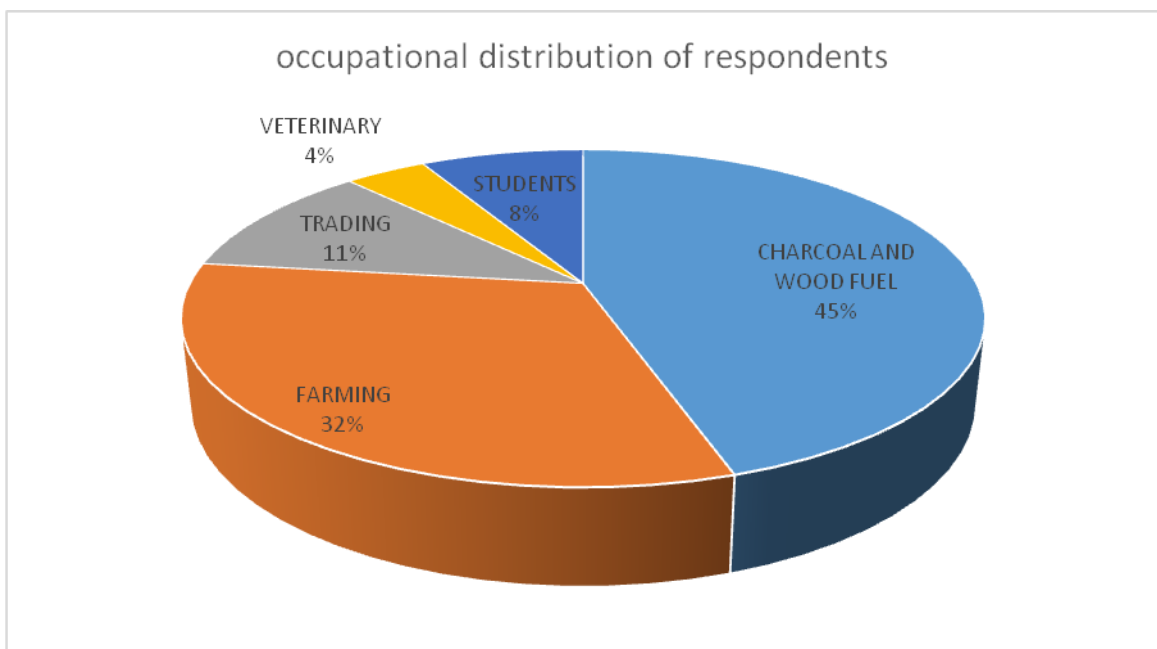


**Figure 8 educational background of respondents**

Source: Field data

### 6.1.3 The occupational distribution of respondents

The figure 9 below illustrates the occupational distribution of respondents.



**Figure 9 occupational distribution of respondents**

Source: Field data



With reference to figure 9, the various occupations identified included charcoal and wood fuel production, farming, trading, veterinary services and students. Although the major occupation identified was charcoal and wood fuel production (45%), a closer look as is illustrated by the above, revealed that the producers were predominantly farmers who engaged in charcoal and wood fuel to supplement incomes earned through farming. Other activities included Shea butter production, thus a combination of farming and Shea butter production.

## **6.2 Reasons for wood fuel and charcoal production**

The subsequent factors account for the high patronage of charcoal and wood fuel production.

### **❖ HIGHER INCOME GENERATED FROM CHARCOAL AND WOOD FUEL PRODUCE**

The income earned by individual producers in the course of production is a major influential factor of steadiness of the activity. As already indicated in the literature review, rural livelihoods are intricately linked to the natural environment, making the charcoal problem a delicate one to solve (Anang et al, 2011). The high incidence of poverty and food insecurity in the region is as a result of the single rainfall regime which supports one season rain fed agriculture. As a coping strategy, the households living in these poverty endemic areas have diversified their livelihood sources. Commercial charcoal production is thus a significant source of livelihood providing incomes to support households especially during the long dry seasons (Songsore, 2003; Guo, 2007; Ottu-Danquah, 2010; Agyeman et al, 2012). Producers of charcoal and wood fuel also aim at profit in profit maximization.

