7th MASTER’S DEGREE IN MANAGEMENT, ACCESS AND CONSERVATION OF SPECIES IN TRADE: THE INTERNATIONAL FRAMEWORK

International University of Andalucía



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Development of a Sustainable Charcoal Industry in Saint Lucia

Thesis Submitted in Partial Fulfillment of the Requirements for the Academic Degree of Master in Management, Access, and Conservation of Species in Trade: the International Framework

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**NOTES**

The currency used in this report is the Eastern Caribbean (EC $) dollar except where otherwise stated. The exchange rates prevailing at the time of this study (December 3 2009)

United Kingdom (UK) pound (£) One pound £1= EC $4.46

United States (US) dollars ($) One US $1= EC $2.70

**The Units of Measurement**

Imperial units are still widely used in St. Lucia and have been employed in this report of local usage. The metric equivalents were also represented of those values reported.

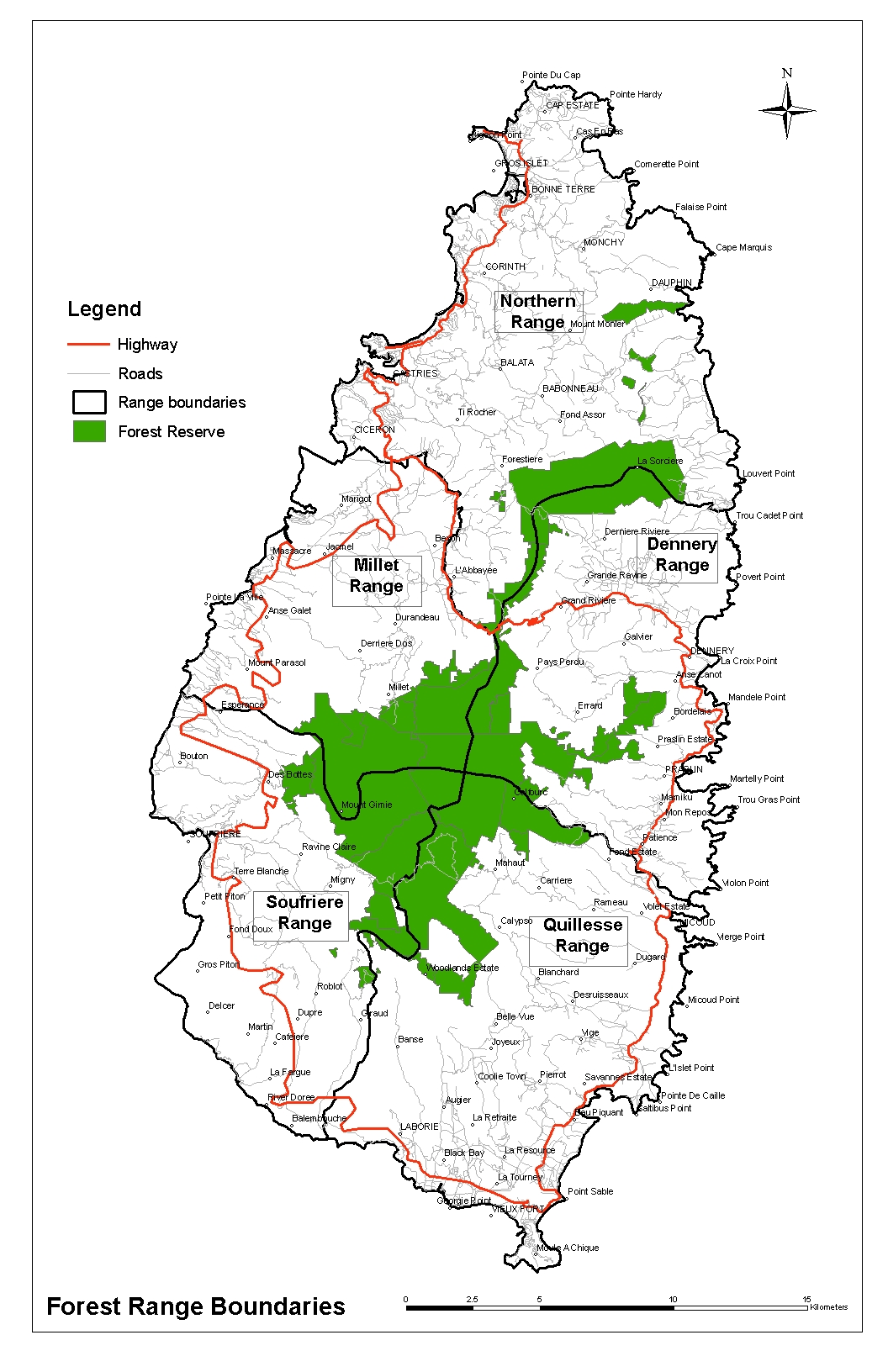


Figure 1 Map of St. Lucia showing the Five (5) Ranges- Millet, Soufriere, Northern,

Dennery and Quillese

**Executive Summary**

At the global level the main effect from the demand, production and use of charcoal, particularly in developing countries was the loss of the livelihood associated with the charcoal industry and land degradation. The loss in biodiversity was also associated with the loss in livelihoods and the identity of the people in reference to the customs in the use of that natural resource.

In St. Lucia, given the general trend of uniform increase in the prices of charcoal from 1970 to 2009 using the linear function y = 0.716689 *X* – 1400, that the National Biodiversity Strategy Action Plan identified charcoal production as a main cause of biodiversity loss, that though charcoal production involved working for fewer hours that the producer obtained a higher or equivalent salary to professions of persons with the same socio economic background and that there is the culture and popularity of charcoal use, there is a need to have planned actions and interventions to mitigate against the negative impacts associated with the charcoal industry. The desired effect is to optimize the benefit to communities and to maintain plant biodiversity in a charcoal industry.

This study of the charcoal industry aimed to examine all the activities of charcoal producers and other key stakeholders within the wider context of the charcoal business including: extraction, production, transport distribution, sale, use, to the availability of wood, forest management and other strategies for sustainability in the charcoal industry.

When the 2001 and 2009 charcoal surveys were analyzed using the independent variables of location for the five administrative ranges of the Forestry Department, namely- the Quillese, Soufriere, Soufriere, Dennery and the Northern ranges-the data confirmed that there was a charcoal industry in St. Lucia and that there were distinct demographic groups, interests, and mode of operations of key stakeholders. The 2009 charcoal survey revealed a production of 290168 kilograms (kg) in weight of charcoal by charcoal producers. The amount of wood necessary for this production was 8290.5 cubic metres (m3). On a range level, the production of charcoal was 17591 kilograms (kg), 1227 kilograms (kg), 156941 kg, 70609 and 43800 kilograms (kg) in the Dennery, Millet, North, Quillese and Soufriere ranges respectively.

In general most persons interviewed in this study of the charcoal industry were within the age range of forty one (41) to “more than sixty one (61)” years old. Sixty one percent (61%) of the persons had only a primary school level of education, followed by twenty three percent (23%) with “No formal Schooling” and twelve percent (12%) with only a “Secondary school” level of education. Seventy four (74%) (109 of 214) of the responses to income were in the income categories of “less than $500” (34%) to “$500 to $1000” (47%). In both the 2002 and 2009 charcoal survey, the persons involved in the charcoal business had “more than three (3) years” experience. Also coinciding in 2002 and 2009 was the high proportion of farmers who were charcoal producers: in 2002 there were a total of 56 farmers out of 70 respondents (80%) whilst there were 106 farmers out of 160 respondents (66%) in 2009. From 2002 to 2009, there was a shift with more persons engaged in other occupations and charcoal related livelihoods. In 2002, 90 respondents indicated that charcoal production was their only occupation. However in 2009 only 19 respondents stated that charcoal production was their only occupation, and 186 respondents stated that charcoal business was not their only occupation. One of the occupations related to charcoal use that was detected especially in the Millet and Dennery ranges was food vending.

The main form of marketing charcoal was “Directly by Self or family member”, followed by the “Wholesaler or Middleman and then by the “Market Vendor”. The popular prices for charcoal sold “directly to the market by self or with members of family” were: $35, $30 and $40. A mark up in the price of approximately twelve percent (12%) on charcoal sold was reported for the marketing channel of “Directly by Self or family member”. The “Market Vendor” reported an average of twenty five percent (25%) in profit for the charcoal sold.

Quillese and Northern range were the major locations for the charcoal business in St. Lucia both having the main role of production and sale. The highest price for the sale of charcoal was in the Northern range in comparison to the other ranges. Quillese, Dennery and Northern had a higher proportion of males whereas Soufriere and Millet had a higher proportion of females involved in charcoal related activities.

The main type of wood that users used for charcoal making was Logwood (*Haematoxylum campechianum*, Savonnèt (*Lonchocarpus heptaphyllus and Lonchocarpus punctatus*), and Gliricida *(Gliricidia sepium)*. The preferred wood for charcoal producers was Logwood and Gliricida.

The main difficulty expressed by charcoal producers was accessibility to areas with wood and the availability of wood for charcoal making.

The highest costs and use of transportation were reported in the Millet, Soufriere and Quillese ranges.

Notwithstanding that this threat exists, a forest inventory in 2009 in St. Lucia determined the existence of 2.8 million cubic metres of wood available on forest reserves. Traditionally forest management had no focus on the supply of charcoal. Forests were only managed for the purpose of biodiversity, soil and water conservation, timber, recreation and tourism. Further, though Leucaena woodlots were established in the 1970s and 1980s to supply charcoal, there was no action to incorporate these woodlots to supply charcoal to the intended communities. The lack of mobilization or action by the Forestry Department may have caused the lack of awareness of Leucaena as an alternative for charcoal making. This was evidenced in the charcoal survey in 2001 survey where only one (1) producer out of one hundred and five (105) knew of the use of Leucaena for charcoal making.

Though the charcoal industry was in existence since the 1800s, using the product cycle model, the industry could be characterized as in the growth phase and currently unplanned and uncontrolled from the point of view government policy and interventions to ensure sustainability for livelihoods and biodiversity conservation. The key competitive factors to the development of the industry were quality with a focus on the development of standards, price, advertising, research, development and service. The commonly used channel intermediaries to the consumer were: the producers and or their family, wholesalers, distributors, and retailers. The key for effective management would be to ensure integrated and sustainable production systems involving the harvesting of trees used for charcoal production, agriculture and to create marketing objectives that convert charcoal from the low involvement product to high involvement products such as specialized packaged bags of charcoal to segments of the market, biochar and wood vinegar.

**ACRONYMS**

|  |  |
| --- | --- |
| ACAPG | Aupicon Charcoal and Agricultural Producers Group. |
| ANOVA | Analysis Of Variance. |
| BPOA | Barbados Plan of Action |
| CANARI | Caribbean Natural Resources Institute. |
| CATIE | Tropical Agricultural Research and Higher Education Center. |
| CBD | Convention on Biological Diversity. |
| CBO | Community Based Organization |
| CDEMA | The Caribbean Disaster Emergency Management Agency |
| CDERA | Caribbean Disaster Emergency Management Agency. |
| CDESRIA | Council for the Development of Social Science Research in Africa. |
| CEPA | Communication, Education, Participation and Awareness. |
| CEPF | International Collaborative Research Project |
| CIDA | Canadian International Development Agency. |
| CLI | Caribbean Law Institute |
| COP | Conference of the Parties |
| DRC | Democratic Republic of Congo. |
| EC | European Commission. |
| EMG | United Nations Management Group |
| ETAP | Environmental Technologies Action Plan. |
| EU | European Union. |
| FAO | Food and Agriculture Organization |
| GEFSGP | Global Environment Facility's Small Grants Programme. |
| GOSL | Government of St. Lucia. |
| HDI | Human Development Index. |
| IFPRI | International Food Policy Research Institute. |
| IFRI | International Forestry Resources and Institutes. |
| IISD | International Institute for Sustainable Development. |
| IMF | International Monetary Fund. |
| IPCC | Intergovernmental Panel on Climate Change. |
| IRIN | Integrated Regional Information Networks. |
| IUCN | International Union for Conservation of Nature. |
| LEAP | Leadership Enhancement in Agriculture Program. |
| LPG | Liquefied Petroleum Gas. |
| MDG | Millennium Development Goals. |
| MEA | Multilateral Environmental Agreement |
| NAPA | National Adaptation Program of Action |
| NBSAP | National Biodiversity Strategies and Action Plans |
| NEMO | Saint Lucia National Emergency Management Organization. |
| NEPNEMS | National Environmental Policy and National Environmental Management Strategy. |
| OCHA | Office for the Coordination of Humanitarian Affairs. |
| OECS | Organization of Eastern Caribbean States. |
| OPAAL | Protected Areas and Associated Livelihoods. |
| PCJ | Petroleum Corporation of Jamaica. |
| PNVi | Parc National des Virunga. |
| POP | Persistent Organic Pollutants |
| PSMA | Power Sources Manufacturers Association |
| Ramsar | Convention on Wetlands of International Importance Especially as Waterfowl Habitat. |
| RAPIDO | Rural Areas People and Innovative Development. |
| SLASPA | Saint Lucia Air & Sea Ports Authority. |
| SPSS | Statistical Package for the Social Sciences. |
| SWOT | Strengths, Weaknesses, Opportunities and Threats. |
| TEAM | Teachers Environmental Action Movement |
| TEEB | The Economics of Ecosystems and Biodiversity |
| TREES | Teachers for the Restoration of the Environment and Educational Society |
| UN | United Nations |
| UNCCD | United Nations Conference to Combat Desertification. |
| UNDP | United Nations Development Programme. |
| UNEP | United Nations Environment Programme. |
| UNFCC | United Nations Framework Convention on Climate Change. |
| WCPA | World Commission on Protected Areas |
| WIPO | World Intellectual Property Organization. |
| WTO | World Trade Organization. |
| WWF | World Wildlife Fund. |

**Introduction**

“Since the 1974 oil crisis, research and analysis on the use of biomass for energy purposes has intensified at an ever increasing rate” (FAO, 2000). In St. Lucia as early as 1979, the former Chief Forest Officer Gabriel Charles[[1]](#footnote-1) initiated the establishment of woodlots of charcoal as a strategy to supplementing the supply of charcoal in St. Lucia. Though there were national surveys and reports on charcoal use and the issues affecting production from the 1980’s to date, there was no consistent government action in terms of monitoring the trends associated with charcoal use and the development of corresponding policy and strategic actions to ensure the conservation of forests, maintenance and creation of the associated livelihoods in charcoal production and for the sustainability of charcoal production.

According to the present Chief Forest Officer- Michael Andrew[[2]](#footnote-2)  the charcoal business was not given the significance as a source of energy in the energy sector at the national level. He stated that it was important to know what had happened in the last twenty (20) years in terms of charcoal use, the associated livelihoods and to develop recommendations for its sustainable management in the charcoal industry for future generations of St Lucians.

**Problem**

The potential threat of charcoal production to biodiversity of charcoal production was identified in 1982 in the document- St. Lucia the Manufacture of Charcoal (1982). Given the general trend of uniform increase in the prices of charcoal, that charcoal production was identified as a threat to biodiversity in 2000 in the National Biodiversity Strategic Action Plan (NBSAP, 2000), that charcoal production was increasingly more attractive as a livelihood because of the fewer hours of work that were necessary to produce a charcoal pit relative to other professions requiring the same academic background, and the popularity of charcoal use documented in the St. Lucia Country Poverty Assessment (2005-6), there is a need to have planned actions and interventions to benefit the communities and to maintain plant biodiversity in relation to charcoal production.

Further according to Klejnot (2007), with the downturn of the economy and escalating food prices, people were turning back to “stripping the rain forest and valleys of Saint Lucia for small trees and brush to create charcoal”.

He also noted the cultural component of using charcoal for “home cooking”, “barbecuing” and use with the traditional coal pot for cooking.

Despite the reports and national surveys on the threat of charcoal production, the activity from a government perspective was currently unplanned and there was little knowledge of the use, perceptions, and trends of the issues affecting key stakeholders in the charcoal business in St. Lucia. A positive change in attitude and behaviour can only be achieved when the current attitudes, behaviours of issues affecting the key stakeholders are factored into an integral plan with solutions to the ensure sustainability of charcoal production (Kopper, 2001).

Moreover within the context of global recession, the increase in the price of fuels, the increase in the price of food, climate change, the dependence on the esthetics of the green landscape for the main source of revenue in the tourism industry, the increasing rate of unemployment and the increasing size of population has the potential to make charcoal use more attractive as an alternative for food preparation, in industries and as a livelihood. The result may be the unsustainable extraction of wood from forests for charcoal production. Another result would be the demise of the natural landscape, increased levels of land degradation, the increased probability of natural disasters or susceptibility to them and hence the increased levels of poverty for the St. Lucian society.

The information from this research was also necessary to prioritize actions in the five (5) locations of the study to manage and to provide baseline data to develop policy, protocols and formal mechanisms with other agencies such as the tourism sector, the Ministry of Social Transformation, community groups, other governmental and non-governmental organizations and natural resource managers in St. Lucia.

One recent event that highlights the importance of this work was the change in policy of the St. Lucian government from subsidizing the price of the liquefied petroleum gas (LPG), to a new “pass through mechanism”[[3]](#footnote-3) that passes the cost of LPG to the consumer (Government of St. Lucia, 2009). Though the aim of this policy may be to optimize budgets and to have more efficiency in the regulation of pricing of LPG, the result of this policy is that all consumers may be exposed to high global prices for LPG. The real threat with the high prices of fuels-a phenomenon that occurred in 2008 during the global economic crisis, is the scenario of charcoal production becomes more attractive as a livelihood and as an alternative energy application. Coupled with the culture of use of charcoal in St. Lucia, the levels of poverty, the existence of vulnerable demographic groups in the population susceptible to falling into poverty, and a reversal in the trend of increased LPG use and reduced use of charcoal, the occurrence of this scenario is more probable. The result would be detrimental to keeping forests intact. Examples of countries where this scenario was observed were Haiti in the Caribbean, and Kenya and Malawi in Africa. Given that tourism is now the main source of foreign revenue, the real cost to maintaining the esthetics of a green landscape with forest may be to subsidize the cost of LPG, to reduce the need to convert forests for agriculture, housing and for charcoal.

**Thesis Statement**

In St. Lucia, any reduced impact on biodiversity loss associated with charcoal production can only be achieved through the establishment of a sustainable system of charcoal production which addresses the interests and needs of charcoal producers and other key stakeholders.

**General Objectives**

The overall aim is to examine all the activities of charcoal producers relating to their operation within the wider context of the charcoal business of extraction, production, transport distribution and sale in relation to the availability of wood and forest management actions and processes to support sustainable charcoal production.

**Specific Objectives**

1. Determine the interests and challenges of charcoal producers relating to charcoal production using data of 2002 for the five (5) Forestry Ranges:

1. The Quantity of Charcoal produced per unit time
2. Price of Charcoal per fixed volume
3. How is Charcoal Marketed by the producer
4. Type of Wood species used.
5. The preference of wood species of charcoal producers.
6. Differences in obtaining preferred wood
7. The Perception of the impact(s) of charcoal use.

2. To determine the stakeholders involved in the charcoal business and how this business is managed:

1. Identify the actors involved in extraction, production, processing, exchange, transportation, distribution, final sale and end use of charcoal in terms of age, sex, and experience.
2. Evaluate the income and profit at each level of the chain that is of prices, quantity and expenses

3. To assess available data of the extent of forest resources under government control that can be used for charcoal production.

4. To assess the past and current forest management practices related to sustainable charcoal production.

5. To make recommendations for sustainable charcoal production and use in St. Lucia.

**Theoretical Framework**

*1.1 Trends in Biodiversity*

The second Biodiversity Global Outlook report cited that Africa and South America had the largest net loss of forests, that the population size and range of major species was declining, that threatened species occurred in all taxonomic groups and that humans had increased the extinction of species by more than 900 times in the past few hundred years (Secretariat to the Convention on Biological Diversity, 2006).