During the study, it came to my notice that the average price per bag of charcoal and a bundle of firewood was higher in especially the rainy season and hence a motivating factor for an individual producer to produce more.

Producers engage in other activities such as farming, trading, Shea butter processing among others but the charcoal and wood fuel production is seen as the fastest way to income generation especially during the rainy seasons when prices of charcoal and wood fuel are higher. The non- profitability of farming which is as result of fluctuations in prices of food serves as push factor for the youthful populace to abandon the farming enterprise for charcoal and wood fuel production leading to food insecurity issues.

The table 4 shows quantity of charcoal production and its level of income generation per week.

**Table 4 quantity of charcoal production and its level of income generation per week**

NUMBER OF BAGS	NUMBER OF PEOPLE	AVERAGE PRICE	INCOME GENERATED
1	9	19	19
2	15	19	38
2-3	9	19	47.5
3	9	19	57
3-4	3	19	66.5
5	5	19	95

Source: Field data

As is indicated in the table 4, the higher the quantity the higher the income generated. This suggests that the average price of charcoal and wood fuel makes them viable economic activities to the people and therefore serves as a pull factor into production. A bundle of firewood was found to be between one and two Ghana cedi, this could serve as a motivating factor to produce so much in order to make much income.

### **6.2.1 Ready market for charcoal and wood fuel produce**

From the study, it was revealed that majority of the producers mainly market their produce at the Wa market. Wholesale of charcoal is carried out at market centres where Retailers and individual consumers obtain their supplies or delivery. The supply of these goods is done either by the producers themselves or through intermediate men from whom customers acquire smaller units .The over-reliance on wood fuel and charcoal as household cooking fuel in the country provides ready markets as over 90% of rural households depend on fuel wood for cooking .Charcoal on the other hand is the dominant cooking fuel used in the urban areas, about 61% of urban households use charcoal as their main fuel for cooking.



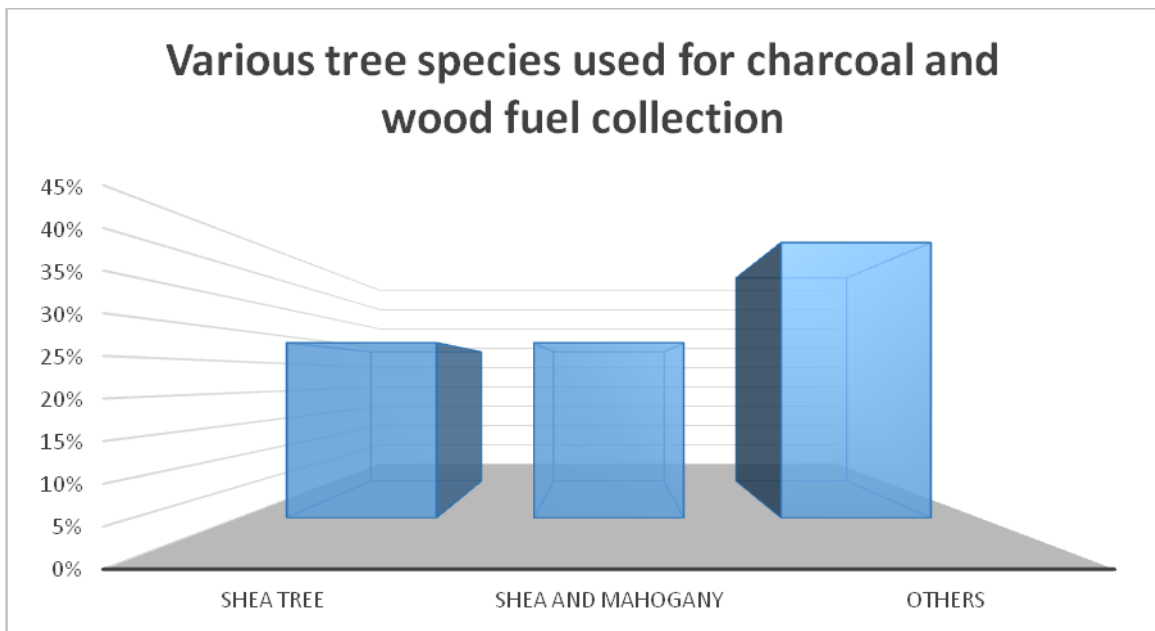
**Figure 10 ready markets for charcoal and wood fuel produce**

Source: [www.mintpressnews.com](http://www.mintpressnews.com)

### **6.2.2 Easy access to wood species**

According to Agyeman et al (2012) as indicated in the literature review, charcoal producers have preference for Shea trees and mahogany for charcoal production. Others however have been indifferent and used any tree they chanced upon.

The figure 11 shows various tree species used for charcoal and wood fuel collection.



**Figure 11 various tree species used for charcoal and wood fuel collection**

Source: Field data

The study conducted in Varimpere community revealed in figure 11 that Shea and mahogany are the most preferred species and other trees are used as well. The use of the Shea tree for production features prominently in two out of the three categories of preferred tree species.

The use of Shea tree accounted for 28%, Shea and mahogany constituted 28%, the cumulative figure of 56% is realized when the Shea tree factor is looked at as compared to the use of other species which is included Nim, dawadawa, the local strawberry trees among others.

### **6.2.3 The role of stakeholders**

The absence of a comprehensive policy on the demand and supply of energy, fuel substitution policy in Ghana may lead to undesirable consequences for the national economy. Wood fuel and charcoal as energy sources have adverse environmental impacts and therefore need policies to deal with them. There are laws governing the use of forest resources which are enforced by the Forestry commission with support from the community, district, municipal and metropolitan assemblies as well as other government institutions like the Environmental Protection Agency.

A visit to the Forestry commission division-Wa revealed that the commission's main role in the regulation of tree cutting in the district is the allocation and issuing of permits and monitoring of the permit. The commission has noticed that the tree cover is diminishing as a result of wild fires, indiscriminate felling of trees for agricultural purposes, fuel wood and charcoal production, overgrazing by animals and expansion of infrastructural development as a result of population increase. The survey revealed that the extent of charcoal and wood fuel in Varimpere is not monitored even though there are laws and regulations governing the exploitation of trees in the district with sanctions for offenders. The lack of records as to the last time an offender was sanctioned suggests that there are problems with the enforcement and implementation of such laws/regulations. Challenges hindering the performance of the commission's role in the regulation of tree cutting were identified to be ignorance on the part of people who perceive tree felling as the accepted norm in order to meet their energy needs. Other challenges were the competition between agriculture and the forestry service division with regards to the protection of the forest, political interferences coupled with the fact that punishments meted out to offenders are not too punitive enough to deter offenders and inadequacy of forestry personnel.

The environmental protection agency mentioned that the tree cover was fading as a result of bush fires, tree felling and farming among others. In spite of these the agency was not aware

of the extent of charcoal production and has no regulations governing the exploitation of trees. On the issue of ensuring the sustainable exploitation of trees, the agency embarks on environmental education on radio and at community fora, livelihoods support programs which includes soap making, Shea butter processing, and small ruminant rearing to reduce pressure on the vegetation.

In order to facilitate the enforcement of the laws, the forestry commission suggested awareness creation among the populace on the dangers of excessive tree exploitation, building the capacity of other stakeholders, empowerment of local/traditional authorities, prosecution in court, enforcement of by-laws by the assembly among others.

The major issue identified from the above was that the various stakeholders, that is the EPA and the Forestry service division were not able to play their roles effectively and efficiently. The existence of conflicts among institutions that should be collaborating to solve this issue hinders any progress made. Ignorance on the part of the general populace, lack of personnel, political interferences among others hinders the attempts made by these stakeholders to effect changes.