The report, in the description of the increasing rate of biodiversity[[4]](#footnote-4) loss, stated that the direct drivers to this biodiversity loss were climate change, land use, over population and invasive species introduction. The recommendation to reverse this trend in biodiversity loss was to effectively manage interventions of the indirect causes or effects of biodiversity loss namely: the demographics of people, economy and the socio political status of the country, availability and access, the application of science, technology, culture and religion.

*1.2 The Relationship between Biodiversity and Poverty*

Poverty refers to “the deprivation of common necessities that determine the quality of life, including food, clothing, shelter and safe drinking water, and may also include the deprivation of opportunities to learn, to obtain better employment to escape poverty and or allow one to enjoy the respect of fellow citizens”[[5]](#footnote-5).

The Economics of Ecosystems and Biodiversity (TEEB, 2009) and the International Union for Conservation of Nature (IUCN, 2004) proposed a correlation of a high abundance of biodiversity to poverty. The observation was illustrated in Figure 2 where the selected biodiversity hotspots have a higher prevalence of stunted people as a result of poverty. In 2005 the loss of biodiversity was harshest in the poor who depended on local ecosystem services for their livelihoods and who were least able to access or afford substitute inputs (IUCN, 2004).

This scene in which poverty was related to biodiversity was applied by James (1980) who explained that in the 1980s, Africa’s increased demand for energy exceeded the supply of energy. Moreover the increase in population growth was associated with the increased scarcity of firewood (James, 1980). In the early 2000s, this correlation was observed in Indonesia when the demand for charcoal increased from 20 to 30 tonnes per month to 90 tonnes because of the increase in the price of fuel (Prasetiamartati, 2008). Figure 2 is a visual representation of this correlation of poverty to areas rich in biodiversity.

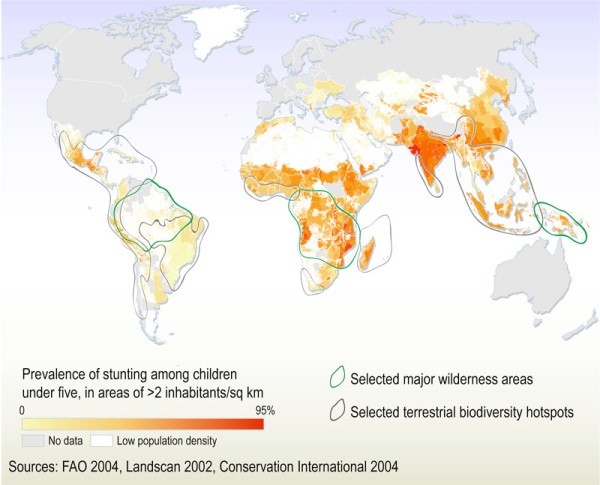
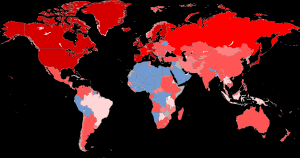


Figure 2 The Relationship between Biodiversity and People

Source Biodiversity and Hotspots IUCN World Conservation Congress, Poverty Mapping Application November 17- 25 November 2004.

According to Dudley (2008) the definitions of poverty, the various forms of its measurement, including the absolute poverty[[6]](#footnote-6), the assessment of sustainable livelihoods and with a focus for that formed the basis for sustainable development did not mitigate or ameliorate the plight of the poor but made the level of poverty worse.

In combination with these actions that were not solving the problem of poverty was the global economic downturn that started in 2008. From a warning that the world economy was going to “shrink for the first time in 2009” by the head of the International Monetary Fund (IMF), to the occurrence of a global recession[[7]](#footnote-7)” Kindleberger (2000) presented a model that assists in understanding the economic shrinkage. This economic shrinkage was characterized by the upswing in business and new opportunities, followed by expansion of business in which investors tried to optimize profit. The expansion then resulted in excesses, speculation and further irrational expansion in which many people used their wealth or credit to obtain financial assets beyond a feasible level of profitability. This was evidenced in most of the industrialized countries, namely the United States of America, England and Europe with panic and financial system reversal with people trying to get money for assets or repayment of debt. The sequence of events then resulted in a global recession[[8]](#footnote-8). This is illustrated in Figure 3 in which most of these areas colored in red confirmed an official recession.

****

*Key*

*Countries in official recession (two consecutive quarters)*

*Countries in unofficial recession (one quarter)*

*Countries with economic slowdown of more than 1.0%*

*Countries with economic slowdown of more than 0.5%*

*Countries with economic slowdown of more than 0.1%*

*Countries with economic acceleration*

*N/A*

Figure 3 World Map showing levels of Recession in the World.

*Source Adopted from Wikipedia, The Economic Crisis of 2008 2007 and 2008, as estimates of December 2008 by the International Monetary Fund) [[9]](#footnote-9)*

As a result of this global crisis, wars, the crashing of the stock market and financial institutions were:

1. massive unemployment worldwide,
2. food shortages especially of staples.
3. the high food prices. The high food prices occurred because the stocks of cereals were declining worldwide since 2000, while its demand was increased at two to three percent per year. The price was also high because of the shortage of cereals owing to drought, for example in Australia, and also due to the increased demand for grain increased for bio-fuels. Moreover, the production of grain for bio-fuel was encouraged by the “US and many European countries through the use of subsidies to encourage farmers to grow them”.[[10]](#footnote-10)
4. inflation[[11]](#footnote-11), according to a professor of economics at Hunter College and the Graduate Centre of the City University of New York in an interview on World Focus with Martin Savidge, if continued within the economic crisis would result in increased interest rates for loans in developing countries. (World Focus, 2008).

One of the key issues mentioned by David Lee Smith in the January issue of Motley Fool [[12]](#footnote-12)was that energy would be a solid sector to invest in because of the anticipated rebound in demand and prices for fuel (Smith 2009). The result and consequent observation of this forecast was the increase in the price of fuel and increase in the demand and supply of goods globally.

The impact from the global pressure increased the reliance on biodiversity for survival and consequently, there was greater extraction and use of biodiversity. Compounding poverty, global recession and the demands for use of the biodiversity was the prediction that factors affecting biodiversity loss would not remain constant but would increase in intensity (Secretariat of the Convention on Biological Diversity, 2006).

One extreme case in which the interplay of the global recession, increased prices and poverty can be observed, with the increase in population size, environmental degradation including deforestation with the associated higher risk to erosion, landslides, flooding and major disasters was in Haiti.[[13]](#footnote-13) It was ranked as the poorest country in the western hemisphere. According to the World Focus news item in Haiti, the only means to survival was to sell charcoal and eating of mud cakes.[[14]](#footnote-14) Charcoal was used for cooking, and heating of water and food[[15]](#footnote-15).

The solution to the global crisis was government intervention for stability by implementation of corrective measures and policies (Kindleberger, 2000). This approach of state intervention to resolve poverty and specifically rural poverty was supported by the second report of the Biodiversity Global Outlook, Evans (2008) and Ashley (2001).

The second report of the Biodiversity Global Outlook offered a checklist of actions for the countries, the community based organizations (CBO) and individuals in the countries that were party to the Convention on Biological Diversity to reverse the trend of problems related to biodiversity loss. Evans (2008) strongly disagreed to using a list of actions to resolve the problems of poverty and biodiversity loss. According to Evans (2008), the strategic, operational and tactical aspects of management could not be reduced to a list of actions, but preferably to an iteratively discussed and agreed sequence of actions related to management at the international and the national level. This would result in development and implementation of actions plans that were flexible to the risks of global biophysical change and to local and international politics of governments and multilateral organizations. .

Ashley (2001) further summarized the need to ensure that the poor can access reasonably performing stable markets for finance, inputs and facilitated services. Ashley (2001) stated that resolving poverty and specifically rural poverty was difficult as poverty was not well defined or understood. Ashley then examined the decline in funding to manage poverty by government and other donor agencies and concluded that there was the need to include in the policy formulation, public expenditure incentive regulatory structures, and a governance framework to optimize operations.

Ashley (2001) further detailed that the solution to rural poverty was managed through using agriculture by pricing, subsidizing, analyzing the livelihood strategies of malfunctioned households, removing general constraints to growth- investment in transportation, communication, education and health, facilitate urban rural links- of migrants, of market price information to rural areas, facilitate enterprise growth- support producer associations for marketing and sourcing; remove regulatory or bureaucratic burden on small enterprises and for the sector or sub sector intervention, provide incentives for industry relocation and provide superior industrial clusters. The next step was to ensure effective management of all the various assets that rural people access, the structures and processes which mediate how those assets were transformed into income and other desired outcomes.

Asheley (2001) summarized that the actions to follow to ensure success in rethinking the management of poverty included having a new poverty agenda with targets, a strategy and a results based evaluation and reward with the focus on opportunity, empowerment and security from risks.

***1.3 The Cultural Dimension to the use of Charcoal***

*1.3.1 Using Charcoal and Coal Pots*

Richardson (1997) highlighted that in the 1800s that charcoal was produced, used locally and exported on a large scale in St. Lucia. The surveys by the Government of St. Lucia Statistics department in 1980, 1990 and 2001 and Smith (2002) though highlighting a decrease in the consumption of charcoal island-wide, still detected a relatively high consumption of charcoal in rural areas. In the publications St. Lucia The Manufacture of Charcoal (1982) and the St. Lucia’s Country Poverty Assessment (2006) were also highlighted the preference to charcoal for cooking despite the availability of more convenient alternatives. The United Nations Development Program (UNDP) Energy report in 1984 for St. Lucia noted a preference for charcoal as a cooking fuel even among the higher income households using liquefied propane gas (LPG). Evidence of the popularity of charcoal in a similar context was also evidenced by Zerbe (2004) in industrialized countries, who the popularity of using charcoal for bar-b-ques. Zerbe (2004) also mentioned that charcoal had the advantage of easy storage and transportation, and was more durable in the presence of moisture.

Klejnot (2007) noted a cultural component of using charcoal namely for “home cooking”, “barbecuing” and use with traditional coal pot cooking in St. Lucia. Barbecuing with charcoal was popular for end of week festivities and cultural events throughout the year. Two of these major events are organized on weekends as a local and tourist attraction and for revenue generation for the local communities in the Dennery and Millet range are “Dennery Fish Fry” in the Dennery Range and the “Anse La Raye Fish Festival” in the Millet Range (Personal Communication: Jahto Mahal[[16]](#footnote-16) Social Transformation Officer and Ananias Verneiul [[17]](#footnote-17)Retired Forest Officer ).

The way in which coal pots were made and the food was traditionally cooked using coals and coal pots was shown in Figure 4 a and 4b. Coal pots were used to sustain “human society”: it was used for grilling, roasting, for longer cooking of ground provisions and stews solely or in combination with indoor gas or electric stoves. Food cooked in this way was thought to give the food a differently desired taste when compared to cooking with gas or electricity. Fay Patricia claimed that the method to produce coal pots had an African origin. Other writers claim that its origin was from the Amerindian inhabitants. One key location in St. Lucia where predominantly women Amerindian descendants produced coal pots as a livelihood was in Choiseul[[18]](#footnote-18) in the Soufriere range.

Figure 4 a. Clay used to make coal pots Figure 4 b. Food being cooked on coal pots

*Source Fay Patricia[[19]](#footnote-19)*

Based on interviews with vendors at the Castries Market, the current selling price of a locally made clay coal pot ranged from EC $25 to $30[[20]](#footnote-20). One factor influencing the choice of fuel was the investment necessary to do cooking: either to buy a stove or to purchase a coal. In today’s context of scarce resources and poverty, these customs may also serve as cost saving strategies for the users (St. Lucia Country Poverty Assessment 2005-6) and as a livelihood for the producers of clay pots (Fay Patricia) and charcoal. Further, these customs can be marketed to differentiate and make the culinary aspects of food preparation more attractive to locals and tourists, and thus further serve to maintain this cultural heritage from the Amerindians, Africans and Indians (Fay Patricia).

***1.4 Approaches to assess and manage charcoal production or use***

*1.4.1 Assessment and Management of Charcoal use with a focus on Institutional framework and processes within and amongst institutions*.

Two countries where a purely institutional approach was employed to assess and manage charcoal use were in Paraguay and Malawi.

Malawi’s focus was on taxes and income generation for the state. The background to this was a loss of 13% of total forest cover to sustain fuel wood collection and subsistence agriculture. About 3000 people were involved in this charcoal industry (IRIN, 2008) [[21]](#footnote-21) . Charcoal production was illegal since independence from Britain in 1966. The government’s effort to control “the unnecessary cutting go down of trees in the forests”, resulted in the preparation of an edict that empowered soldiers to arrest people found producing charcoal illegally. However, though people were not arrested, their tools and charcoal bags were confiscated for illegal production. This policy only included the application of a tax on revenue from charcoal produced. Money was collected from producers, transporters and vendors. All of this was in an effort to make the sector sustainable as the revenue collected was to be used for rehabilitation of forest. Sustainability of production was not possible under the regime of trees not reaching the next cycle of harvest in the forests when there was no management (IRIN, 2008).

In Paraguay however, the focus for the management was on charcoal production and use. The solution to the problems was to have a committee at Cabinet to manage energy. The recommendation was then to develop a national plan for fuel wood and rural energy should be developed and adopted with:

1. established plants
2. fuel efficient stoves
3. 9 year afforestation programs especial for areas worst affected. Then have a support program for the remaining areas of the country (UNDP Energy Sector Management Assistance Program Paraguay ,1984)

*1.4.2 Assessment and Management with a focus on Participatory Approaches*

One study detailing the focus on the users of resource was in the Philippines[[22]](#footnote-22). The objective was to determine the main factors that influence farmers’ decisions to plant trees. Quantitative methods were now used to determine and understand the perceptions of users of a resource using the regression analysis research design. Selected variables were given scores and assessments were made of the farmers. The analysis focused on modeling the results of users to knowing the intention, capacity, opportunity and constraints of users in terms of: Site Characteristics, Demographic and Cultural Aspects, Economic factors, and composite factors having the strongest influence on farmers’ decisions to plant timber trees (Table 1 and 2).

Table 1 Variables Assessed as Factors Affecting Farmers to plant Timber trees

|  |  |  |
| --- | --- | --- |
| Level of Information | Topics covered | Description |
| Site Characteristics | -Soil characteristics  -Access to forest  -Accessibility | -Productive or Degraded  -With or without forest  -Distance to nearest market |
| Demographic  and  Cultural aspects | -Number of HH members  -Age  -Education level  -Migrant  -Tree experience | -Including working and dependent  -Of HH head  -Of HH head  -Province or Region level  -Years in tree farming |
| Landholding and  Labour resources | -Total area manage  -Number of parcels  -Area owned  -Working HH members  -On farm working members | - Area Owned and Tenanted  -With different land-use systems  -Excluding tenanted and rented  -On-farm and off-farm members  -Excluding off-farm members |
| Economic factors | -Total HH income  -On-farm income  - Land productivity | -On-farm and off-farm resources  -Agricultural and tree products  - Income per unit of land |

Table 2 Overview of independent variables used for the analysis

|  |  |  |  |
| --- | --- | --- | --- |
| Response Variable | Variable Type | Description / Unit | Hypothesis Effect |
| Plant timber-tree | Dummy | 0 or 1 (0 not planting, 1 planting) |  |
| Independent Variables |  |  |  |
| Soil | Dummy | 0 or 1 (0 degraded, 1 productive) | Negative |
| Forest | Dummy | 0 or 1 (0 No forest, 1 Forest) | Negative |
| Accessibility | Continuous | Kilometres | Negative |
| Migration | Dummy | 0 or 1 (0 No migrated, 1 Migrated) | Negative |
| Education | Dummy | 0 or 1 (0 No education, 1 Education) | Positive |
| Age | Continuous | Years | Positive |
| Tree-Experience | Continuous | Years | Positive |
| Total Area | Continuous | Total number of hectares | Positive |
| Parcels | Continuous | Total area / Number of parcels | Negative |
| Area Owned | Continuous | Area owned / Total Area | Positive |
| Work | Continuous | Working HH member / Total Area | Negative |
| Labour | Continuous | Working HH member / HH members | Negative |
| Income | Continuous | Total HH income / Working HH members | Negative |
| FarmInc | Continuous | Farm Income / Total HH income | Negative |
| Productivity | Continuous | Farm Income / Total area | Negative |

Mexico also employed a matrix in the analysis of the groups and areas of the country to target for action. The aim was to obtain improved charcoal production within forest management for the state of Vera Cruz in Mexico. The concern of state authorities was to capitalize on market opportunities for charcoal production with the emphasis on techniques that were efficient and environmentally sound.

This resulted in the assessment of charcoal production within a framework that addressed efficiency, forest management, environmental integrity, safeguards and increased financial economical benefits for targeted low income rural communities.

This matrix was used to explore and profile various locations and stakeholders and to determine areas of priority (Table 3).

Table 3 Matrix Used to Explore the profile of locations and stakeholders to improve charcoal production within forest management for the state of Vera Cruz in Mexico.

|  |  |
| --- | --- |
| Issue(s) | Location |
| Stakeholder analysis and Identification |  |
| Size of stake |  |
| Scope of Involvement |  |
| Analysis and mapping institutional arrangements, analysis of key stakeholders |  |
| Capacity of other groups/individuals to become involved |  |
| who is left out |  |
| What is the purpose, focus, interest and mission |  |
| Determine what steps are needed before institutional change, who leads, linkages need |  |
| Building Capacity through the participatory process in the conceptualization, planning, implementation, monitoring and adaptive management to engage in forest based livelihoods. |  |
| Needs |  |
| Knowledge |  |
| Research necessary |  |
| Training |  |
| Conflict management |  |

*Source: Joint UNDP Energy Sector Management Assistance Program*

*Mexico Improved Charcoal Production within Forest Management for the State of Vera Cruz Report 138/91 August 1991*

In another case study cited by Newton (2006) in Mexico, the sustainable livelihoods approach was used by the International Collaborative Research Project (CEPFO). This project was designed to examine the commercialization of non timber forest products. CEPFO employed a team of specialists in economics, social science and forest ecology to integrate data collected to examine human capital, financial capital and social capital[[23]](#footnote-23). The main objectives were to determine how to explore demand and the market for the products, the management of a committee in charge of the resource and how to manage the forest resources with an ecological balance. Newton (2006) described a paradigm shift in the need to link forests with people in a sustainable system of forest management. He explained that the role of a forester has evolved from forest management of biophysical factors including practical silvicultural to “involve the public, consult stakeholders, develop partnerships with local communities and understand the role of forests in supporting livelihoods.” Despite this recognition of the evolution of forest management, Newton acknowledged that this should only be done by specialists’ professional staff with appropriate training. The techniques used for this process include participatory rural appraisal, rapid rural appraisal and sustainable livelihoods approach. Tools that were commonly used as part of these methods included interviews with key informants, group interviews, focus group discussions, preference ranking and scoring, mapping and modeling, seasonal and historical diagramming, use of timelines, direct observation, foot transects, participation in activities, case studies, ranking and scoring (Newton, 2006).

Unlike the three other studies mentioned, in South Africa, a farm-hold survey was used to determine the perceptions of farmers in 794 households in the Limpopo River Basin for the farming season 2004–2005. The independent variables examined were: education, gender, household size, farming experience, wealth, farm size, highly fertile soil, infertile soil, extension, climate information, credit, off-farm employment, tenure, latitude, longitude, rainfall and temperature. “The study examined how farmer perceptions corresponded with climate data recorded at meteorological stations in the Limpopo River Basin and analyzed the farmers’ adaptation responses to climate change and variability.” The results from the survey and the data on climate were then modeled to determine the main factors that affect the capacity of farmers to adapt to climate change. The final recommendation was for the government to design and implement policies with a focus on improving or enhancing these factors (IFPRI, 2009).