#### **6.2.4 No external support**

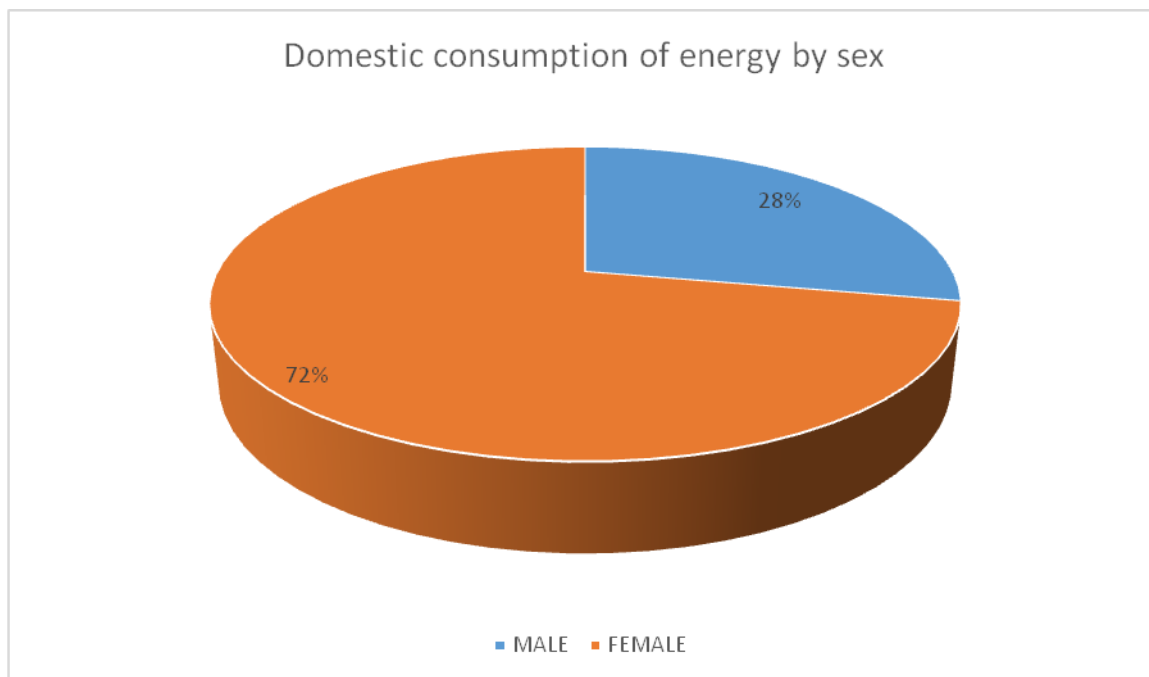
The research conducted revealed that all producers (100%) do not get any or have any external support with regards to the sources of livelihood. Access to credit facilities for the purchase of fertilizers and other farm inputs was a major source of worry to them as they could not embark on commercial farming as a major source of livelihood.

### **6.3 Reasons for the high consumption of the traditional sources as compared to the modern sources of energy**

This section explores the usage of charcoal and wood fuel as against other sources of energy and reasons for such usage. According to the study undertaken, the major determining factors were the ease of accessibility and affordability coupled with the fact that charcoal and wood fuel were seen as indigenous and traditional forms of energy.

### 6.3.1 Distribution of charcoal and wood fuel consumption

The figure 12 below shows domestic consumption of energy by sex.



**Figure 12 domestic consumption of energy by sex**

Source: Field data

From the figure 12 above, it can be seen that women constitute 72% of consumers. Thus it is prudent to actively involve women in any measures aimed at regulating excessive wood exploitation within the community. They could also be the best change agents to start with in the event of an introduction of mitigating measures.

**Table 5 distribution of energy consumption by sex**

ENERGY SOURCES	MALE	FEMALE	TOTAL	PERCENTAGE
<b>CHARCOAL</b>	1	2	3	12
<b>WOOD FUEL</b>	2	11	13	52
<b>CHARCOAL AND WOOD FUEL</b>	4	5	9	36
<b>LPG</b>	0	0	0	0
<b>ELECTRICITY</b>	0	0	0	0
<b>TOTAL</b>	7	18	25	100

Source: Field data

The table 5 shows distribution of energy consumption by sex. With reference to the table 5 above, it can be deduced that the use of wood fuel is on the increase constituting 52% of consumer interviewee's .Charcoal and wood fuel constitutes 36%, charcoal consumption constitutes 12%, while LPG and electricity use accounted for 0% of energy usage in the community. This confirms the point made in the literature that wood fuel usage is dominant in rural areas since more than 2.2million families depend on it for cooking and heating while about 280 thousand use it for small scale processing activities such as pito brewing and oil extraction (groundnut and Shea batter). (Ghana Energy Commission, renewable energy Commission 2005 report).

Charcoal production is an important economic activity in most rural areas in development countries, and an important source of energy in developing countries. Energy demand in Ghana has increased too significantly in recent time as a result of population increase and urbanization, adding that the increase demand is however pronounce in the consumption of wood fuel.

The study revealed that LPG usage and the use of electricity are virtually non-existence in the community. This could be attributed to the fact that these sustainable alternatives of energy are not readily available in all parts of the country, especially in very remote areas. The challenge has been that the renewable energy technologies involved in general are very expensive to the rural poor even when credit schemes and subsidies are provided to overcome the initial cost barrier maintenance and replacement cost. This suggests that wood fuel was dominantly used as source of energy in the rural areas of which Varimpere community is no exception.

### **6.3.2 Affordability**

Across a sample size of 25, 18 of them constituting 72% declared that the use of wood fuel and charcoal is comparatively inexpensive and easy to get as opposed to the modern source of energy as LPG and electricity. Literature also revealed that charcoal and wood fuel can be bought in small quantity at a time and are suitable for the preparation of indigenous Ghanaian dishes.

Also literature revealed that the government policy of substituting charcoal for LPG by distributing gas cylinders free of charge and subsidizing gas prices led to a greater increase in LPG consumption which then had to be imported and since the government could not afford,

the subsidize had to be terminated and many users reverted to the use of charcoal or wood fuel as they were not able to pay for LPG at a real prices.

Also all income groups use wood fuel and charcoal because the use of LPG, kerosene and electricity for cooking requires relatively higher capital outlay for the purchase of cooking devices (Ghana Energy Commission, Renewable energy division, and 2005 report). This accounts for the higher patronage of these traditional sources of energy.

### **6.3.3 Easy Accessibility**

Easy accessibility to charcoal and wood fuel products by the household accounts for the increase usage of these energy sources. Out of the 25 respondents interviewed, 18 out of them attributed consumption of charcoal and wood fuel to the ease of accessibility as well as its affordability.

This represents 72% of the interviewees, the study revealed that household did not have to travel very long distances in other to fetch firewood for cooking and heating purposes. The acquisition for firewood for consumption is also devoid of middlemen which could make it a bit expensive to acquire. This suggested that affordability coupled with accessibility were the two major contributing factors to the increased production and usage of charcoal and wood fuel in the community.

### **6.3.4 Other reasons**

A significant percentage (28%) constituting 7 out of 25 respondents revealed that they use firewood because it is the only source of energy they know of. Aside that they also claimed that firewood use adds some taste to food prepared as such increasing their preference. This means that the community gives regards to their culture and hence a contributing factor to the usage of these energy sources.

## **6.4 Adverse effects of charcoal and wood fuel production on the vegetation of varimpere community**

### **6.4.1 Loss of vegetative cover**

The economic and agricultural activities undertaken by residents of Varimpere is a major determining factor of the nature and density of the vegetation? Natural and most importantly human activities course destruction to the environment thereby reducing the ambient nature of the bio-physical environment from the study conducted, it was revealed that charcoal and



wood fuel activities contribute to the loss of the vegetative cover in the community the frequent felling of trees for charcoal and firewood coupled with farming activities leads to the depletion of valuable tree species such as Shea, mahogany, dawadawa and Nim among others.



**Figure 13 Loss of vegetative cover**

Source: [www.vuthisa.com](http://www.vuthisa.com)

In the literature researchers observed that the harvesters of the trees cut about 40cm above the ground level such as axes, cutlasses at times chain saws with the hope of enabling the forest to rejuvenate (Agyeman et al, 2012) it was found that trees cut in the community could not rejuvenate. This means that the situation applies to Varimpere community. Out of the 50 producers interviewed 84% did not replace trees cut whilst 16% did. The situation if continued, could lead to the extinction of the Shea tree which has a gestation period of 20 to 25 years. Apart from the loss of foods and livelihoods as a result of the cutting of the Shea tree and other important economic trees, medicine, feed for animals building materials from the mahogany tree are also lost.