Europe adopted another approach in trying to address the problems in European societies of an ageing population, high unemployment rates, social disparities and the lack of adaptive potential to the global market in rural areas. As a large percentage of Europe’s territory consists of rural areas that contained more than half of its population, the framework of the Lisbon Strategy aimed to make Europe the most competitive, knowledge-based society in the world, focusing on jobs and economic growth especially in the rural areas. The methodology used, called RAPIDO[[24]](#footnote-24), was established to resolve the aforementioned problems by linking public, private and inter-sectional initiatives to foster innovation to the problems. This would be done in the areas of “agriculture, forestry, the food sector and the wider rural areas. There was also analysis of the methods used to transfer knowledge to different target groups. RAPIDO was a specific support action under the sixth (6th) EU Framework Research Program that ran from March 2007 to February 2009. To achieve this aim RAPIDO had the following specific objectives:

1. To identify key areas on which to focus in agriculture, the food industry and forestry.
2. To exchange information on experiences and strategies in rural development and to foster mutual learning and knowledge exchange across regions in Europe.
3. To identify key factors for success, and also existing barriers and constraints to the creation of innovation in rural areas.
4. To identify sectors where innovation would help to create employment in rural areas.
5. To analyze the role of different actors (public / private / industry / policy makers / community stakeholders) in the promotion and uptake of initiatives.
6. To review the most promising methods to facilitate innovation (processes) and knowledge transfer.
7. To evaluate the role of ETAP (Environmental Technology Action Plan) in fostering innovation in rural areas.

Consideration was then given to the formulation of recommendations to facilitate innovation through rural policies in terms of policy design and the efficiency of policies, public or private and sectional initiatives to foster innovative development, funding mechanisms and bottom up initiatives locally and regionally.

*1.4.3 Use of an integral approach with Institutional Frameworks and Participatory approaches to Assess and Manage charcoal production and use*

James (1980) stated that it was necessary to examine first the institutional constraints for alternative fuels and improving combustion efficiencies. The next step was to do consumer surveys to know the perceptions of producers, that is of the problems that exist, when why, how serious and the feasibility of various solutions. Considerations were then given to review the national resource supply situation and the social and the institutional factors that were obstacles for management, that is:

1. Based on the information collected, solutions should be developed to
2. Execute feasible collective and individual/ family productions strategies
3. Enforcing land tenure,
4. Enforcing tree tenure,
5. Planting the appropriate species
6. Land tenure
7. Protection from livestock grazing
8. Protection from humans.

Ribot (1998) in Senegal, Kopper (2001) in Tanzania and the UNDP in a Jamaica energy sector report in 1984 explained the role of both institutions and participatory approaches in assessment and management of the charcoal industry. All three publications were proposals and the recommendations were not implemented and or measured.

Ribot (1998) focused on “increasing community or indigenous benefits by participation of key stakeholders. By the determination of who profits in the charcoal industry and how they do so” the information retrieved was mapped using the commodity chain[[25]](#footnote-25) analysis. In doing the commodity chain, the aim was to increase access to specific stakeholders[[26]](#footnote-26) . Features of a commodity chain were: the focus on empirical and theoretical focus on markets; the source use and effects of power; the politics and political institutions necessary for the functioning of the markets and the manner in which regulation was undertaken by state or non state means.

The underlying goal was to have greater control[[27]](#footnote-27) in the market of charcoal production. The commodity chain analyses also incorporated the determination of the mechanisms structures and processes supporting access to stakeholders for both maintenance and for control. The control component was very important to the state as it had to consider ideological control strategies against cultures of resistance, re-appropriation of land and similar mechanisms for persons or groups that wanted to control state land, monitoring and controlling plant diversity and number, and control of labour where there could sabotage or slow down by strikes of workers.

The methodology involved was to:

1. identify the actors involved in extraction, production, processing, exchange, transportation, distribution, final sale and end use of the commodity.
2. evaluate the income and profit at each level of the chain that is of prices, quantity and expenses
3. use the distribution of income and profit to detail a map of the mechanism to maintain or control access to benefits. The result is two maps of profit distribution and of the mechanism, structures and processes at work in control and maintenance of distribution (Figure 5).

Commodity chain analysis detailed the location of benefits and the tools that could be used to devolve those benefits to the local population. This served to analyze the actual practices or outcomes of prescribed policy prescription. This type of analysis was essential to know the non policy mechanisms shaping the dynamics of production or exchange. The outcomes were the result of attenuating policies, other policies acting in parallel to or interaction with policy mechanisms.

This writer gave specific warnings in assuming ecological security and sustainable management based on the mechanisms from policy prescription to foster access to stakeholders. Some of the relations and logical propositions to consider in detail were that:

1. The relation between the properties assigned to a person or group and a desired ecological outcome. He warned that though the property should give security to the owners in terms of control and the benefit of access, there was an assumption that the land owner would the internalize all the cost for management.
2. The relation between local control and the associated benefit that may be presented as an incentive for better management, but that did not provide the economic means for the ecological function.
3. The relationship between the management of the forest to a group and the disposition of the forest. Though a group may be given the right to manage an area, the success of management and state of the forest depended on the interplay of socio economic and political factors.

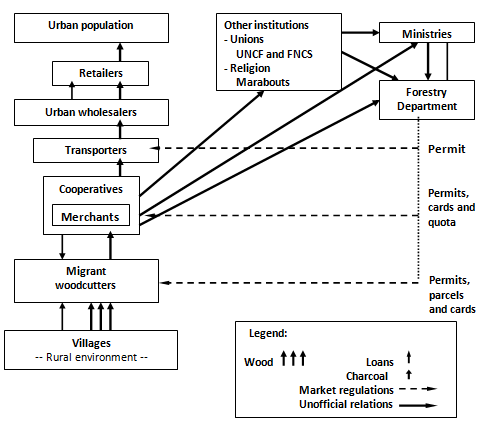


Figure 5 the Actors in the Commodity Chain for Charcoal Production

(*Adopted from Theorizing Access: Forest Profits along Senegal’s Charcoal Commodity Chain, Jesse C. Ribot*

In Tanzania, the production and marketing of charcoal were considered together in a proposal. Production and marketing of charcoal were stated as occurring unplanned and uncontrolled. This system of production was described as ecological detrimental for the area of the study mainly because of the increasing size of population requiring more charcoal that could not be supplied sustainably. The writer considered that the technical aspects of production were not the limiting factors for consideration and management but that of finance, the institutions, politics and socio economic factors. He then summarized that the project failure occurred only when the project was not economically and financially feasible or that there was no political will to change. He first defined sustainable charcoal production as the harvesting of certain species that does not exceed or harm the mean annual increment of a particular forest (Kopper, 2001). For Kopper (2001), the key to solving these problems was to change the attitude and behavior of both producers and consumers towards control and sustainable use of charcoal use with the following preconditions and conditions:

1. Secondary stakeholders- that are governmental and non-governmental stakeholders needed to act in unison and agree on the levels of sustainable production that should be controlled and that is legal.
2. Negotiate or have discussions based on financial cost benefit analyses of the current systems versus financial cost benefit analyses of the proposed.
3. The justification for the project should be based on alleviation of poverty and not and not on environmental protection.
4. There should be provision of legal information and forest policy to stakeholders on: tree cutting, land, and powers.
5. There should be a public awareness campaign before discussions and negotiation.
6. Preparation: secondary stakeholders unite and have an agreed agenda, collection and monitoring systems and how to collaborate effectively and efficiently in the future.
7. Inform the general public. This was done by the public sector using leaflets and other means of communication to invite all stakeholders. This stage had one to 2 month duration.
8. Have a preparatory conference with the aim of the discussion and the negotiation process.
9. Distribute translated copies of information to groups.
10. Legitimize the process by making only persons or groups that had registered to be able to negotiate: for traders they should be in a registered association. If not registered they were not allowed to operate. For producers, they should be in a village association with flexible membership.
11. Produce and distribute pamphlets and of legal information of the discussions during the conference and other extension and awareness activities.
12. Begin discussions with focus on empirical data and explanation results driven plans. The long term objective was to prepare an agreement for a new more sustainable charcoal production and marketing system.
13. Conduct research on the growth rates of species, on research, planning, patrols, control fire prevention, enrichment planting and inventory and to incorporate into management plans.

Similar to Kopper’s (2001) approach, but within the Caribbean context, an energy plan for the energy sector was prepared by a joint United Nations Development Program (UNDP) and the World Bank Energy Sector Management Assistance Program Activity in 1998 stated that charcoal production in Jamaica took place in the informal economy and was unregulated by government. This was also stated as a cause of concern not only for the fall in income but the potential for land degradation on low rainfall, steep slopes and soil cover. That report stated that it was necessary to do background studies to detail concrete actions based on knowledge of charcoal systems and its impact on the environment by survey of charcoal producers and resource based assessments. The strategy to follow then was to develop a national charcoal policy, then to factor in financial requirements and sources and an implementation plan for policy by government agencies. The plan would have to include the organization of charcoal producers, wood fuel pricing, resource management, incentives to private landowners to practice sustainable charcoal production, pilot forest management schemes, training courses on improved charcoal production and a media campaign.

Other considerations mentioned in the Jamaica study that should be included in the plan were:

1. The amount of money earned by charcoal producers
2. The amount earned by charcoal producers if they increased the efficiency in production using a kiln.
3. The producer costs.
4. Wood sources
5. Ownership of wood sources
6. Absentee land owner
7. Sustainability of production.

Three other studies with partial success using the integrated approaches of institutional and participation were described by Faye (2006) in Senegal, by Guilhermina (2000) in Mozambique and Prasetiamartati (2008) in Indonesia.

The main problem in Senegal was that ineffective regulation of charcoal production was not successfully managed by management (Faye, 2006). Two main issues had to be managed: a quota system measuring the quantity of wood or charcoal exploited per year; and the power to village chiefs- who had a major stake in management of communities. Though the village chiefs’ powers were supported by the forest service orders and decrees, they were not by law. Further, there was the main problem of superimposition of new institutions without abolishing or incorporation the pre- existing ones. This arrangement did not provide or reinforce democratization and neither gave powers to village rural council to influence resolutions (Faye, 2006).

For this reason the aim of this study was to focus on the prevention of conflicts or disputes on resource exploitation to better control forest resource management, and to have improved levels of accountability (Faye, 2006). For this purpose, the following indicators were identified: freedom in exercising power transferred by the forestry code, that financial profit obtained by local personnel and access to local people.

The methodology employed in this study was a detailed analysis of the limits and advantages of pluralist management[[28]](#footnote-28). This involved interviews, participatory approaches, observation and survey of rural communities, review of laws, literature on decentralization, reports, definition and detailing of rural council’s roles and responsibilities stakeholder- rural community, village chiefs, forest service’s agents, committees, forestry operators and village councils to:

1. Determine the suitable levels of powers of each institution or actor. Then, to see how the nature and origin of the actor informed the accountability of the institution or actor.
2. Review the laws to determine the powers transferred in theory to each institution.
3. Detail the practices of administration and decision making effects of institutional pluralism.
4. Determine the effects of institutional pluralism on the extent to which local democracy established democratic decentralization- whether effective or not.
5. Determine the political, economic and social implications and recommendations.

Faye (2006) then examined the sequential steps by which powers were exercised for institutional pluralism in Senegal. This was done through the approval of:

1. signature of license – without which charcoal exploitation was not allowed,
2. through protocol agreement that was based on management plans and defined by the forestry law and approved by the Director of Forestry.
3. Protocol of intent: the intent was signed by the President of Community group, Forestry Operators, the Director of Forestry and the Committee.

One socio economic and political outcome of this management was that local populations were allowed to produce charcoal for sale without requiring a professional exploitation card. Also 80% of taxes on charcoal produce was re-funneled to producers, 20% to local population, 9% to the rural council; that local production was contracted with forestry operators; also 25% of taxes on charcoal produced was returned to the local population and 9% to the council; taxes were withheld for agreed resource commercialization. As a result, rural communities could have gained 70% of forestry receipts from fines and sale of confiscated products.

Similar to Kopper’s (2001) admonitions of assuming sustainability in use based agreements with individuals or communal groups, one problem identified with this form of management of local institutions was the accountability in communitarian forest management. As the powers of these intuitions were now institutionalized, there was a challenge in the nature of accountability of local elected authorities to local populations. The result was that whilst there was always a need of charcoal for cooking, elected authorities were not always made to be accountable. There was also the possibility of the elected authorities’ loss of power when government did not support stipulated requirements. There was also the lack of trust amongst members of the local institutions and also political inefficiency. Hence there was the recommendation to permit villagers to establish their own committees through free elections. Faye (2006) contended that notwithstanding the study undertaken, that the practices of decentralized power had not yet created the conditions and opportunities under which local democracy was reinforced.

Unlike Senegal’s focus on the powers of groups and democracy, the focus of the study in Mozambique was analysis of the strengths and weaknesses of all stakeholders to be balanced in terms of: gender, in the regulation of governance and the use of natural resources (Guilhermina, 2000). Consequently, the main objectives were to do an inventory and management plan for natural resources, create a legal mechanism for charcoal making, delimitation of area, ecotourism development and alternative activities for income, and the elaboration of a participatory management plans for the community. The elements in this exercise involved rural rapid appraisal, socio economic surveys, forest inventories, wild life surveys, identification of local problems and alternative income source. Management plans then had to be developed to address:

1. Who cuts or hunts or collects.
2. Where to cut or hunt or collect.
3. How to cut or hunts or collect.
4. How much to cut or hunt or collect.
5. When to cut or hunt or collect.

Similar to Guilhermina (2000), Prasetiamartati (2008) proposed a research framework for institutional analysis with a focus on the institutions. The key was to examine the formal and informal rules needed to solve social dilemmas and conserving ecosystem goods and services. In Indonesia, there was the logging of timber for charcoal making. This was the main source of employment for revenue and economic grout.

The methodology for this work, done from December 2007 to February 2008, was to use qualitative data collected from the field observation, in depth interviews with key informants and literature review to study the logging operations before in 1998 and after when logging with concessions was done.

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With the transition to community groups receiving forest concessions, the community received permits of one year duration and payment for quota for extractions from the site. The payment from quotas and other revenue generating activities was too used in the establishment of a revolving fund for community members.

For Prasetiamartati (2008), the role of institutions was to shape incentives and actions of individual, and with institutional adjustment, the objective was to reduce the reliance of charcoal production to intermediaries for financial capital and market channels, to improve the position of local charcoal producers directly in terms of charcoal price when market access.

After 1998, non-governmental organizations started to participate in development activities, and the importance was given to the participation of local stakeholders in resource management. These are the lesson learnt from this research study:

Though the formation of the cooperative proved successful, after 3 years the operation stopped in 2004 there was failure of the cooperative owing to mismanagement of funds. Prasetiamartati (2008) explained that whilst the revolving fund lent money to members, these members began selling their charcoals elsewhere in order not to pay deductions from debt. He also detailed that the cooperative was too tolerant to the latter problem as no sanctions were imposed to non conforming members. Other problems cited that resulted in the failure of the cooperative in succession planning- observed by the lack of leadership when the leader left. There was also the conflict of interest as the cooperative endangered the interest of middle men and capital support for charcoal producers.

Another important element incorporated in this study was the use of standards for charcoal:

1. Class A Complete cylinder 6-20 cm with length 30 cm
2. Class B Incomplete cylinder with a length of 9 cm
3. Class C broken charcoal.

The range in the size of trees cut was from 15 to 30 cm in diameter. Plants with diameters greater than 30 cm were used for seeds.

Kilns were also used to increase efficiency with an output of 5 times per year of 2.13 tonnes (Prasetiamartati, 2008).

***1.5 Approaches to resolve Biodiversity Conversation and Sustainable Use***

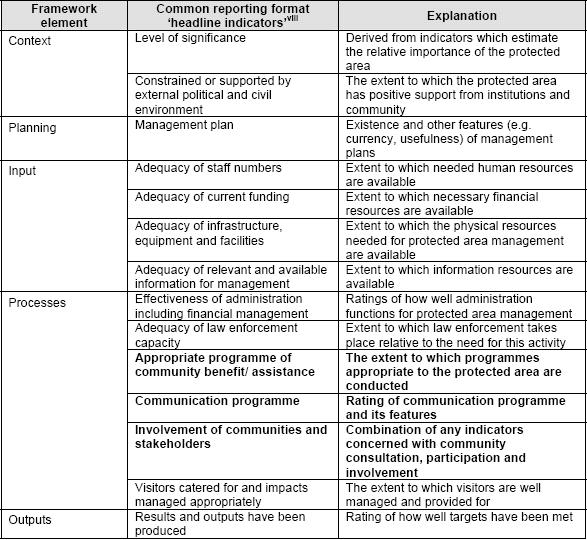
*1.5.1 Use of Protected Areas for Conservation and Sustainable Use*

In the second report of the Biodiversity Global Outlook, the section “Prospects and challenges for meeting the 2009 biodiversity targets” detailed some innovative aspects to agricultural biodiversity management. The prospects and challenges included using trees to obtain credits, including biodiversity in trade and policy plans, have a limited expansion of lands for agricultural purposes into lands with a high biodiversity content, introduce and promote incentives for biodiversity conservation, cooperation, trade off and synergies amongst the multilateral environmental agreements (MEAs) or conventions on biodiversity management, and development of cross cutting programs on conservation using

1. technology transfer techniques,
2. taxonomy and
3. protected areas,

A more detailed methodology was proposed by the IUCN World Commission on Protected Areas (WCPA) to effectively manage protected areas. A task force developed a methodology to assess management effectiveness in poverty reduction in protected areas. The aim of this management was to ensure that “the livelihoods of the poor can be enhanced by capturing greater value from ecosystems” within the protected area. The recommendation was to focus on strategic planning and actions to have effectively managed protected areas. A summary of the components of the processes and details of the components of a framework to ensure that management is effective was presented in Table 4.

Table 4 Framework to Ensure Effective Management in Protected Areas



*(Adopted from the IUCN World Commission on Protected Areas (WCPA))*

Finally another focus for management was cost and quality. This focus was of a production system with the main objective to produce high quality seedlings from the nursery. This high quality was a prerequisite to ensure that the best growth of plants in the field and thus the maximum quantity of wood (Riley, 2006). The strategy was to reduce the cost per unit of wood produced by providing the optimal treatments and conditions for growth from nursery, to establishment of plants in the plantation to growth to maturity to harvest. A deliberate attempt was made not to focus on minimizing the cost per acre but to focus on the optimal treatments and conditions of growth. The writer holds the position that this can only be achieved by the investigation into long term practices and benefits on survival and growth (Riley, 2006).

*1.5.2 1Use of Natural Forest and Woodlots to Supply Timber using a Management Plan.*

As far back as 1965, Reineke (1965) studied wood fuel markets and analyzed how markets in the rural areas were lost to alternative fuels in the metropolitan and highly industrialized zones. These markets were influenced by the distance for haulage of wood, the reliability of the supply of wood fuel, the number of independent owners controlling supplies, the rate at which the forest is cut for fuel wood and the priority and silvicultural prescriptions assigned to the forest.

For Kopper (2001), the focus of the silvicultural prescription for sustainable charcoal production from forests was the harvesting of certain plant parts or tree species that did not exceed or harm the mean annual increment of a particular forest.

Chamorro (1996) focused on the development of a forest management plan for a natural forest. The framework examined the geographic location, classification of the land, the route of communication, the legal situation, social aspect, economic situation and biophysical data. Based on an inventory and stratification of the sites, the volume of timber and charcoal selected to be produced was presented based on the distribution of diametric classes of existing wood resources. Considerations for natural regeneration of species, enrichment planting, and protection against forest fires, growth rates and mortality were factored in the analysis for production. Finally not only were markets for products detailed but there was also a financial analysis that included cost benefit analysis, marginal cost and revenue, variable cost, profit and net profit.

In St. Lucia, the Forestry Department’s operations are guided by a forest management plan. The management strategies focused on three main areas: “production”, “protection” and “production and protection” of biodiversity. In the past plans, including the last forest management plan 1992 to 2002, no consideration was given to the use of forests to supply charcoal (Forest Management Plan Volume 1 1993). According to PKF Consulting (cited in the Strategic Business Plan for the Forestry Sector, 2008) there was an underutilized potential for wood based industrial development. This was evidenced by the “average of 24% of saleable standing timber in natural forest and 4% of the potential harvest in plantation timber. One explanation given for the current situation on sales was the “policy by practice of holding back sales to the public”. The recent timber inventory of 2009 estimated the volume of timber to be 2.8 million cubic metres of wood.

*1.5.3 Use of Woodlots to supply wood for Charcoal*

Simons et al[[29]](#footnote-29) for the Food and Agriculture Organization (FAO) gave biomass stands of 37.4 tons per hectare (t/ha) for *Gliricidia sepium*, 85.6 t/ha for *Gmelina arborea* and 46.2 tons per hectare (t/ha) for Leucaena (*Leucaena leucocephala*). Such levels of productivity may be used to support the idea of using woodlots to provide charcoal for consumption

When Leucaena was used to make firewood, the inter-row spacing was 1-2 to 2-3 metres (m) and the intra row spacing was 1 to 2 to 3 metres (m). Based on this spacing, the respective population density per hectare (ha) was equivalent to 5 to 9000 and 190 to 2500 plants per hectare. Dense spacing was a necessary criterion for maximal early mean annual increments. Data from trials confirmed these observations and suggested that a 4 to 6 year harvest of trees at 1 x 1 m or 1 x 2 m spacing provided the maximum yields when moisture was not a limiting factor.

There were no recommendations for fertilization of Leucaena woodlots in the Caribbean. Weed control was by hand weeding; inter cropping with other plants and the use of contact herbicides. The harvesting of Leucaena for fuel wood and charcoal was done using 4 to 6 centimeters for fuel wood 9 to 15 centimeters of charcoal. The rotation was 3 to 4 years for giant type cultivars and 5 to 6 years for common type cultivars. The trees were recommended to be cut 30 to 50 centimeters above the ground, and the new shoots thinned to leave 2 to 3 shoots for the next crop. Leucaena is not only used to produce charcoal, but also for forage and green manure (Batson, 1987)

The Petroleum Corporation (PCJ) in Jamaica sector did research on Leucaena in plantations as fuel-wood to comply with the goals of the energy sector. Though the plants were established in woodlots, the PCJ claimed that the venture for sustainable production of charcoal was not possible and economically feasible for commercial production of charcoal. Leucaena was only recommended for reforestation or afforestation purposes.

Gliricida was used for fuel wood, living fences, green manure, shade, forage and wood. It also burns slowly producing “good embers, and gives off little smoke or sparks explaining its general acceptability” (CATIE, 1986). It has a good heating value (19.8 MJ/kg) with an average specific gravity of 0.5 to 0.6. Also reported were dry wood yields of up to 6.3 cubic metres per hectare per year (m3/ha/year) from trees in Costa Rica. Simons et al (FAO) gave data for another site with yields of 1520 cubic metres per hectare per year (m3/ha/year).

In the Philippines, where Gliricida sepium was grown in woodlots on a three-year rotation to provide wood for tobacco curing, yields of up to 23-40 cubic metres per hectare per year (m3/ha/year) were obtained (Simons et al, cited in the FAO). In the Cook and Solomon Islands, Niue, Samoa, Tonga and Vanuatu, the benefit to use Gliricida was observed as cover plants with cassava. Not only was there improved soils in the space of a year, but there was also increased cassava yields and a reduction in the need for fertilizer inputs for the crop (Spore, 2009).

There was a general sigmoidal pattern of growth for individual trees and populations of trees grown together in stands. Growth was measured in the following ways: stem diameter (measured at 1.3 m), tree height, stand basal area (sum of the cross-sectional area of all the stems in the stand), tree or stand wood volume, and tree or stand biomass.

The harvesting age at which long-term yields were maximized was the age at which the current annual increment equals the mean annual increment. At this stage, cutting and replanting the stand provided a greater yield in the long term than allowing the stand to continue to grow even though the tree size will continue to increase. This principle also applied to maximizing total volume, merchantable volume or biomass production, or the profitability of a commercial plantation.

In the Philippines, Gliricida sepium was grown in woodlots to produce fuel wood for curing tobacco. Trees were spaced at 1.5 x 2.0 metres or 2.0 x 2.0 metres and fuel wood size is ideal for the kilns. Annual yields of up to 20 cubic meters per hectare (m3/ha) were obtained from these lots. Living fences with spacing as low as 50 cm produced smaller sized wood.

The major threat to fuel wood lots reviewed was the occurrence of wildfires. Fire was also cited as “probably” the major cause of loss of forests planted for fuel wood in the tropics (Brewbaker, 1984). Fuel wood lots established without adequate control of perennial grasses were especially prone to fire damage (Ryan for the FAO[[30]](#footnote-30)).

Logwood (*Haematoxylum campechianum L.*) is a valuable dyewood, leguminous, native of Central America. The tree attains a height not exceeding 40 feet. It is said to be ready for felling when about 8 years old. When considered for woodlots, in southern western Puerto Rico, measurements of *Haematoxylum campechianum* made at 30 cm height after 18 years showed the plant had a growth rate of nearly 1 cm per year. This growth rate was slower than Leucaena’s and Gliricida’s (Weaver Peter[[31]](#footnote-31)).

The wood, separated of its bark and sap-wood, can be sold in the market in the form of large blocks and billets. It is very hard and dense, and the exterior has a dark brownish red colour.

*1.5.4 Use of Tourism to Generate Revenue from Increase to Pristine and Ecological sustainable managed ecosystems.*

Apart from woodlots, another alternative to consider in terms of alleviating poverty and yet reduce the impact and need for using biodiversity for charcoal is using the biodiversity for purposes of tourism.

With the popularity of nature based tourism worldwide, the United Nations World Tourism Organization (UNWTO) stated that the number of international visitors to Central America rose from 1.9 to 7 million in 2007. They presented tourism as another alternative for investment and income generation. For them, the only condition necessary for the sustainable development using tourism was to have the associated ecological friendly practices with the minimal impact on the environment (IUCN, 2008).

*1.5.5 Marketing and Innovation in the Charcoal Industry.*

Drucker (2005) and Kotler (cited by Silbiger, 2005) viewed marketing as a very important consideration as this function integrates all the other functions of business and addressed customers who sustain the business or livelihood (Silbiger, 2005). Drucker (2005) considered that the second function of any business enterprise was innovation. On the product end, innovation was mentioned as a creative process from the study and experimentation of the product’s use or function. The product’s use and function may be redesigned for specific target groups in existing or new markets. Innovation and marketing were described as the main considerations to “achieve sufficient profit to cover the risks of economic activity” or abandoning existing products if customers could not be satisfied with products (Drucker, 2005).

The framework of marketing and innovation as practiced by the development and implementation of a marketing plan can be implored in developing strategies to develop sustainable management plan. The review of the marketing plan has seven processes: of consumer analysis, market analysis, review of the competition, review of distribution channels, development of marketing mix, evaluation of the economics and revision and extension of steps 1 to 6 and development of a consistent plan.

There are five questions in consumer analysis: “what is the need category being satisfied, who is buying and using the product, what is the buying process, is the product a high or low involvement product and how to segment the market”. The first two questions were determined through consumer research. High or low involvement products were reactions of consumers to products based on their perception of the utility and importance of the product. High involvement products have high price, have a perceived reliability and there is a need for psychological reward from using the product. Low involvement products had a lower level of involvement and were less differentiated. Therefore the price was lower for a low level involvement product. The writer highlighted that the key ability of a marketer was to be able to take a low involvement product and convert it to a high involvement product.

Silbiger (2005) contended that the first two questions are determined through research. The current form, use and sale of charcoal are a basis charcoal to be considered as a low involvement product. First the price is low relative to other energy sources and it is less differentiated in terms of added value[[32]](#footnote-32).

In terms of the charcoal industry, the marketer then has to decide if to segment, why he should and how to manage different segments of the market. One form of segmentation is demographic segmentation in which the market is divided into homogenous groups based on:

1. Age
2. Sex
3. Income
4. Marital status
5. Family life cycle
6. Education or Occupation
7. Ethnicity, religion and race

Another component in marketing and development of a market plan is considerations given to the product cycle of the product being managed. There were four phases that a product goes through in the product life cycle. McDonald (1989) stated that the product life cycle approach was important in determining the marketing objectives. These phases are:

1. *Introductory Phase of the product*

This phase involves creating awareness of the product through education.

1. *Growth Phase of the product*

Education is also important in the growth phase as competition intensifies. Marketing is done and pricing to control and take market share is done preferably in the growth phase. McDonald (1989) stated that in the case of high growth rates of the product, that price was generally not a consideration for consumers as there was concurrently a high demand for the product in this phase.

1. *Maturity Phase of the Product*

In the maturity phase brand loyalty plays a significant role as there is mass purchase of the product. Advertising is done here to differentiate products.

1. *Decline Phase of the Product*

In the decline phase advertising was not recommended as products offered to the consumer were perceived to be less differentiated from the various companies. The strategy employed then was to focus on reducing the price whilst the competition remained (Silbiger, 2005)

The key ability of a marketer or a manager would be to examine the product life cycle of charcoal, and to create marketing objectives to be able to take this low involvement product and convert it to a high involvement product. The framework of innovation as practiced by the development and implementation of a marketing plan involves taking the marketing objectives and developing strategies for a sustainable management plan. In this way, the use and or functions may be redesigned for specific target groups in existing or new markets. (Drucker, 2005)

*1.5.5.1 Diversification of the Business Within and Away from Charcoal*

In terms of diversification into new markets, wood vinegar (Agriculture Chemistry Group[[33]](#footnote-33)) is a by-product from charcoal production. It is a liquid generated from the condensation of the gas produced by the combustion of fresh wood burning in an airless condition. Wood vinegar contains as many as “200” chemicals including most of which can improves soil fertility and consequently plant growth, can be used for pests . As the origin of this liquid is organic, it has been described as safe with no negative impacts on the environmental. Moreover the technology to produce wood vinegar is not costly and materials can be improvised name using a charcoal kiln, made from a 200-liter oil drum and 120-cm-tall concrete chimney with a 4-inch diameter.

One other alternative in the charcoal industry was revealed in the Amazon region where the ancient Amazonian Indians used charcoal mixed with compost to increase the fertility of their soil. The discovery sparked fresh interest in using this method, especially in areas where soil was degraded or scarce. Charcoal improved the capacity of soil to absorb nutrients, which was particularly beneficial to grow food crops. (Spore February 2009). Confirmation of the application of this technique was done in Belize, where a project launched by the Taiwanese Mission at Central Farm in the Cayo District using layers of charcoal and compost to grow vegetables, just as the ancient Indians did thousands of years ago. This technique can only be applied on a large scale if existing forestry resources are managed sustainably, especially for charcoal production.

Diversification and adding value in the charcoal industry may also take the form having other functions for the raw materials. The heart wood and roots Logwood have a valuable dye that is violet dark blue or purple in colour. The dye is used on material such as wool and silk” (MacMillan, 1989). There was a large export trade of logwood of good quality done by Honduras and Jamaica (Encyclopedia Britannica, 1982) Logwood can also be used for its scented flowers and to attract bee plants. (MacMillan, 1989) It also has medicinal properties with uses such as an astringent, of relief of diarrhea, killing germs, reduction in pain/inflammation and to aid in digestion[[34]](#footnote-34). From the point of view of value, the price of that *Haematoxylum campechianum L*. “rose consistently from eight pounds (£8 sterling) per kilo to one hundred and fifty pounds (£150 sterling) per kilogram”[[35]](#footnote-35).

*1.5.6 Trends in Conservation Using Conventions*

Crawford (2008) contended that MEAs[[36]](#footnote-36) were ineffective in management and that they had not addressed environmental decline and conflicts related to environmental issues. To resolve this limitation of the MEAs, Noam offered the following recommendations (Crawford, 2008):

1. Change the emphasis on treaty creation and public relations to a focus on actions resolving issues in the environment.
2. Have sustainable policies incorporate social, economic as well as environmental plan.
3. Include non-governmental organizations and the culture of society in developmental policies.
4. Use regional and international coalitions and conference of the parties meetings to present and get support for environmental issues affecting country.

Crawford (2008) identified a number of multilateral environmental agreements that can be used to source technical help or financing to solve issues and governance of the environment in the Democratic Republic of the Congo (DRC).

The articles of the Convention on Biological Diversity detailed the scope of activities and focus of this convention. Article 1 of the Convention on Biological Diversity detail the three major thematic areas of the entire convention namely: conservation of biodiversity, sustainable use of biological diversity and the equitable sharing of the benefits accrued from biodiversity for all users. The other articles detail how these key areas may be achieved. Article 7 for instance deals with the identification and monitoring of biodiversity, and article 12, 13 and 14 deal with research, training and the assessments of the impact threats. Whilst article 8 and 9 focus on “in and ex situ” conservation for the purposes of rehabilitation and restoration of ecosystems, article 8 focuses on access and benefit sharing issues for all users of biological diversity as well as the protection of traditional knowledge of users. Finally incentives, in reference to biodiversity, access to genetic resources and the transfer of technology are presented in articles 11, 15 and 16 respectively.

The Convention on Biological Diversity also presented a publication called the Addis Abba Principles guidelines as a publication that addressed sustainable use of biodiversity. In reference to the guidelines: 2, 3, 6, 7 and 12, the following processes were viewed as fundamental in sustainable use:

1. resource users should be empowered in the sustainable use of biodiversity,
2. research and validating of sustainable practices, and that
3. policies presented to manage biodiversity must consider the current, potential, intrinsic, and non economic, market forces affecting values and use, minimize waste and optimize use,
4. ensure access and benefit sharing for users and the cost of management and conservation of biodiversity
5. that marketing arrangement for the products or by products in use of biodiversity should not result in market distortion.

The assignment of World Heritage Site is another MEA to sites or locations. This designation was meant to encourage the identification, protection and preservation of cultural and natural heritage around the world considered to be of outstanding value to humanity[[37]](#footnote-37). In the Democratic Republic of Congo (DRC) there was a project to protect the World Heritage site of the Virunga park. As there was war and conflict, and the threat of losing biodiversity in this park, this project had the goal of establishing infrastructure, capacity building, ensure security of the working environment, guaranteeing salaries of the park employees, addressing the conservation needs for wildlife promoting collaboration with indigenous communities and establishment of sources of finance to support sites in the long run. The output of this project was regular pay for work, returns to tourism and unified management of parks and the outcome was conservation of the biodiversity in the park.

Currently through the Convention on Biological Diversity (CBD) through the World Conservation Monitoring Centre there were efforts for the type of international support that was done at Virunga park using MEAs to develop mechanisms for the systematic identification, assessment and implementation of needs of countries using conventions.

Another channel identified for consideration of issues was in the United Nations Management Group (EMG) designed to enhance the coordination among agencies on environment and human settlements. The focus was on having problem solving results oriented approaches for sharing of information, consultation of new initiatives and networking, in the conceptualization of frameworks, planning, development of priorities and the implementation of priorities.

Ramsar is another convention that can be used to support biodiversity conservation related to wetland conservation. The support can be obtained from financing of projects that would increase publicity and conservation of designated wetlands. For example through the CEPA Communication Participation Awareness Programs funds may accessed for environmental and educational awareness and there is the access to tools and educational resources and update to information, technological support and advice of internationally accepted standards in wetland management.. Issues in the countries that are member to this convention can also be presented at Conference of the Parties (COP) meetings.

Under the Ramsar Strategic Plan 2009 15 Strategic plan there is funding that can be provided for Invasive alien species that may be affecting wetlands (Strategy 1.9) and wetland restoration (Strategy 1.8).

The use of the Millennium Development goals and the Johannesburg Plan of Implementation is another MEA and consequently a framework that can be considered to manage poverty and biodiversity directly or indirectly. Though there are eight (8) goals, three main goals are applicable to the charcoal industry namely: the opportunity to [eradicate extreme poverty and hunger](http://www.undp.org/mdg/goal1.shtml), to promote gender equality and empower women and to [ensure environmental sustainability](http://www.undp.org/mdg/goal7.shtml). However, within the global crisis that started in 2008, and increased poverty the United Nations Millennium Development Goals (MDG) proposed to reduce the proportion of people in poverty by 2015 may not be achieved. Also, the United Nations development goals did not consider energy in solving problems of poverty (Crawford, 2008). Crawford (2008) recommended consideration to a specific target on energy for cooking with a focus on enabling access to fuels that were affordable, available, safe for cooking fuels and can contribute and maintain national security within an efficiently management of ecosystems. Based on the proposition, by “ensuring access to energy” it would be possible to reduce the proportion of people in poverty in half by 2015, Crawford (2008) recommended improved efficiency, sustainable managed plantations and reduced demand for charcoal.

Another action to consolidate effective management using the framework of the conventions was for securing the intellectual rights and benefit sharing issues for the users of biodiversity. This would empower the poor to profit from nature. As legislation was a major challenge based on the debates with the World Intellectual Property Organization (WIPO) and the World Trade Organization (WTO) this may be done by financing, strategic and tactical planning at the national and international level to:

1. Secure property and resource rights for the poor.
2. Tenure reform
3. Community based natural resource management
4. Continued role of the State accompanied with good governance.
5. Poverty Reduction Strategies Paper (PRSPs) should be developed that include the role of ecosystems in the lives of the poor and the potential to reduce poverty. (Intellectual Property Quarterly Update, 2007)

*1.5.6.1 Theoretical Policy and Legal Framework to Environmental Management in St. Lucia*

In 1981, the Organization of Eastern Caribbean States (OECS) was formed. St. Lucia is a member of this conglomeration of states. Two of the regional frameworks of the OECS territories are the St. George’s Declaration (Revised 2006) and the Barbados Plan of Action. Though the framework provided by these policy documents are regional in scope, they are applicable at the local level, to understand the current status and challenges of land management and the way forward in St. Lucia in the management of natural resources. The following were the issues identified:

The small size of developing states was the first issue identified. The main problem was the creation of intense competing interests for land use. The proposition was that the planning and utilization of land resources was dependent on the tenure systems, soil types, relief and climatic variation, the limited area available for urban settlement, agriculture, mining, commercial forestry, tourism and the types of infrastructure established in the various countries.

The second issue was satisfying the human needs by resolving the competing demands for land resources especially with consideration to population growth, commercial development and subsistence agriculture on marginal lands.

The main long-term land management issue identified was the degradation of the limited land caused by the increasing population pressure on a limited resource base, deforestation for timber and agricultural purposes, wildfire and natural events, such as catastrophic cyclones. The impact and the justification for management of land degradation was accelerated erosion and decline in fertility, agricultural productivity, reduction in water quantity, a deterioration in water quality, siltation of rivers, decline in the continuity and quality of village water supply, the depletion of genetic resources of both timber and non timber forest products, pollution of soils and loss of the livelihoods and the associated culture

The St. George’s Declaration has four goals to manage these issues with the overall aim to foster improvement in quality of life.

1. Incorporate objectives, perspectives, resources and talents of all Society in for management.
2. Achieve long-term protection and sustained productivity of regional natural resource base and ecosystem service it provides.
3. Ensure that natural resources contribute optimally and to economic, social and cultural development.
4. Natural resources contribute optimally and equitable to economic, social and cultural development.