#### **6.4.2 Loss of soil fertility**

All of the charcoal and wood fuel producers use the earth mould method which inflicts the damage to the vegetation. In the process of the production, the grasses are lost, the heat from the earth mould kill off micro bacterial organisms in the soil rendering the soil infertile for a long time.

The process often causes bush fires which has implications for the sustenance of flora and fauna in the community.



**Figure 14 Loss of soil fertility**

Source: [www.olitha.wix.com](http://www.olitha.wix.com)

### **6.4.3 Drying up of water bodies**

Trees in the catchment area of the streams in Varimpere community fell for charcoal and wood fuel activities expose the water bodies to direct sun shine. As a result there is a reduction in the volumes of the streams which are already seasoning. This eventually leads them to drying up hence affecting aquatic eco-system, domestic consumption and the prospects of setting up an irrigational facility. This supported the literature that harvesting of trees for solid fuel also destroy the eco-system and the habitats of animal species which exposes water bodies to the risk of drying up which is gradually affecting the rainfall pattern and climatic conditions of the country.



**Figure 15** drying up of water bodies

Source: [www.newvision.co](http://www.newvision.co)

#### **6.4.4 Land degradation**

Trees and grasses cut in the production process leave the land bare, making it unable to withstand the pounding effects of rain drops. The fertile topsoil is washed away as a result of erosion which eventually leads to the land being degraded.



**Figure 16** Land degradation

Source: [www.savingstripes.wildlifedirect.org](http://www.savingstripes.wildlifedirect.org)

## **7. MAJOR FINDINGS, RECOMMENDATIONS AND DISCUSSION**

### **7.1 Major findings**

This section explores the summary of major findings with respect to the data that formed the basis of this research which envelopes mitigation measures and recommendation.

The major findings include the following;

Females dominated in the production of charcoal and wood fuel with only a handful of men doing the same. This is due to the fact that the women, most of whom are illiterates, having little or no livelihood options due to the lack of skills. Men were discouraged from this kind of work due to the existence of negative perception that those who engage in this production activities were lazy.

Majority of the youth were engaged in charcoal and wood fuel production not as an option but a necessity due to the limited employment opportunities.

Incomes generated was the major motivating factor for the continuous involvement of the youth. Even though they undertake other income earning activities such as farming, trading among others, charcoal and wood fuel production was seen as the fastest way to earn income.

Shea and Mahogany trees were the most preferred species due to the quality of charcoal and wood fuel products produced. However other trees were used by producers who could not find these preferred species easily.

The forestry services division whose role is to regulate the cutting of trees was not playing this role well due to inadequate personnel, logistics among others.

The environmental laws protecting the planting of trees are not implemented and therefore most dweller do know have any ideas about these laws.

## 7.2 Recommendations

The suggested recommendations for addressing issues raised. The table 6 below shows my suggested recommendations.

**Table 6 suggested recommendations**

CATEGORY	RECOMMENDATION
Rural dwellers ( people of Varimpere )	<ul style="list-style-type: none"> <li>• There should be attempts to help the people find alternative sources of incomes. Information gathered from the study revealed that the people engage in the production of charcoal and wood fuel because there was nothing else to do especially during the dry seasons.</li> <li>• The formation of women groups should be encouraged with the support of civil society organizations and the district assembly to promote the expansion of the Shea butter processing industry as well as the introduction of other income generating activities such as small ruminant rearing among others to reduce the pressure put on the environment by the populace in their search for incomes for sustenance.</li> <li>• This should be supported by micro finance institutions such as MASLOC. The area is within the catchment area of SADA, therefore steps should be taken to ensure that programs aimed at poverty reduction are extended to the area.</li> </ul>
Government and International organisations	<ul style="list-style-type: none"> <li>• There should be conscious efforts by the government to commercialize agricultural activities in the area in particular and the region in general.</li> <li>• Farmers need to be educated on proper soil management practices to control erosion and infertility. Irrigation dams should also be constructed to help them undertake all year round farming.</li> <li>• Fertilizers and other agricultural chemicals should be made available through government subsidies to help increase productivity.</li> <li>• Storage facilities for storing perishable farm produce should also be made available.</li> <li>• Subsidies on LPG should be granted, thus making it affordable to the urban and rural poor and also ensuring regular supply of gas in the country. The Government should create awareness and make the price of alternative energy affordable in urban areas where the most people use charcoal.</li> </ul>

	<ul style="list-style-type: none"> <li>• The Government also, should find and recognize charcoal burners in areas where they are. They need to be provided with education on environmental issues and the essence of license issues.</li> <li>• Government need to enhance the implementation of environmental laws in the country. I will also suggest that country need to invest in other forms of sustainable energy to uplift the sole burden on the few options available. This would go a long way to reduce the pressure on the savannah vegetation and ensure sustainability</li> </ul>
<p>Forestry Commission</p> <p>Environmental Protection Agency</p> <p>Agricultural Ministry</p> <p>Civil Society Organisation</p> <p>and Etc.</p>	<ul style="list-style-type: none"> <li>• Tree planting programme should be initiated in areas where they are not. There is also a need to adjust to the climate change effects urgently. Tree planting areas need to be highlighted inland use for the plans of the villages</li> <li>• There is also the need to strengthen the various institutions of the various stakeholders to ensure that they play the roles well.</li> <li>• There should be collaboration between the forestry commission, the environmental protection agency, the agricultural ministry, civil society organizations and the community to form a comprehensive team that will serve as a watchdog over the conservation of both on and off reserve areas in the savannah vegetation.</li> <li>• It is also recommended that the forestry commission should collaborate with the ministry of Food and Agriculture (MOFA) to embark on afforestation.</li> <li>• This can be achieved by upgrading or resourcing the field and extension officers to provide suitable tree species such as the Acacia, Nim, and Teak among others which thrive well in this part of the country.</li> <li>• There should also be woodlot practices and silviculture which involves the transition between lumbering and agriculture. In this system, trees are planted along with the cultivation of crops to help the risk of crops failure. In the event of crop failure, the loss can be compensated for by the plantation product. It is of the view that, natural or artificial regeneration activities if properly perused in consonance with the local community are often the most effective methods of revitalizing the ecosystem.</li> </ul>

### 7.3 Discussion

Fuel wood is mostly the only source of domestic fuel especially in the rural areas in Ghana. This is mostly due to its availability, accessibility and affordability. This issue in discussion has caused desertification which is also disturbing agriculture in the zone due to dryness of the environment, dry spells, drought, insufficient rainfall, increasing temperature, reduction in transpiration, increasing evaporation, low soil nutrients, inadequate pasture, erosion and flooding among others. The unwarranted cutting of tree species for charcoal has brought about unpleasant ecological outcomes.

The matter of deforestation in Ghana due to charcoal production and other human factors is a life-threatening one. The effects are usually tough to reverse. Several significant tree species are fast dying through commercial charcoal production. In some part of Ghana due to the unregulated practice of charcoal production fixed with bush fires which destroys the vegetation.

However, in Mozambique, Tanzania, Malawi and Zambia considerable effort has been expended to alleviate fuel-wood shortage through the introduction of fast growing exotic trees, agroforestry, and use of energy saving stoves. In Kenya, in the past Conventional agroforestry approaches have met with little success because of inappropriate species, long cropping intervals and inadequate husbandry techniques used by the harvesters, mostly the rural poor (Young and Francombe, 1991)

There is a vital need to grow environmentally sound methods of sustainable fuel-wood production. Sustainable methods of extracting wood fuel must be implemented to ensure a friendly environment.

## **8. CONCLUSION**

The aim of this study looked at the effect of charcoal and wood fuel production on Ghana's vegetation. (A case study of Varimpere in the Wa West District). A combination of qualitative and quantitative methodological approaches was used in data collection and analysis. These methods include: questionnaire and interview. Conclusively, the study showed that Ghana's environmental resources are becoming over – exhausted specifically the vegetation. Wood, flowers, herbs, grasses, stems, roots, leaves as well as fruits are on the degeneration due to non – replacement of trees. It is approved that charcoal production activity in Varimpere village is refusal to environmental conservation strategies in Ghana. Due to the over – extraction of vegetative resource without replacement, the existence of imbalance to the extent that even if this resource is left unharnessed to regenerate, it would take many years for it to re – produce and for an environmental balance to be achieved.