To achieve the first goal were the following principles:2- Integrate social economic and national consider into National Development Policy Plans and programs and Principle 3 Improve institutional framework and Principle 15- Promote cooperation in Science and Technology.

For the second goal were ascribed the following principles: Principle 4 – Ensure meaningful participation by civil society in management, Principle 5 – Ensure meaningful participation by private sector, Principle 7 – Foster broad bases in education, training and awareness, Principle 15 – Provide cooperation in Science and Technology.

In the case of the third goal, the principles assigned were principle 11 – Ensure sustainable use of natural resource, Principle 12 – Protect cultural and natural heritage, Principle 13 – Protect and conserve biological diversity, Principle 16 - conserve energy.

The fourth goal has the following principles: Principle 6 – Use economic instruments for sustainable management, Principle 9 – Prevent and manage the causes and impact of disasters and Principle 14 – Recognize the relationship between trade and the environment (St. George’s Declaration of Principles for Sustainability in the Organization of Eastern Caribbean States (OECS), 2006)

At the operational level, the Barbados Plan of Action recommended three courses of action to resolve these problems and issues:

1. National action, policies and measures
2. Regional action
3. International action

National action: policies and measures include development and improvement of national databases and the dissemination of information to relevant groups, for decision-making; preparation of comprehensive land-use plans, encourage improved land administration for development including land tenure; formulation and enforcement for sustainable and integrated use, v) Support appropriate afforestation and reforestation programs, (vi) Improvement in availability, affordability and environmental quality of shelter in human settlements, in accordance with chapter 7 of Agenda 21. Agenda 21 is a blueprint for sustainable development into the 21st Century. Its basis was agreed during the "Earth Summit" at Rio in 1992, and signed by 179 Heads of State and Government.

Regional action: Provide necessary training and other capacity-building for implementation, evaluation and monitoring adverse of national actions; collect, synthesize and share among small island developing States, in a structured and systematic way, relevant information, knowledge and experience on sustainable land-use practices and policies, including issues pertaining to environmental, agricultural, forestry, mining and other land-based sectors, market intelligence information, and the assessment of potential interested overseas investors.

International action: Support the improved availability of shelter and the improved economic and environmental quality of human settlements for small island developing States in accordance with chapter 7 of Agenda 21; facilitate the development and improvement of national databases and the dissemination of information to relevant groups, facilitate more effective international and interregional cooperation, coordination, collaboration and technical exchanges in the fields of agriculture, forestry and other land-use, through international and interregional networks and training programs.

*1.6 Risk and Disaster Management in Biodiversity Conservation*

Small island developing states are vulnerable not only to global financial and economic shocks but also to natural disasters. Aaslt (2002), proposed this problem of disaster planning focused on relief and rehabilitation and not on prevention of the disasters. He explained the general trend in disaster management was of short term economic interest with the purpose of overriding the impact of the disaster. Highlighting that disaster planning would be more effective if considerations were made to prevention or reducing the probability of the disaster, he explained that the current short term focus occurred because of the lack of capacity and coordination in disaster management. He detailed that the focus should be on how to stop poor people with little alternatives for economic survival to manage the patterns that create vulnerability. The recommendation for disaster management planning to incorporate risks, short term needs, concerns interest and long term sustainability by use of early warning systems, infrastructure design, building codes, raising awareness of the issues, increase capacity for implementation and enforcement of set standards. An example given for St. Lucia of how this problem was resolved was in the Mabouya Valley in Dennery. The aim was to address rural land and watershed degradation and poverty by using national and local measures including legislation, land planning and registration, micro credit, redistribution of unused land or underutilized suitable land and sustainable development of marginal lands (Aaslt, 2002).

Another report- the Barbados Plan of Action (2002) was in congruence to Aalst’s explanation for the need to focus on disaster planning using an integral approach. The report detailed that the constraints of risk and disaster management in St. Lucia were: weak institutional capacity, lack of public demand for mitigation measures, significant human resource constraints and the continued perception by the general public of disaster management as the sole purview of government. Examples of disasters cited were Tropical storm Debbie, Environmental degradation, unsustainable cutting of trees for charcoal, floods and landslides (Barbados Plan of Action Report on Risk Management and Disaster Preparedness, 2002)

Significant resources were allocated to disaster management over the past 9 years with some critical successes achieved as a result and there are legislative provisions for disaster management. The Disaster Preparedness and Response Act (No. 13 of 2000) provides for a more effective organization of the mitigation of, preparedness, and recovery from, emergencies and disasters. In addition, the Emergency Powers (Disasters) Act (No. 5 of 1995) makes provision for the welfare and safety of the community in case of hurricane, earthquake, fire, flood or other disaster. This Act empowers the Governor General, by proclamation pursuant to section 17 of the Constitution, to declare a state of emergency. Additional action includes the adoption of the National Disaster Plan by The Cabinet [[38]](#footnote-38) in 1996 and the development of the Emergency Shelter Management Policy (BPOA report 2002). The National Emergency Management Organization (NEMO) is the agency charged with the responsibility to develop, test and implement adequate measures to ensure the efficient functioning of preparedness, mitigation and response actions regarding both natural and manmade disasters. This agency is closely associated with OECS Emergency Recovery and Disaster Management Project locally coordinated by the Ministry of Physical Development, Environment and Housing. This project has the goal to develop and strengthen early warning systems and provide training and capacity building for community-based disaster management organizations. There was a component of this project funded by the Caribbean Development Bank (CDB) of EC$24.15 million drainage program to reduce flood risks across the island. One major activity has been the undertaking of works to safeguard the Hewannorra Airport against flooding by the Vieux Fort River and by sea surges from the east. This was to ensure minimal disruption to airport activities during severe storms and reduce incidences of closure. Additionally, significant physical prevention and mitigation works were undertaken (Barbados Plan of Action Report on Risk Management and Disaster Preparedness, 2002)

*1.6.1 Climate Change threats to biodiversity Conservation*

According to the Inter–governmental Panel on Climate Change report in 2007, consideration must be given to building resistance or flexibility in the ecosystem due to the risk of climate change as the effect of climate change was underestimated and greater than initially postulated (IPCC, 2007). The reported also stated that on a global level, deforestation affected the carbon cycle by warming up the atmosphere and that deforestation was responsible for 1.6 billion tonnes of carbon emissions every year, equivalent to one fifth of the global total by the world’s energy intensive transportation sectors.

In St. Lucia climate change is a risk that cannot be controlled but only adapted to. Climate change scenarios were done with a projected 20% decrease in rainfall (John, 2002). The results of this scenario are in the Figure 6 in which the tropical moist forest would be converted to tropical dry forests. This condition would increase the probability of wildfires (National Wildfire Plan, 2008[[39]](#footnote-39)) and would threaten the livelihoods associated with forests including charcoal production (Andrew, 1986). The recommendations for land use, land use change and forestry were:

1. Reducing emissions from deforestation and forest degradation
2. Forest management
3. Forest restoration
4. Afforestation and Reforestation

(Robledo, 2008)

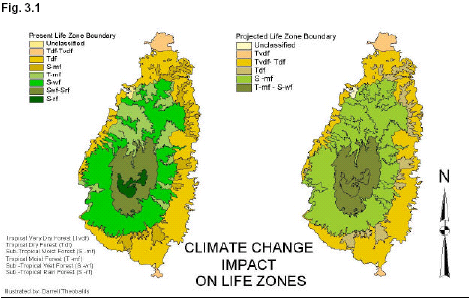


Figure 6 The Effect of Climate Change for Saint Lucia Dark Green represents Tropical

Moist Forest and pale green represents Tropical Dry forests (John, 2002)

Another study highlighting the potential threat of climate change to biodiversity was in Martinique[[40]](#footnote-40). The potential threats to mangroves from climate change were the increase in the intensity of tropical storms and rising sea levels. (Climate Change and Biodiversity in the European Union Overseas Entities- 2008).

**2. Contextual Framework**

*2.1 Background*

*2.1.1 St. Lucia’s Geography*

St. Lucia falls into the Windward group being the second largest, located 21 miles south of Martinique and 26 miles north of St. Vincent. More precisely, it lies between 60° 53' and 61° 05' West longitude and 13°43' and 14°05' North latitude. The surface area is 616 km2, with maximum length and width of 43 and 23 km respectively. It has a mean annual temperature of 21 to 27 οC which drops with increasing elevation and has little seasonal or diurnal variation. The highest point on the island (950 m) is normally about 18 οC. The rainfall pattern shows both topographic and seasonal variations. The highest average annual rainfall of approximately 4000 mm falls on the mountainous south-central part of the Island, and the lowest rainfall of about 1124 mm occur at the lower coastal regions, indicating its orographic origin. Mid-December to May is the period of lowest rainfall and June to December, rainfall is significantly higher. Approximately 50 % of territorial has marginal [[41]](#footnote-41)soils (Biodiversity Country Report, 1998).

St. Lucia is within the hot spots [[42]](#footnote-42)of biodiversity and has the challenge of reducing poverty. St. Lucia’s protected areas are called Forest Reserves and St. Lucia has the challenge to manage this resource; a resource half of which at the global level is not effectively managed (World Wide Fund for Nature, 2000)

*2.1.2. Land Tenure History in St. Lucia*

Related to occupation of land was a French law- the Napoleonic Code (St. Lucia’s UNCCD report, 2000) that legalized the ownership of land by the family. Richardson (1997) stated that this law inspired the communal tenure of land. One effect of this law was the fragmentation of lands to smaller units to facilitate individual ownership. This fragmentation into smaller units resulted in the multiplicity of land owners. Further for any action related to use of this land, there must be agreement and permission of all family members. As all family members can lay claim to lands and because of potential or real conflict amongst owners for the use of the land, the outcome of this law was reduced efficiency and economies of scale in agricultural production. Users of the land generally chose short term crops and livestock farming systems. Other factors impacting on land tenure were the absence of a legal framework for management of agricultural lands, physical economical, cultural, and educational factors, and deforestation, solid and liquid waste management, unplanned development, natural disasters, and squatting for housing and agriculture. (St. Lucia’s UNCCD report, 2000)

*2.1.3 Population Dynamics in St. Lucia*

The increase in population was another factor affecting St. Lucia’s socio economic development. St. Lucia experienced a significant increase in the population from 120,000 in the mid 1980s to approximately 160,000 in 2003 (Assessment of Poverty in St. Lucia, 2006). This linear increase in population was illustrated in figure 7. A more recent estimate stated the population at 168842 in 2005. (St. Lucia Country Poverty Assessment 2005/6 Volume 1)

Figure 7 Population Dynamics in St. Lucia from 1981 to 2003. (The X axis is of

Population and the Y axis represents year

*Source: The Assessment of Poverty in St. Lucia, Volume 11,The Macroeconomic and Social Analysis of St. Lucia, 2006.*

*2.1.4 Poverty definition and assessment in St. Lucia*

Measured as a head count[[43]](#footnote-43), the St. Lucia Poverty Assessment calculated that poverty increased from “25.1 percent in 1995 to 28.8 percent in 2005, but indigence[[44]](#footnote-44) fell substantially from 7.1 percent to 1.6 percent over the same period”. “The poverty line, which is a measure of the minimum spent per adult in order to meet basic food and non-food needs, was estimated at EC$ 13.93 (US$ 5.22) daily or EC$ 423.83 (US$ 158.74) monthly or EC$ 5,086 (US$ 1904.87) per annum. Using an estimate of 25 percent above the poverty line (EC$ 6,357.50 per annum) as the criterion of vulnerability[[45]](#footnote-45), 40.3 percent of the population was deemed to be vulnerable”.

There are other indicators and assessments that may be used to inform the government and the people of S. Lucia of the challenges to confront for economic survival. Using the framework of the UNDP Human Development Report for St. Lucia (Table 5), the human poverty index was at 6.5 in 2008 but 6.3 in 2009[[46]](#footnote-46). St. Lucia ranked twenty sixth out of one hundred and thirty four countries when the calculations were done in 2006. The gross domestic product per capita was US $ 6707 in 2008; the public debt-to-GDP ratio was about 70%, unemployment was at 18.7 % in 2005 with an inflation rate of 3.9% in 2005 and an employed labour force of 65,772.50 in 2005 (St. Lucia Government Statistics Department).

Table 5 Indicators for Human Development Index (HDI) and Poverty in St. Lucia Where GDP means Gross Domestic Product HDI means Human Development Index and GDP is the Gross Domestic Product and PPP represents Point-to-point Protocol

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | HDI value Life expectancy at birth | (%) GDP per capita (PPP US$) | Human Poverty Index (HPI-1) | 2004 Probability of not surviving past age 40 (%) 2004 |
| Value | 0.795 | 6707 | 6.5 | 5.6 |

(Adapted from Indicators for Human Poverty and Development in St. Lucia 2004 Where *(Source UNDP, Human Development Report Saint Lucia, The Human Development Index - going beyond income 2007/2008[[47]](#footnote-47)).*

It is within this context of global economic downturn and the reality of these indicators that the St. Lucian society may be described as vulnerable to a variety of external shocks including volatile tourism receipts, natural disasters, and dependence on foreign oil. For this reason it is necessary for the government to the challenge these issues by being proactive and plan to improve the condition of lives of all St. Lucians.

*2.1.5 The St. Lucian Economy and its Adaptation to Globalization*

*2.1.5.1 Agriculture, Tourism and Conducting Business in St. Lucia*

The St. Lucian economy has evolved from the production of charcoal and sugar mainly for export in the 1800s (Richardson, 1997) to bananas and coconut production in the 1940s. Banana production peaked in the 1980s with the production of 120,000 tonnes of bananas per year (Dujon, 1997)

St. Lucia is a member of the World Trade Organization since January 1 1995 (Zwaag, 2001). Due to the erosion in the trade preferences of the European Union’s import preference regime caused in part by globalization and the need to have open markets in trade based on the standards of the World Trade Organization, there was a significant reduction in the prices and revenue from the sale of bananas for banana farmers in St. Lucia. This in turn resulted in the reduction in the number of farmers and also a reduction in the volume of bananas produced. From 120,000 tonnes per year in bananas production in the 1990s, the production reduced to 30,000 tonnes per year in 2005.

St. Lucia now relies on tourism as the main source of revenue but within the context of the global economic downturn, the tourism sector is likely to face declining revenues with the actual and projected decline in the US and European travel.

The current emphasis is on marketing and promotion of St. Lucia for tourism with the focus on service and scenery of an exotic tropical island. In this regard, St. Lucia has received accolades including one from Oprah Winfrey[[48]](#footnote-48)- St. Lucia’s Piton Mountains is the one spot to visit in a lifetime. St. Lucia was also one of the leading honeymoon destinations. It was selected as the “World's Leading Honeymoon Destination” in 2008 and was selected as the best honeymoon destination in the world in 2009.

In the evolution of the St. Lucian economy from agriculture, to tourism, the St. Lucian government tried to attract investors to do business in St. Lucia. That effort and the organization of the economy resulted in the ranking of St. Lucia as the number one destination for doing business in the Caribbean and 34th in the world, out of 178 economies (Doing Business, 2008)[[49]](#footnote-49). Only Singapore ranked before St. Lucia as a small island state. All of these efforts of agriculture, tourism and foreign investor investment must have a framework of to exploit the business opportunity, conserve the environment and the same time contribute to the well being of the current and future generations of St. Lucians.

***2.2 Assessment and Management of Charcoal in St. Lucia***

*2.2.1 Agriculture and the Exportation of Charcoal*

In the 1800s St. Lucia was regarded as having “cultivable” and “worthless” land. The “worthless” category was assigned to steep areas. For this reason, agriculture was practiced in the “lowlands” and charcoal production in the highlands. In terms of agriculture St. Lucia exported sugar in the 1800 and was also renowned for its export of charcoal especially to Barbados (Richardson, 1997)

The challenges to operations in agriculture and settlement were: accessibility by roads, waterlogged conditions and steep terrain in dense forest and “landslides and landslips” associated with heavy seasonal rains, squatting on “Crown Lands [[50]](#footnote-50)and land abandoned by previous owners”.

In the 1800’s, St. Lucia also exported logwood- Hematoxlon campechianum to Britain and North America the dye was extracted and used in the metropolitan dye industries.

*2.2.2 St. Lucia Surveys and Studies on Charcoal Production and Consumption*

From 1934 to 1942 St. Lucia exported 25600 tonnes of charcoal. From 1943 to 1973 there was a sixty percent decline in the areas covered by forest. Production of charcoal after the intense period of production was 5 tonnes per year to Barbados. This report stated that there is an ecological threat caused by the need for wood for charcoal. In St. Lucia charcoal production is done by the earth clam method which is inefficient in terms of yield. The key aim of this report was to examine the ecological base, issues involved in charcoal production and the technical and feasibility study of non traditional methods of charcoal production. The findings revealed that charcoal is produced from scrub, mangrove and central forests and land clearances. They also stated the use of coconut shells for charcoal production. The volume of production was estimated as equaling to the consumption and was stated as 7500 to 8000 tonnes per annum. The yield of timber for charcoal on scrub land was one cubic meter per hectare per year, four (4) cubic metres per hectare per year for rain forest, ten cubic metres per hectare per year for pioneer species per year and Leucaena fifty cubic metres per hectare per year.

The National Household Survey of 1981(cited in St. Lucia the Manufacture of Charcoal, 1982) determined that ninety percent of all households used charcoal with a retail sale of EC seven million, a value twice as great as the retail sales from liquid propane gas (LPG). Though this survey also detailed that 55 percent of households sampled had gas and eighty five percent (85%) also cooked with charcoal, only 9 percent of the respondents of the survey cooked only with LPG, and 20 percent with charcoal only. Further, that survey reported a greater proportion of 73 percent of households with higher incomes used LPG than those in lower income. A correlation was made with the increase in use of LPG and the rise in income and a prediction made that as real incomes rise, the demand for LPG would have also increased and that of charcoal would fall.

The demand for charcoal was stated as price inelastic [[51]](#footnote-51) as it is a preferred cooking application. Despite the view that charcoal was price inelastic, the dynamics in the price of charcoal from 1970 to 1981 represented in Table number 6, shows a linear increase in the price of the medium sized bag of charcoal.

The availability of wood, returns on other jobs and inflation were mentioned as the factors affecting the supply of charcoal. The determinants for future changes in consumption are the price of charcoal, the availability and price of competing fuels, changes in real income and the likely growth in population. This report also cautioned that in a severe rise in the price for LPG or a prolonged interruption of its supply that the demand for charcoal would increase.

Table 6 The Dynamics of Price in Charcoal 1970 to 1981

|  |  |
| --- | --- |
| Year | 90 pound large bag |
| 1970 | $7.50 |
| 1974-76 | $9 |
| 1977-78 | $18 |
| 1978-79 | $24 |
| 1980-81 | $30 |

*Source: (St. Lucia The Manufacture of Charcoal, February 1982)*

That report also examined the various forms of sale of charcoal and the corresponding sizes, retail prices and the percentage of profit made. The types of container or bag, the corresponding prices and the profit made on charcoal sold were represented in Table 7.

Table7 Type, Sizes, Retail Prices and Gross Mark ups on Charcoal sold (1982)

|  |  |  |  |
| --- | --- | --- | --- |
| Type | Size (pounds) | Retail price ($) | Gross Mark up (%) |
| Small paint tin | 1 | 0.60 | 116 |
| Large paint tin | 1.75 | 1 | 96 |
| Wooden Box | 20 | 8 | 44 |
| Small bag | 30 | 12 | 44 |
| Rice/Sugar bag | 90 | 30 | 20 |

*Source: (St. Lucia The Manufacture of Charcoal, February 1982)*

In the 1980s, the producer consumed 5 to 9 percent of the charcoal produced. Thirty percent of the charcoal was then sold directly through charcoal markets and the balance- approximately 60 percent was sold through vendors. The Castries market was viewed as the most important single outlet for charcoal with full market traders as women. (St. Lucia the Manufacture of Charcoal,1982)

Transport of Charcoal in St. Lucia

That report also examined the issues related to transport. The figures quoted from producers were $1 to $3 per bag for transport. The government mileage freight rate stated was $1 to $1.40 per ton per mile that is equivalent to 0.8 to $1.15 per ninety pound bag for every 20 miles. Noteworthy is that the report noted that though the transportation costs were not significant and that the price charged per bag had inconsistencies in rates namely: for the shorter distance from Canaries to Castries the cost $3.00 per bag, but the longer distance from Saltibus to Castries cost $2 per bag. .

The technical and feasibility study recommended the use of kilns for charcoal production as the efficiency in their use would give twice as much charcoal. The recommendation was then to introduce metal kilns and develop programs in the public sector under the aegis of the Ministry of Agriculture, Forestry and Fisheries and specifically by the Forestry Division. The Forestry Division should in term focus on conserving forest and preventing excess production that would depress prices. (St. Lucia the Manufacture of Charcoal,1982)

The effects of this use resulting and potential increase in the demand and sale of charcoal was becoming more alarming as there are more pressures on forests to provide fuel wood, expansion in agricultural development together with heavy use of agricultural chemicals also aggravate downstream pollution and sedimentation problems in watersheds. (The Barbados Plan of Action for St. Lucia, 2002)

In St. Lucia the first attempts at collecting data on charcoal consumption was done by the Statistics Department. The data revealed an exponential decrease in the percentage of households using charcoal from 68% in 1980, to 28% in 1990 and finally to 12% in 2001. The table 6, 7, 9 and figure 8 illustrate the dynamics in charcoal consumption of these surveys.

One observation was that though the use of charcoal decreased island-wide from 19 % to 7 % of the households surveyed, the distribution of the consumption was not uniform for all locations Noteworthy was Anse La Raye, Canaries, Soufriere and Choiseul in 2001 where 15, 32, 17 and 18 % respectively of the households surveyed reported charcoal use.

Table 8 Distribution of households by fuels used for cooking

|  |  |  |  |
| --- | --- | --- | --- |
| Type | 1980 | 1991 | 2001 |
| Charcoal Wood | 68.9 | 28.9 | 12.1 |
| Gas | 24.5 | 68.5 | 85 |
| Kerosene | 1.6 | 1.1 | 0.2 |
| Electricity | 0.6 | 0.9 | 0.4 |
| Other/ Not Stated | 4.4 | 0.7 | 2.3 |
| Total Households | 24.733 | 33,079 | 41,481 |

*Source: St. Lucia Government Statistics Department (2001)*



Figure 8 The distribution of households by fuels used for cooking according to District *(Data from the St. Lucia Government Statistics Department)*

Table 9 District Distribution of Household by Fuel Used for Cooking and District: 1991

and 2001 (*Where for the second row 91 refers to the year 1991 and 01 refers to*

*the year 2001*)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DISTRICT | Charcoal | | Wood | | Gas/LPG | | Kerosene | | Electricity | | Other | | Not Stated | |
|  | 91 | 01 | 91 | 01 | 91 | 01 | 91 | 01 | 91 | 01 | 91 | 01 | 91 | 01 |
| percentage of households | | | | | | | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Castries | 13.9 | 4.7 | 3.2 | 1.6 | 80.1 | 88.2 | 1.2 | 0.3 | 1.0 | 0.5 | 0.7 | 1.0 |  | 3.7 |
| Anse La Raye | 44.2 | 15.5 | 6.2 | 4.1 | 46.6 | 75.2 | 0.8 | 0.1 | 1.0 | 0.3 | 1.2 | 1.4 |  | 3.3 |
| Canaries | 69.8 | 32.2 | 4.2 | 1.7 | 24.2 | 63.0 | 0.4 | 0.2 | 1.4 |  | 0.0 | 2.5 |  | 0.4 |
| Soufriere | 31.3 | 17.6 | 15.2 | 7.7 | 52.1 | 72.1 | 0.3 | 0.2 | 0.5 | 0.3 | 0.6 | 0.7 |  | 1.4 |
| Choiseul | 27.4 | 18.1 | 33.1 | 14.2 | 33.9 | 65.5 | 4.6 |  | 0.5 | 0.1 | 0.5 | 1.2 |  | 0.9 |
| Laborie | 23.3 | 9.1 | 24.8 | 7.3 | 50.8 | 80.3 | 0.4 | 0.2 | 0.1 | 0.1 | 0.6 | 0.8 |  | 2.3 |
| Vieux Fort | 15.6 | 4.6 | 11.9 | 5.6 | 69.5 | 86.9 | 1.6 | 0.1 | 0.6 | 0.3 | 0.8 | 1.2 |  | 1.2 |
| Micoud | 16.8 | 5.9 | 12.5 | 5.3 | 68.7 | 87.1 | 0.5 | 0.1 | 0.7 | 0.1 | 0.7 | 0.6 |  | 0.9 |
| Dennery | 25.7 | 7.6 | 9.4 | 6.1 | 62.9 | 83.2 | 0.9 | 0.2 | 0.4 | 0.2 | 0.8 | 1.1 |  | 1.6 |
| Gros Islet | 15.3 | 3.5 | 7.4 | 2.3 | 74.4 | 90.1 | 0.7 | 0.2 | 2.0 | 1.0 | 0.3 | 0.8 |  | 2.1 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Total Island | 19.6 | 7.0 | 9.2 | 5.1 | 68.5 | 85.0 | 1.1 | 0.2 | 0.9 | 0.4 | 0.7 | 1.0 |  | 1.3 |

*Source Saint Lucia Government Statistics Department*

In the UNDP Energy Sector Management Assistance Program (1984) report was presented an the energy plan for St. Lucia. That plan detailed four main issues for management: supplies, policy, demand and institutions. One of the major issues under supply was fuel wood and, geothermal power development and hydropower development. The policy issues considered were of petroleum prices and power tariffs. For demand the energy plan considered an opportunities in energy conservation. Finally consideration was given to institutional issues amongst all the institutions that manage the energy subsectors.

This report also identified a national survey in which the total charcoal consumption was estimated at 7300 tonnes a year. Most of the charcoal used is claimed to be sourced from scrublands.

From the forests was identified an average sustainable yield of 40000 m3 of wood. The limitation to obtaining this wood was access to supply charcoal and fuel wood, short rotation fuel wood plantations and improved management of existing forest were the recommendations of the mission to improve the quantity of wood supplied. In addition, the report recommended steps to improve the efficiency of carbonization/ production of charcoal production through use of portable kilns and modified earth kilns to charcoal producers. The plan for afforestation on public and private lands was to plant 90 ha of commercial species and 12 hectares (ha) of fast growing species- mainly Leucaena leucocephala. The yield for Leucaena was estimated at 50 m3/ha and expansion of Leucaena plant 400 hectares (ha) or a minimum of 90 hectare (ha) would have been needed by 1992. The report also recommended that the establishment of the fuel wood plantations be best carried on private landowners’ lands and that government should try to generate interest through educational campaigns.

For the demand issues, the recommendation was to experiment with improved efficiencies with the local coal pots. Also recommended for investigation was of the structure of production, transport, trading and end use of charcoal and fuel wood and to develop a policy and program for effective management of forest resources. Coconut shell and stem wood were also mentioned as potential sources of biomass for charcoal. The total area with coconuts was 9300 hectares and the estimated supply per year from stem wood is 2700 tonnes per year. One problem identified with the charcoal from coconut stems was that it was less dense than charcoal from other trees, that it was doubtful whether it would be adopted by “the country’s discriminating users” and a large scale organized operation was a prerequisite to be a feasible activity.

Charcoal production was described as carried out island wide and unregulated. Production was described as carried out in forests near roads. Part of production was used by the producer and the remaining brought and sold in the main coal market in Castries for EC $ 30 per 90 pound sack (US$272/ tonne) and in small tins containing two pounds for EC $ 1.25 (US $59 /tonnes). At the time, prices were described as highly notional but had not changed for “for a few years”. The report also state that charcoal in tin was quite expensive- even comparable with electricity at the time but, that purchase of the bag made cooking costs cheaper and comparable to gas (LPG). The cultural dimension of charcoal was highlighted when the report noted a preference for charcoal as a cooking fuel even among the higher income households using LPG. Another factor influencing the choice of fuel was the investment necessary to buy a stove compared to $EC 25 to purchase a coal pot.

For the demand issues, the recommendation was to experiment with improved efficiencies with the local coal pots. Also recommended for investigation was of the structure of production, transport, trading and end use of charcoal and fuel wood and to develop a policy and program for effective management of forest resources. In the 1982 report- the Manufacture of Charcoal, the Forestry Department again was cited as the agency with the responsibility to formally monitor the activities of charcoal makers and to control the indiscriminate cutting of trees. It was also proposed for management to have cooperatives jointly produce charcoal from portable kilns (UNDP Energy Sector Management Assistance Program Report, 1984).

In a survey of the Castries Market for five days in 1986, Lyndon John calculated that a total of 27680 pounds of charcoal entered the market place to be sold. In this study the main issues in charcoal sold at the market were that ninety percent of the vendors were charcoal producers, that women were the members of the family responsible for the sale of charcoal, that the price of charcoal was not stable owing to competition amongst vendors at the market. Table 10 details the sizes of bags produced. At the time of the study the medium 50 pound bag was the main type of bag used to sell charcoal, followed by the large 90 pound bag and then the 30 pound bag. In terms of location as can be seen in Table 11, main source of charcoal sold was from the Northern range (68%) followed by Dennery, Micoud in the Quillese range and then Canaries of the Millet range (John, 1986)

Table 10 Number and Weight of Charcoal Bags in a survey of the Castries Market

Quantities in 1986

|  |  |  |
| --- | --- | --- |
| Size of Bag | Number of bags | Total Weight of bag in pounds |
| 90 | 79 | 719 |
| 50 | 392 | 19600 |
| 30 | 40 | 1200 |

*Adopted from Lyndon John’s Investigation of Castries Charcoal Market- Carried out from 29/4 to 8/5 1986*

Table 11 Distribution of Quantity of Charcoal Brought into the Castries Market 1986

|  |  |
| --- | --- |
| Location | Total Quantity of Charcoal brought to Market (pounds) |
| Gros Islet | 12235 |
| South Castries | 99 |
| Baboneau | 5400 |
| North Castries | 300 |
| North Total | 18845 |
| Micoud | 2250 |
| Canaries | 1480 |
| Dennery | 3500 |
| Wholesale | 1605 |
| Total | 27680 |

*Adapted using data from Lyndon John’s Investigation of Castries Charcoal Market- Carried out from 29/4 to 8/5 1986*

A sociological survey in 1992 examined quantitative aspects of charcoal production in St. Lucia. The general trend observed was a decrease in the total consumption of charcoal per household with more rural households purchasing charcoal than producing it. It also revealed that 85% of rural households buy charcoal; that 15% produced at least half of the supply and that rural households consumed 1 to 2 bags of charcoal per month equivalent to 400 to 600 pounds of charcoal per year. The study stated that to 8.6 pounds of fuel wood to one pound of charcoal. This conversion rule was applied and calculated that the total fuel wood consumption per year was “3500 to 4500 pounds.” The preferred species determined in this study were Log wood or Capeche (Haematoxylum campechianum) and Gliricida (Gliricida sepium). The study also examined some of the processes involved in charcoal production by producers. The survey recorded that it took 1 to 2 hours per day to collect a week supply of fuel wood and 2 people working 2 to 3 hours for 1 week to collect a two month supply of wood to make charcoal. Also noted was a decrease in use of charcoal, this was owing to the increase in communication, education level and rise in economic level as well as the availability of the bottled liquid propane gas (LPG).

Smith (2002) also cited the decrease in use of charcoal in 2001. He cited the explanation given by CIDA in the sociological survey, as reasons for the decrease in the use of charcoal. He used three sets of data: compiled data from a 2001 and 2002 survey on consumption and production and data from a study of the Makote mangrove in Aupicon. Smith (2002) cited “Wilkinson (1983)”, in a household survey of 358 households with an average annual consumption of 727 pounds of charcoal per year. The annual consumption was 6200 pounds of charcoal (Wilkinson cited by MALF, 1992)

Smith’s analyses of the data indicated that the annual production of charcoal was 629815 kg island-wide (Table 12). He used the average weight of the bags reported in the survey to calculate the average weight of bags sold to consumers (Table 13).

Table 12 The bags Sizes most commonly used for packaging of Charcoal

|  |  |  |  |
| --- | --- | --- | --- |
| Original Size of flour bag Pounds (lbs) | Original Size of flour bag Kilograms (kg) | Average Weight of Charcoals pounds (lbs) | Average Weight of Charcoals Kilograms (kg) |
| 50 lb |  | 30 |  |
| 90 |  | 47 |  |
| *75* |  | *75* |  |

*Adopted from Report by Allan Smith Report on production and consumption of charcoal in St. Lucia to the FAO 2002*

Table 13 Charcoal production estimates for St. Lucia from 2001 and 2002 surveys

|  |  |  |  |
| --- | --- | --- | --- |
|  | North | West | South/East |
| Annual production (lbs) | 195888 | 275844 | 913861 |
| Annual production (kg) | 89040 | 135383 | 413391 |
| Island Total (lbs) | 1385593 | | |
| Island Total (kg) | 629815 | | |

*Adopted from Report by Allan Smith Report on production and consumption of charcoal in St. Lucia to the FAO 2002*

Based on the conversion factor 35kg of charcoal per m3 of wood, Smith claimed that the results from the surveys for 1982 and 2001 survey “were overestimated” given the total annual consumption is estimated to be 7,6229,958kg for 2001 compared with estimated annual consumption of 8,173,132kg in the early 1980s. He explained that there was a small difference of 629,815kg in consumption and this level of consumption would need more than 217,000 m3 of wood from to sustain consumption (Table 13).

Charcoal production was also identified as a cause of loss to biodiversity in the National Biodiversity and Action Plan (NBSAP) for St. Lucia. (National Biodiversity Strategy and Action Plan of St. Lucia, 2000)

*2.2.2.1 Woodlots to Supplement the Supply of Charcoal*

Another alternative to resolve the supply of charcoal in St. Lucia was to introduce the exotic Leucaena leucephala. In 1991, there was a charcoal Project in Aupicon near Makote Mangrove to improve the woodlot supply of charcoal. This was done in the 1970s by the Forestry Department. This supply of Leucaena was meant to provide more wood throughout the year. It was particularly important to charcoal producers from mangroves as the mangroves would be flooded in the wet season. In this way Leucaena would address the seasonal variations and patterns in resource use.

Table 14 Locations where Leucaena plots were established

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Attribute | | | | | | | |
| Location | Louvet | St. Urbain Aupicon | Dennery Fon D’or | Dennery  La Ressource | Dennery  Parisoe | Choiseul | Vielitte |
| Area (acres) | 25 | 25 | 9 | 6 | .03 | .25 |  |
| Date Planted | 1983 | 1977, 81,83 | 1988 | 1988 | 1980 | 1979 |  |

From 1979, 60 acres of Leucaena were established in St. Lucia by the Forestry Department for the purposes of supplying fuel wood to the community and for soil conservation. These plants were successfully established in dry marginal lands around the island. Table 14 gives the locations of these Leucaena plots that were established in St. Lucia. The Leucaena variety named K-8 [[52]](#footnote-52)was used giving 214 cubic metres of wood equivalent to 39 tonnes of charcoal per hectare in five and a half years (Batson, 1987). A Report on the Leucaena Project Activities from 1982 to 1988 in St. Lucia, 1988 Forest and Lands Department

Although Leucaena was cited as invasive species, it was introduced since the early seventies and no studies have been done in St. Lucia of its impact on biodiversity. One study was done in Puerto Rico to examine the impact of this plant on biodiversity. The study of Leucaena leucocephala was in two (2) 45 to 50 year study areas: one with canopy maintained consisting of houses and farmland, and the other with the canopy removed consisting of charcoal pits and mature forest sub tropical dry forest in Puerto Rico. Leucaena dominated growth where the canopy was removed. Significant is change of species composition and modification of the landscape in this setting in the long term. The forest cover was not altered (Lugo, 2006 ).

The mangrove was the other site which has been exploited for charcoal. There is an area in Vieux Fort referred to the as the Pointe Sable Management Area (PSMA) which is land owned by the government of St. Lucia but vested in the St. Lucia Air and Sea Ports Authority (SLASPA) and the National Development Corporation. This Makote mangle was declared a protected area in 1986 and in an informal agreement with government; the Aupicon Charcoal Association and Produce Growers (ACAPG) were given sole access rights.

Together with the agency named CANARI (Caribbean Natural Resource Institute) the Aupicon Charcoal Association and Produce Growers (ACAPG) were investigations to solve the problems of sustainability in the harvesting of wood from the mangrove to make charcoal. In 1999, working with Allan Smith of CANARI, a number of permanent circular quadrats were established employing “a stratified random sampling” of vegetation in which quadrats of 0.1 acres in area (0.04ha). All the trees above 25 millimetres (mm) in diameter at breast height (dbh) were recorded. The plots were to be re-measured once a year. The Man Whitney test was used in the analysis of the results. The results established an agreement on the cut limits of mangrove trees for charcoal use. With the adoption of the prescribed treatments, there was an in increase in the density of basal area of the mangrove and harvesting was sustainable.

There were a number of problems encountered in the project for charcoal production by the ACAPG in Vieux Fort. Walters (1991) detailed the following experiences relevant for future efforts in charcoal production especially at Makote: that centrally planned and implemented resource management strategies fail to conserve resources and meet the development needs of the majority because of the “top down” approaches that served as a disincentive to the local people as the environmental and social and economic and cultural conditions were not factored into the action plans. The resulting inefficiencies and created barriers to effective implementation. He also cited the limitations of the Forestry Department’s “meager budgets” and limited capacity that made it unable to cope effectively with increased demand and competition over diminishing natural resources. The recommendations then for effective project planning and implementation were:

1. There should be technical planning and monitoring of work to be undertaken.
2. The institutional priorities and capabilities of implementing agencies should be reasonably compatible if the project is to be co- managed. Though agencies involved in coordinating and implementation and management of the project were Caribbean Natural Resource Institute, Forestry Department, Aupicon Charcoal producers, and the National Development Corporation, there was little payoff in terms of formalization and finalization of tenure over the plantation or mangrove by the producers. The Forestry Department was also accused of having ill suited methods to work with community user groups. Therefore responsibilities of implementing agencies and local community groups must reflect within the framework of existing institutional capabilities.
3. There must be a harmonization of agendas if significant project responsibility is to be shared between different implementing agencies.
4. Determination of the social factors: perceptions, priorities, community development issues, or use of demonstrations plots
5. Economic and financial analyses made and especially of the profit to be made.
6. Institutional roles and responsibilities are clear detailed in terms of the current capabilities, ownership, tenure and security, management communally or individually oriented strategies and building on existing structures.
7. For project management, the lessons learnt section detailed the following experiences relevant for future efforts in charcoal production especially at Makote
8. The implementing agency should not assume too much project responsibility for threat of stifling local initiative and hindering the development of local responsibility. The Forestry Department was accused of creating an unhealthy dependency with the management of the Leucaena plots.
9. Local knowledge and expertise are a valuable source of practical information and skills that should be utilized fully in all aspects of planning and implementation of work.
10. Monitoring should be incorporated into local level management programs to enable communities to demonstrate ecological sustainability of community based management as well as the economic value of natural resource to community development.
11. The impacts on policy are difficult to assess and government management agencies are generally slow to responds to novel approaches. Notwithstanding this situation, the writer noted that with persistence that government agencies are receptive especially when timing is factored and when the right contact persons are established in the early phases of operation and relationships maintained. (Walters, 1991)

Another study by Hudson Brett[[53]](#footnote-53) with a focus on the socio economic aspects of the community based management of the Aupicon Charcoal Producers at Makote, had the methodology of a transect of work area, observation, group interview, diagramming, seasonal calendars, focus group meeting and triangulation of information to assess the perception and views of members. The Fisheries Act empowered this group to through the formation of “local management authorities” with powers of arrest within the Makote Mangrove.