Nevertheless, Charcoal business appears to be the source of revenue for the rural dwellers and it seems to be a substitute for economic activity that involves low principal and operation costs. From the foregone discussions, it was concluded that the production, sale and consumption of charcoal and wood fuel products have accounted for the depletion of the vegetation in Varimpere



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**Appendix A**  
**Questionnaire for producers of charcoal and wood fuel**  
**DEMOGRAPHIC INFORMATION**

1. Sex/Gender male ( ) female ( )
  
2. Age                    20-29( )    30-39 ( ) 40-49 ( ) 50-59 ( ) 60 and above ( )
  
3. Marital status    married ( )    single ( )    divorced ( )    separated ( )  
                                  widow/widower ( )
  
4. Level of education    Basic ( )    Senior high ( )    Tertiary ( )    No formal  
                                  education ( )
  
5. Ethnicity Wala ( )    Dagarti ( )    Sissala ( )    Frafra ( )    Fulani ( )    other  
                                  (specify).....
  
6. Religion    Christianity ( )    Islam ( )    Traditional ( )    others  
                                  (specify).....
  
7. What type of tree do you use for the charcoal production ?  
                                  Shea tree ( ) Nim ( )    Dawadawa ( )    others (specify.....)  
                                  Why do prefer those species? .....
  
8. Rank the likely effect of charcoal and wood fuel on the vegetation in the future?

IMPACTS	RANK
Deforestation	
Nutrient Depletion	
Bush Fires	
Reducing Wildlife	

9. Which of these benefits do you derive from these trees besides the charcoal production or wood fuel ?

BENEFITS	TICK
Medicinal Value	
Improves Air Quality	
Beautification of our Communities	
Reduce storm water runoff and improve water quality	

10. How many bags of charcoal do you produce in a week?

RANGE	BAGS
10 – 20	
21 – 30	
31 – 40	
41- 50	
51 – 60	

11. Do you replace the trees you cut down for charcoal? Yes ( ) No ( )

If NO, why .....

12. How is the charcoal burning done?

.....  
 .....  
 .....

13. How do you market your produce?

.....  
.....

14. Do you have any other source of livelihood? Yes (specify.....) no ( )

15. Do you get any external support? Yes (specify.....)/ no ( )

**Appendix B**  
**Questionnaire for consumers of various energy sources**

**DEMOGRAPHIC INFORMATION**

1. Sex/Gender male ( ) female ( )
2. Age 20-29( ) 30-39 ( ) 40-49 ( ) 50-59 ( ) 60 and above ( )
3. Marital status married ( ) single ( ) divorced ( ) separated ( ) widow/widower ( )
4. Level of education basic ( ) senior high ( ) tertiary ( ) no formal education ( )
5. Occupation?
6. What is your source of energy for cooking and other activities ?

TYPES OF FUEL	TICK
Wood fuel	
Charcoal	
charcoal and wood fuel	
liquefied petroleum gas (LPG)	
all of the above	

7. Do you know of any other economic benefits from trees?

.....

.....

.....



8. Have you noticed any changes in the tree cover of this community?

.....  
.....  
.....

## Appendix C

### Interview guide for forestry services commission

1. What is your role in the regulation of tree cutting in the district?

.....  
.....

2. Do you notice any changes in the tree cover in the district ?

.....  
.....

3. What accounts for the changes in the tree cover?

.....  
.....

4. Are you aware of the extent of charcoal production in Varimpere ?

.....  
.....

5. Are there laws / regulations governing the exploitation of trees in the district ?

.....  
.....

6. Are there sanctions for offenders?

.....  
.....

7. When was the last time an offender was sanctioned?

.....  
.....

8. What are some of the challenges faced in enforcing these laws ?

.....  
.....

9. What can be done to facilitate the enforcement of the laws ?

.....  
.....