Hudson Bret detailed the following aspects related to cost of charcoal production: the hourly rate for payment was $5.40/hr. Persons worked for 3 to 5 hours per day with a total of $500 to $600 / month or in 2 weeks work $600. Hudson also gave the alternative pay of working for 20 days and making $900. He also worked out that the salary of $68.63 per day was comparable to any other as there was less work.

The work involved the following tasks: burn time, monitoring time and the loading of the charcoal to market. (Hudson Bret)

Espeut (2006) also examined charcoal production of Makote and the complementary project to supplement the supply of charcoal wood using Leucaena, Gliricida from nearby plots for the Aupicon Charcoal producers. There were a number of problems encountered in that project.

In an OECS study, Espeut (2006) first analyzed geo-referenced data on unemployment, poverty and settlement, land tenure and disposal of waste and the problems associated with livelihoods of users from charcoal production from two (2) main mangrove species: White Mangroves- *Laguncularia racemosa*, and Buttonwood- *Conocarpus erecta* in the 63 acres large mangrove named Makote. The problems encountered in the management of the Makote mangrove were:

1. “fewer members cutting charcoal- only 6 members in a meeting in March 2004;
2. there is no enforcement of the agreement between government and ACAPG;
3. less mangrove now;
4. there is a vine taking over the mangrove;
5. the agreed coppicing method was not followed;
6. 12 non members cutting illegally and unsustainably”.

Espeut (2006) made the following recommendations for sustainability in the Makote area:

1. Makote must be brought under the active management.
2. Either ACAPG resuscitated with the return again to the agreed procedure or no further cutting in Makote allowed.
3. White and Button wood mangroves should be planted.
4. Study on why tourism failed, and based on the findings a new tourism strategy should be prepared and implemented.
5. An education program
6. Building a watchtower

(Espeut, 2006)

*2.2.3 St. Lucia’s Policy framework for Biodiversity Management*

In 1991 (St. Lucia UNCCD report 2000) through a review of environmental laws of Commonwealth Caribbean done by Caribbean Law Institute (CLI) commented that the legislative infrastructure in St. Lucia was outdated and inadequate to cope with the current problems, they also reported “ the commendable” efforts made to conserve biodiversity by acceding to relevant international conventions and implementing their provisions. The report concluded that what was left to do was the enforcement of existing laws and regulations for more effective management of problems.

The main conventions ratified by Saint Lucia and which are directly related to the GEF SGP which are as follows:

1. United Nations Convention on Biological Diversity;
2. United Nations Framework Convention on Climate Change;
3. The Kyoto Protocol to the UN Framework Convention on Climate Change;
4. United Nations Convention to Combat Desertification;
5. The Stockholm Convention on Persistent Organic Pollutants;
6. The Convention concerning the Protection of the World’s Natural and Cultural Heritage.

Though Saint Lucia met its obligations in terms of timely production of reports under these conventions “the recommendations into concrete actions on the ground is slow.” The reasons given for this problem in the slow pace of implementation is “the lack of adequately trained staff, inadequate financial allocations and political priorities.” The following critic of the legal and policy framework in St. Lucia by the UNCCD sponsored Country Program Strategy 2007-9 claimed that the principal policy instrument for environmental conservation and sustainable development-the Constitution of Saint Lucia and in the OECS Constitutions “is silent on environmental management and integrity”.

The Country Program Strategy noted 25 pieces of legislation that dealt directly or indirectly with the environment. They include The Physical Development and Planning Act Number 29, 2001; the Forest, Soil and Water Conservation Ordinance of 1946; the Fisheries Act of 1984; the Wildlife Protection Act 1980; and the Saint Lucia National Trust Act Number 16, of 1975.

The Country Program Strategy stated that “in recent times” that “the single most important cohesive policy on environment and sustainable development came from the National Environment Policy and National Environmental Management Strategy of Saint Lucia [[54]](#footnote-54)(NEPNEMS)”. The NEP NEMS (Cited in the St. Lucia Country Program Strategy 2007) stated that the GOSL needed to complement this policy framework to include the documentation on: Climate Change, Coastal Zone Management, Forest Conservation, Marine Management, Persistent organic pollutants (POPs), and Land Degradation.

One problem identified in the implementation of the Country Program Strategy was that various policies and pieces of legislation were a complex institutional nexus with more than one agency responsible for the environment or a specific resource. This resulted in overlapping responsibility, and conflict in use with the outcome of this is ineffective and inefficiencies in management of resources. The absence of an effective mechanism for genuine public consultation was also considered as a deficiency in environmental policy formulation in Saint Lucia.

*2.3 Experience of the Forestry Department in use of Participatory Approaches*

Michael Andrew, the current Chief Forest Officer indicated that in one of the reasons for failure in implementation of earlier recommendations related to charcoal production in the 1980s and early 1990s was owing to a limited capacity in the quality and quantity of trained staff and because the priority at that time that was allotted to preserve the boundary of forest, removal and restriction of squatting in the forest. He explained that the first Chief Forest Officer was the only person with formal training in forestry at the diploma level in the early 1980s. Based on the 2010 Forest Resource Assessment (FRA, 2010) there are currently more trained people in the Forestry Department that had up to fourteen people with degrees.

Walters (1991), also detailed the issue of human capacity in the Forestry Department in the study of Makote mangrove. Walters stated that the Forestry Department committed many technical faux pas that resulted in the ability to have healthy plants at Aupicon; that they had “ill suited methods to work with community user groups”; and that the responsibilities of implementing the project created an unhealthy dependency with the management of Leucaena plots that stifled local initiative and hindered the development of local responsibility. This occurred because the Forestry Department invested both time and capital in planting and maintenance of the plot without allowing the group to take ownership and implement the project.

Another case study in St. Lucia that showed that the Forestry Department had capacity in reference to skills using the participatory approach and research in solving problems related to natural resource management that contributed to the revitalization of the Latanye broom industry. The Latanye broom is made from the leaves of the palm *Coccothrinax barbadensis*. A socio economic study by John (2002) of the Forestry Department detailed the vulnerable nature of the Latanye Broom Industry. There was also collaboration with the government services- Forestry and Extension, St. Lucia Representative (SLREP), Ministry of Commerce, Ministry of Planning, St. Lucia Bureau of Standards, Broom Producers and Exporters, Agro- processing organization- Baron Foods and Non Governmental Organizations in planned activities using the mechanism of a task force. The objectives and activities of the task force were guided by a mandate (Gustave, 2005). This work also highlighted the capacity existing within the Forestry Department and other governmental, non-governmental and community groups for St. Lucia in an integrated approach for sustainable management of natural resources (Gustave, 2006).

The entire process for Latanye leaf and broom production involving the stakeholders may be considered as a poverty reduction strategy (PRSP) without investments of the World Bank and the International Monetary Fund (IMF) or loans from local banks (World Resources, 2005). This experience was selected as a case study in a liaison group meeting organized by the Global Strategy for Plant Conservation in 2006 the Subsidiary Body on Scientific, Technical and Technological Advice of progress in the achievement of the Global Strategy on Plant Conservation targets. The work done on Latanye was also featured by the Food and Agriculture Organization under “Readers Research” for non timber forest products.

*2.4 Biodiversity Awareness in St. Lucia*

Two surveys in 2001 and 2003 confirmed the importance of environmental education in creating awareness and changing attitudes of people towards conservation issues in the environment. In 2001, the Attitudes Towards Hunting and Development of National Wildlife Policy publication revealed that St. Lucians had changed their attitude towards hunting in which there was the prevalence of hunting to one that they do not condone hunting (John, 2001). This change resulted because of the program of protection, monitoring, restoration of wildlife stocks and an effective public education program. Other countries such as Dominica, Puerto Rico, St. Vincent, Grenada, the islands of the South Pacific, and South Africa, under the auspices of Rare Centre for Tropical Conservation have tried to use the strategies used by St. Lucia to improve the situations of conservation of wildlife resources.

Some of the strategies used in the past, included programs for school children, for environmental action groups and community based organizations and for the public and visitors. For the children, programs centered on school visitations using animations of wildlife in Saint Lucia – Zando[[55]](#footnote-55), Iguana for lizard and Jacquot[[56]](#footnote-56), the Saint Lucia National Bird, the Parrot were used for forest conservation. The target group was students in primary and secondary schools. For students in Forms 1-3 in Social Studies, a LEAP (Learning for Environment Action Program) Kit was also developed to help school children develop action oriented approach to learning about the environment. In addition River and Forest kits were also developed to generate interest specific to rivers and forests.

At the community level, community based organizations and environmental action groups were formed. Noteworthy, groups included the TEAM- Teachers Environmental Action Movement, “TREES”[[57]](#footnote-57), and the Talvern and Thomazo Water Catchments Groups. The first two groups published teachers’ newsletters, engaged in various projects including development of school gardens and the latter two were engaged in watershed management to improve water quality. Even a forest extension manual has been produced to work with communities. For local and visitors to St. Lucia, educational materials- trail guides, brochures and booklets have been produced.

Though the second publication in 2003, also revealed that a high percentage of respondents knew the importance of forests (98%) and biodiversity (67%), the two surveys mentioned revealed that there are many challenges and gaps that an environmental education strategy and action plan should address in Saint Lucia. Some of the challenges include understanding and addressing the biodiversity issues of the impacts of specific activities on habitats and wildlife. Examples of these activities were charcoal production, sand mining, wetland reclamation, farming, residential development and deforestation. and the concomitant demands made by society to use the natural resources for survival. Moreover the St. Lucian society has to prepare at the cognitive level to prepare to manage the challenges of the impact of climate change and other natural disasters.

*2.5 Trends in the Use of Charcoal globally.*

Table 15 detailed the issues related to charcoal production in various countries mainly with Haiti in the Caribbean and the others from Africa. Each issue that was observed was given a heading and presence and absence of the issue was indicated using the number one (1). The numbers were then totaled. Based on the literature review, the most outstanding issue recorded globally related to charcoal production was the loss of the livelihood. The latter, the countries of origin and other cause and effect issues were presented in Table 15.

Table 15 The Causes and Effects of Charcoal production Globally

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Country | Year | Civil Conflict/ conflict of interest | State Prohibition of Charcoal Making | Lack of trained personnel | Short rainy season | Extreme heat/  Drought | Flood | Deforestation | Land Degradation | Food shortage | Children are not attending School | Loss of Charcoal livelihood | Creation of Charcoal Livelihood |
| Democratic Republic of Congo[[58]](#footnote-58) | 2008 | 1 | 1 |  |  |  |  | 1 |  | 1 |  | 1 |  |
| Haiti[[59]](#footnote-59) | 2009 | 1 |  |  |  |  | 1 | 1 | 1 | 1 |  | 1 |  |
| Kenya[[60]](#footnote-60) | 2008 |  | 1 |  |  |  |  |  | 1 |  | 1 | 1 |  |
| Mauritania[[61]](#footnote-61) | 2008 |  |  |  |  | 1 |  |  | 1 |  |  | 1 |  |
| Senegal[[62]](#footnote-62) | 2006 | 1 |  |  |  |  |  |  |  |  |  | 1 |  |
| Senegal Ziguinchor [[63]](#footnote-63) | 2007 |  |  |  |  |  | 1 |  |  |  | 1 | 1 |  |
| Somalia, Hargeisa[[64]](#footnote-64) | 2008 |  |  | 1 |  |  |  | 1 | 1 | 1 |  | 1 |  |

Table 15 Continued Causes and Effects of Charcoal production globally

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Country | Year | Civil Conflict/ conflict of interest | State Prohibition of Charcoal Making | Lack of trained personnel | Short rainy season | Extreme heat/  Drought | Flood | Deforestation | Land Degradation | Food shortage | Children are not attending School | Loss of Charcoal livelihood | Creation of Charcoal Livelihood |
| Somalia[[65]](#footnote-65) | 2008 |  |  |  |  |  |  |  | 1 |  |  |  | 1 |
| Sudan[[66]](#footnote-66) | 2008 |  |  |  |  |  |  |  |  |  |  | 1 |  |
| Russia[[67]](#footnote-67) | 2008 |  |  |  |  |  |  |  |  |  |  |  | 1 |
| Zambia[[68]](#footnote-68) | 2008 |  |  |  | 1 | 1 | 1 |  |  |  |  | 1 |  |
| Total |  | 3 | 2 | 1 | 1 | 2 | 3 | 3 | 5 | 3 | 2 | 9 | 2 |

One notable explanation for charcoal production was that it was an adaptation of people to their economic situation as evidenced in Zambia’s National Adaptation Program of Action plan (NAPA, 2007). There was a component in this plan that examined the relationship between water and the energy sector. Examination of Table 16 showed how charcoal production was generally considered as a coping strategy for varied conditions in the availability of water for income diversification for money to buy food and to cope with crop losses.

Table 16 Conditions for which Charcoal is used as a coping strategy for survival.

|  |  |
| --- | --- |
| Water availability Condition | Coping Strategy |
| Drought | Income diversification for money to buy food |
| Floods | Income diversification for money to buy food |
| Extreme heat | Income diversification for money to buy food |
| Short Rainy Season | Income diversification- charcoal production to cope with crop loss. |

*Source of Zambia, Tourism, Environment and Natural Resources, September 2007*

**Methodology**

The aim was to interview all charcoal producers in 2002 and 2009. In 2002, a total of 92 producers were interviewed and 214 in 2009.

The data from 2002 and 2009 survey was classified was classified under three headings:

1. Site and biophysical characteristics
2. Demographic and Cultural Factors
3. Socio Economic Factors

1. The data from the Charcoal survey of 2002 was from- Allan Alexander-a student pursuing a master’s degree in natural resource management at the University of the West Indies in 2001. That study was collaboration with the Forestry Department and the Food and Agriculture Organization (FAO) on charcoal consumption and production in St. Lucia. Only a preliminary report on the level of consumption and production of charcoal use was done by Allan Smith (2001). That data was analyzed using SPSS version 10.1 software within the framework presented in Table 17.

Table 17 Factors affecting stakeholders in the Charcoal

|  |  |
| --- | --- |
| Level of Information | Questions covered |
| Demographic  and  Cultural Factors | -Sex  -Age  -Education level  -Experience  -Professions  -Alternative employment |
| Economic factors | - Income,  -Production , timing of production, and sale, prices of charcoal, frequency of use, quantity of wood sold- |
| Site Characteristics | -Difficulty in Obtaining Charcoal  -Source of Charcoal  -Wood used type of bag produced, extraction, transport, distribution  -Preferred wood used  -Perception of impact of the charcoal production  -Method of Harvesting |

The independent variables were the five ranges: Millet, Northern, Dennery, Soufriere and Quillese.

Descriptive analyses of total of responses and respondents including the mean average and error were done. Graphs were also used to illustrate the results.

For questions involving yes or no responses, the bivariate tests were performed. All the respondents’ responses were placed in one column and compared to the five locations. The option of Cross Tabulation was then done by placing the locations in Rows and responses in Columns. The Chi square test was also selected in this function or analyses were done using the mean to observe where there were differences in the data. The same analysis was performed with discrete variables pertaining to the question of, production of “same, more or less” quantity charcoal, method of harvesting of wood: “clear fell or selective fell”, and the duration of production : “less than a year”, “one to three years”, and “more than three years”.

For continuous variables, the data was tested for homogeneity of variance, and in function of the result, a test of Analysis of Variance was performed for if the data was normally distributed and non parametric tests were performed if the data was not normally distributed. Kruskal Wallis test were the non parametric tests performed.

For each response involving multiple responses, a list the responses was made and copied in separate columns horizontally. The locations were placed in one column. For each questionnaire, the response of the location was placed in the column and the number one (1) placed in the column associated with the response of the respondent in the horizontal column. One table of absence and presence was prepared in this way for each question.

The total sum of occurrence for the each was totaled for each range. Then one composite table was prepared of one column with the title location and the five ranges ( of Millet, Northern, Dennery, Soufriere and Quillese) and the other columns represented the responses for occurrence.

The Cluster Analysis was then used to determine similarity and dissimilarity amongst the ranges. The Cluster Method of “Furthest Neighbour”, the Measure Interval Squared Euclidean Distance and the Label by Case of the five ranges Millet, Northern, Dennery, Soufriere and Quillese was used. A dendrogram was generated.

In function with the subgroups identified by the Cluster Analysis, Discriminant Analysis was used to determine the variables/attributes differentiated the sub-groups. The Grouping variable was the Location of Millet, Northern, Dennery, Soufriere and Quillese, or subgroups of locations that were predefined. This analysis was done for the questions pertaining to the 2002 data for: Professions of charcoal producers, Preference of Wood Species, Wood species used and Difficulty to obtain Charcoal.

In function of the independent variables of the five locations and the parameter analyzed, the Extraction method of Principal component was used using eigenvalues over 1, the factor analysis rotation method of Varimax was used to determine the variables contributing mostly to the variability in the data. This analysis was done for the questions pertaining to: Preference of Wood Species, Wood species used, Difficulty to obtain Charcoal.

2. The questionnaires and interviews were conducted from April to July 2009 in the five ranges: Millet, Northern, Dennery, Soufriere and Quillese. The other Forestry Department’s officers who assisted in the data collection were: Margaret Severin, Chris Sealys, Nerius Mitchel, David Lewis and Odetta James. The questionnaire was attached in Appendix number 7.

The data from the Charcoal survey of 2009 was analyzed using the SPSS version 10.1 software for the variables identified in Table 17:

1. Based on the observation that some respondents indicated that they did participate in various stages of in the production of marketing (that is of extraction, production, distribution, transport, sale) but did not give sufficient quantitative data, their contribution to the process was given a value of 1. This value was treated as a count either as a person or as a monetary form e.g. as $1. In the cases where information was given the responses were recorded. In the case where there was no response this was recorded as “no answer” (NA).
2. The data was standardized for: extraction, production, distribution, transport, and for sale.
3. Extraction: when payment or purchase was done in bags of charcoal, the quantity of bags was multiplied by the average price of $35.
4. Production: when payment or purchase was done in bags of charcoal, the quantity of bags was multiplied by the average price of $35.
5. Transport: when payment or purchase was done in bags of charcoal, the quantity of bags was multiplied by the average price of $35.
6. The total distance travelled was divided by the cost of the stated or calculated in monetary values expressed as cost per mile.
7. Distribution: all forms of distribution stated were represented.
8. In terms of marketing the charcoal: directly, to a middle man, to a market vendor the percentage of profit made was calculated as a percentage expressed as the mark up by the respondent.
9. For each questions of
10. “Distribution of Charcoal: price purchased and price sold”.
11. “Sale of Charcoal: price purchased and price sold”.
12. “Professions” of charcoal producers directly, using a middle man or a market vendor: the response of the location was placed in the column and the number one (1) placed in the column associated with the response of the respondent in the horizontal column. One table of absence and presence was prepared in this way for each question.

The total sum of occurrence for the each was totaled for each range. Then one composite table was prepared of one column with the title location and the five ranges (of Millet, Northern, Dennery, Soufriere and Quillese) and the other columns represented the responses for occurrence.

1. Descriptive analysis of total of responses and respondents and the frequency of responses was then done. Graphs were used to illustrate the results.
2. For questions involving yes or no responses, the bivariate tests were performed. All the respondents’ responses were placed in one column and compared to the five locations. The option of Cross Tabulation was then done by placing the locations in Rows and responses in Columns. Analysis of the distribution of the mean and or Chi square test was also selected in this function. The same analysis was performed with discrete variables of sex, age range, production of “same, more or less” charcoal.
3. Comparisons of data for 2002 and 2009 were done in the following areas:
4. Quantity of bags of charcoal produced or sold.
5. Alternative professions associated with or stakeholders in the charcoal business.
6. Experience in Charcoal production
7. Regression analysis using the dependent variable of “Price” and the independent variable of “Year” was used to determine the most appropriate mathematical function of the trend in the prices of a ninety (90) pound bag from 1973 to 2009. The linear and logarithmic models were tested. Other statistical indicators used in the regression of analysis were ANOVA, error, statistical significance, and the model fit R squared.

3. Interviews were conducted with Forestry Department personnel, Fisheries Division of the Ministry of Agriculture Lands, Forestry and Fisheries and interviews were conducted with the approaches and challenges in trying to manage charcoal production.

4. Literature was consulted on the local, regional and international approaches and challenges in trying to manage charcoal production.

5. The limitations to the current study in terms of the methodology were then presented.

**Multivariate Statistics**

Factor analysis

There are two ways to represent this type of analysis: component analysis and factor analysis. Techniques are used to analyze interactions between many variables and explain these variables in terms of their common underlying dimensions or factors. The goal is to gather information on a reduced set of variables and hence maximizing the use of data and minimizing data loss. This analysis provides an empirical estimate of the structure of the variables considered. (Hair, 1999)

Cluster analysis

Is a technique for developing meaningful subgroups of individuals or objects. It is a way of classifying groups based on similarity information, and to group similar result. This analysis takes part in the first stage of determining how many groups exist in a sample; the second stage is to describe the variables to know its composition. The second stage is done with the discriminate analysis (Hair, 1999). For the cluster analysis with binary data, you must use indicators. The index is used depends on the situation it faces. For example the index of Jacquard and Dice (Czekanowski or Sorenson) emphasize the presence of species, as well exclude or do not consider the absence of species. For example the index is calculated with the Jaccard formula: a / (a + b + c), where a case is present between the two groups represent cases in one group but absent in another group (34) (SPSS 2000). But using the Sokal and Sneath index 1, it is the absences and presences between groups was calculated using the formula 2 (a + d) / (2 (a + d) + b + c) in which double weight is given to the absences and presences in the numerator. In the formula, d represents cases absent between the two groups (SPSS 2000).

If instead of binary data the data used has intervals the option of “Squared Euclidean Distance Measure” is used. The distance between two cases is the sum of the squared differences between the values of the cases. This dissimilarity measure is for continuous data.

Discriminant analysis

It is used when the variable is dichotomous and when this variable is not metric. The independent variables are metric. This method is useful when the total sample can be divided into groups based on a variable characterized by a number of known classes. It seeks to understand the differences between groups and predict the likelihood that a group or class belongs to several independent variables (Hair, 1999).

**4. Results**

The initial test of homogeneity of variance detected significant differences with a probability less than .05 for Sex, Age and Education (Table 18) indicating the suitability of parametric tests for Age and Education and non parametric tests for Sex and Income.

Table 18 Summary of Results for Demographic Factors



***4.1 Demographic and Cultural Factors***

*4.1.1 Sex*

There were a total of 214 persons in the survey in the 2009 charcoal survey. Eleven (11) respondents did not want their gender to be identified. Of the 203 respondents who volunteered information to this question, one can state that the charcoal business was made predominantly of fifty seven percent (57 %) of male’s equivalent to 122 persons, and thirty eight percent (38%) of females corresponding to 81 persons. ( Table 19, 20 and Figure 9).

Table 19 Frequency of Males of Female in the Charcoal Survey of 2009

122

57.0

60.1

60.1

81

37.9

39.9

100.0

203

94.9

100.0

11

5.1

214

100.0

Male

Female

Total

Valid

Missing

Total

Frequency

Percent

Valid Percent

Cumulative

Percent

Table 20 Frequency of Males and Female according to Forestry Ranges in the Charcoal Survey of 2009





Figure 9 Graphical Distribution of Males and Females according to Ranges

At the administrative level, in forestry units referred to as ranges, the analyses detected significant difference with a probability of .000 using Chi Square tests amongst the ranges in terms of sex of the respondents (Table 21). Dennery and Millet were the ranges where there was a greater activity in the charcoal business by females. Soufriere (3 females) and Quillese (11 females) were the ranges with the least activity by females. Quillese with 63 males and then Northern range with 26 males recorded the most males. Noteworthy was the relatively lower number of male respondents in the Dennery, Millet and Soufriere ranges with a total of 9, 11 and 12 male respondents respectively.

Table 21 Results from Chi Square tests of Significance of Male and Female Frequency in the Five Ranges (Quillese, Millet, Northern, Soufriere and Dennery)



*4.1.2 Age*

The predominant age of charcoal producers was from forty one to sixty years and over sixty years. The relative abundance was twenty nine percent (29%) for the age range of 41 to 50 years, twenty eight percent (28%) for the range greater than sixty (60) years and twenty one percent (21%) for the age range of fifty one (51) to sixty (60) years old. Only sixteen percent (16%) equivalent to thirty four (34) of the respondents were in the range of thirty one to forty year. (Table 22, 23 and Figure 10)

Table 22 Distribution of Respondents according to Age

AGE

2

.9

.9

.9

8

3.7

3.8

4.7

34

15.9

16.0

20.8

62

29.0

29.2

50.0

45

21.0

21.2

71.2

60

28.0

28.3

99.5

1

.5

.5

100.0

212

99.1

100.0

1

.5

1

.5

2

.9

214

100.0

Age 5 to 20

Age 21 to 30

Age 31 to 40

Age 41 to 50

Age 51 to 60

More than 61

7

Total

Valid

No Answer

Total

Missing

Total

Frequency

Percent

Valid Percent

Cumulative

Percent

Missing

Table 23 Distribution of Respondents according to Age in the Five (5) Forestry Ranges *(The Number 7 was assigned to one person who did not want her age known)*





Figure 10 Graph of the Distribution of Respondents according to Age in the Five (5)

Forestry Ranges

Like gender, significant differences with a probability of 0.001 were detected using ANOVA, in the comparison of ages in the five ranges (Table 24). For a total of 212 respondents, Quillese was the range with the highest number of respondents of 75 persons. Also Quillese had the highest proportion of respondents within the range of 27 and 25 within the age range of 41 to 50 years and greater than 60 years respectively. Dennery and Millet followed with 41, 37 and 39 respondents respectively with more people in the age range 31 to 40 years than the other ranges (9, and 11 respondents out of 34). Northern range recorded the most respondents in the age range of 51 to 60 years old Soufriere recorded the least number of respondents with the highest number of 12 in the age range of greater than 60 years.

Table 24 Statistical Significance of the Distribution of Respondents according to Age in

the Five (5) Forestry Ranges Using ANOVA tests

28.476

4

7.119

5.180

.001

284.481

207

1.374

312.958

211

Between Groups

Within Groups

Total

Sum of

Squares

df

Mean Square

F

Sig.

*4.1.3 Education*

The educational background of persons in the charcoal was characterized with respondents who were primary school graduates, equivalent to sixty two percent (62%) of the total 214 respondents. This sub group was followed by the respondents with No Formal Schooling equivalent to twenty percent (23%) of the total, Secondary School with twelve point six percent (12.6 %). Two persons did not want their educational background to be disclosed.

(Table 25, 26 and Figure 11)

Table 25 Frequency of the Level of Education of Respondents

EDUCATON

132

61.7

62.9

62.9

27

12.6

12.9

75.7

50

23.4

23.8

99.5

1

.5

.5

100.0

210

98.1

100.0

2

.9

2

.9

4

1.9

214

100.0

Primary School

Secondary School

No Formal Schooling

Tertiary

Total

Valid

System

Total

Missing

Total

Frequency

Percent

Valid Percent

Cumulative

Percent



Figure 11 Graphical Representation of the Frequency of the Level of Education of

Respondents

Table 26 Frequency of Respondents for Level of Education according to Forestry Ranges



Educational background analyzed using the independent variables as ranges resulted in the detection of statistically significant differences with a probability of 0.013 using ANOVA (Table 27). Most Primary and No Formal School respondents were from Quillese with 48 out of total of 132 for Primary School respondents and 21 out of a total of 50 respondents for No Formal Schooling. Soufriere and Millet were the other two ranges with 9 persons respective for the category of No Formal Schooling. Northern range was the only respondent with a respondent who had Tertiary level education. Secondary School education was highest in Dennery, followed by Millet and Quillese with 6 respondents respectively and 5 from Northern range. Soufriere had the least number of respondents- equivalent to 19 out of a total of 29 respondents.

Table 27 Statistical Significance of the Distribution of Respondents according to

Educational background in the Five (5) Forestry Ranges



*4.1.4 Experience*

Significant differences were detected amongst the ranges in 2002 charcoal survey in terms of the experience in the production of charcoal using ANOVA with a probability of .028 (Table 29). This trend continued in the 2009 survey For both surveys, there was a greater frequency in the category greater than three (3) years experience.

In 2002, Quillese Dennery and Soufriere dominated with 25, (27%) 25 (27%) and 24 (26%) respondents out of total of 90 respondents in the category More than three (3) years experience. There were a total number of 105 respondents in the 2002 survey (Table 28).

In 2009, the significant difference in frequency was detected within the category of experience of “greater than three (3) years” in the Quillese range. The Quillese range recorded the highest number of respondents equivalent to sixty three (63) followed by 21, 16, 9 and 9 respondents in the Northern Range, Soufriere, Dennery and Millet Ranges respectively (Figure 13 and 14 and Table 30). A similar trend was detected for “Use” and sale (“Sell”) of charcoal for more than 3 years. Again the Quillese range recorded the most counts (25) for respondents who used charcoal for more than 3 years and for “Sell more than 3 years” (56). Northern range when ranked in terms of areas selling charcoal for more than 3 years was second with a total of 27 respondents (Figure 13 and 14 and Table 30). .

Table 28 Experience of Charcoal Producers in the 2002 Charcoal Survey

3

4

25

32

25

25

2

5

24

31

1

7

8

9

9

5

10

90

105

Quillese

Dennery

Soufriere

Millet

North

Locations

of Survey

Total

Less than

1 year

1 to 3 years

More than

3 years

Experience Categories

Total



Figure 12 Histogram of the Experience of Charcoal producers in the 5 ranges for the

2002 Charcoal Survey.

Table 29 Statistical significance of the Experience of Charcoal stakeholders in the

Production for the 5 Ranges for 2002 survey using ANOVA.

2.897

4

.724

2.847

.028

22.893

90

.254

25.789

94

Between Groups

Within Groups

Total

Sum of

Squares

df

Mean Square

F

Sig.

Figure 13 Experience of Charcoal stakeholders in the Production of Charcoal 2009

Figure 14 Experience of Charcoal stakeholders in the Production, Use and Sale of

Charcoal 2009

Table 30 Experience of Charcoal stakeholders in terms of Production, Use and Sale of

Charcoal in the 2009 Survey

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Produce Less than 1 year | Produce 1-3 years | Produce more than 3 years | Use Less than 1 year | Use 1-3 years | Use more than 3 years | Sell Less than 1 year | Sell 1-3 years | Sell more than 3 years | Total |
| Dennery |  | 1 | 9 |  | 3 | 5 |  | 3 | 9 | 30 |
| Millet | 1 | 1 | 8 | 1 | 5 | 5 | 2 | 2 | 15 | 40 |
| Northern | 3 | 1 | 21 | 1 |  | 6 | 3 | 3 | 27 | 65 |
| Quillese |  | 4 | 63 |  | 4 | 25 | 1 | 4 | 56 | 157 |
| Soufriere | 2 |  | 16 |  |  | 11 |  | 1 | 12 | 42 |
| Total | 6 | 7 | 117 | 2 | 12 | 52 | 6 | 13 | 119 | 334 |

*4.1.5 Alternative Professions to the Charcoal Business*

In the 2002 charcoal survey, eighty seven point three (87.3%) (90 of 103) of the respondents reported the charcoal business as their only occupation (Table 31 and Figure 15). Only thirteen percent (13%) (13) of the respondents at that time said that charcoal production was not their only occupation.

Table 31 Number of Respondents to the question: Is this your only occupation in 2002





Figure 15 Responses to the Question Is this charcoal production your only Occupation in

2002

Unlike 2002, 2009 recorded an opposite trend in the number of persons who stated that they were involved exclusively in the charcoal business as a livelihood. In the 2009 survey ninety one percent (91%) (186) of respondents stated that the charcoal business was not their only occupation and nine percent (9%) (19) stated that the charcoal business was their only occupation (Table 32 and Figure 16). Quillese range recorded the highest number (72) of persons who reported having other occupations; Dennery and Northern range followed with 35 and 31 respectively. The last two ranges- Millet and Soufriere recorded the least number of respondents with alternative professions to the charcoal business equal to 25 and 20 persons respectively.

Table 32 Responses to the Question Is the Charcoal business your only occupation in

2009

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Range | Response of Yes | Response of No | Total | Percentage of Yes responses (%) | Percentage of No responses (%) |
| Dennery | 1 | 38 | 39 | 0.5 | 19 |
| Millet | 8 | 25 | 33 | 3.9 | 12 |
| Northern | 9 | 31 | 40 | 4.4 | 15 |
| Quillese | 1 | 72 | 73 | 0.5 | 35 |
| Soufriere |  | 20 | 20 | 0.0 | 10 |
| Total | 19 | 186 | 205 | 100 | 100 |
| % | 9 | 91 | 100 |  |  |



Figure 16 Responses to the Question Is the Charcoal business your only occupation in

2009

Cluster analysis of the 2002 data of the occupation of persons involved in the charcoal business detected three (3) subgroup out of the five (5) ranges. These 3 subgroups were: a) the Millet and North, b) Dennery, and Soufriere and Quillese (Figure 13).

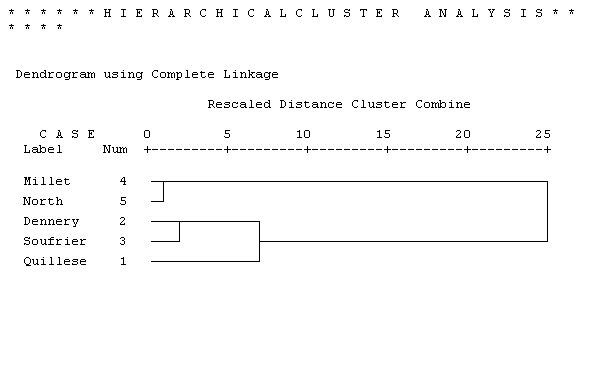


Figure 17 Dendrogram of Clusters resulting from Similarity of Ranges in terms of

Respondents with Alternative Employment

These subgroups were confirmed as correctly classified using discriminant analyses (Table 33, 34 and Figure 18). Figure 18 illustrates the representation of the functions showing that these subgroups were correctly represented.

Table 33 Results from Discriminant Analysis of Similar subgroup of Ranges in terms of

Respondents with Alternative Employment





Figure 18 Results from Discriminant Analysis of Similarity of Ranges in terms of

Respondents with Alternative Employment

Table 34 Results from Discriminant Analysis Showing that Classification of the Clusters

of Ranges in terms of Respondents with Alternative Employment Were

Correctly Classified.



The discriminant analysis also revealed that the two occupations that differentiate the three subgroups identified were those of farmers and labourers for the 2002 data (Table 35).

Table 35 Results from Factor Analysis of the variables that differentiated the sub-group

of Ranges.

Canonical Discriminant Function Coefficients

1.971

-.339

.339

1.971

-22.686

.254

Farmer

Labourer

(Constant)

1

2

Function

Un-standardized coefficients

In terms of the number of famers, Dennery and Soufriere had similar number of farmers equal to 15 and Millet and the North had 10. Dennery and Soufriere had more labourers- 5 and 4 respectively than the other ranges (Figure 19 and 20)



Figure 19 Mean Number of Farmers per Range Engaged in Charcoal Production in 2002



Figure 20 Mean Number of Farmers per Range Engaged in Charcoal Production in 2002

The trend of the domination of farmers producing charcoal continued in 2009. Though there were a total of 56 farmers in 2002, there were 106 farmers in 2009. In addition there were 41 food vendors and 6 labourers. From the point of view of the range Quillese range had the most number of farmers who were respondents (19) (Figure 19). Five (5) of the six (6) respondents who were labourers in the 2009 survey were from the Northern range (Appendix 5: Table 1a, Table 1b. Table 81 c, Table 2 a and Table 2b).

***4.2 Economic Factors***

A general examination of the charcoal business from the perspective of the incomes level, extraction, production, transport distribution and sale indicated that the Quillese and Northern Range are the major ranges in St. Lucia for this business.

*4.2.1 Incomes*

Of the 214 respondents, 105 stated that they were not answering this question for personal reasons or owing to suspicion that the information would be used for other purposes related to the” payment of tax”.

Only 109 respondents out of 214 participants of the survey responded to the question on their level of income. Examination of the distribution of responses in Table 42 indicated that most of the respondents to the question on income were from the Quillese and Northern. Thirty four percent (37) of the respondents were in the income range of “Less than $500” and forty seven percent (51 persons) earned “500 to $1000”. (Table 36 and Figure 21) Most of the responses were made in the Quillese with forty one (41) persons (38%), Northern range with twenty one (21) persons(19%), followed by the Millet and Dennery with seventeen (17) persons each (16%), and finally by Soufriere with thirteen respondents (12%) (Table 36 and Figure 21).

Table 36 of the Income reported by respondents in the 2009 Survey

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Range | Less than $500 | Greater than $500 but less than $1000 | Greater than $1000 but less than $2000 | Greater than $2000 | Total | % |
| Dennery | 12 | 4 | 1 | 0 | 17 | 16 |
| Millet | 8 | 6 | 1 | 2 | 17 | 16 |
| Northern | 7 | 10 | 2 | 2 | 21 | 19 |
| Quillese | 6 | 22 | 11 | 2 | 41 | 38 |
| Soufriere | 4 | 9 | 0 | 0 | 13 | 12 |
| Total | 37 | 51 | 15 | 6 | 109 | 100 |
| % | 34 | 47 | 14 | 6 | 100 |  |



Figure 21 Income of Respondents in 2009 Survey in 5 ranges

Quillese in comparison to the other ranges also registered 43% (22 out of a total of 41) persons in the income level “Greater than $500 but less than $1000’. Northern range followed with a 19% (21 out of 109) proportion of all the respondents and 20% of who were in the income level “Greater than $500 but less than $1000”. Next in line within the decreasing trend in the number of respondents was Dennery and Millet with 17 respondents each (16%) and then Soufriere with the lowest total number of 12 respondents. Most of Soufriere’s respondents were from income level of “Greater than $500 but less than $1000” (Table 36 and Figure 21).

Similarly the income level “Less than $500” accounted for 34% (37 of 109) of all the respondents. The distribution of respondents was highest in the Dennery range with 12 respondents, with a uniform decrease in the number of respondents with Millet (8), Northern (7) Quillese (6) and Soufriere (4) (Table 36 and Figure 21).

For the income level “Greater than $1000 but less than $2000” Quillese range had the greatest representation of 11 of the 15 (73%) respondents (Table 36 and Figure 21).

The last category- “Greater than $2000” were recorded 6 persons. These persons were evenly distributed with two persons each in the Quillese, Northern and Millet ranges respectively. There were no respondents from the Dennery and Soufriere with incomes “greater than $2000 (Table 36 and Figure 21).

*4.2.2 Sale and Marketing of Charcoal in St. Lucia*

The assessment of the charcoal business involved the analysis of the sub-activities of extraction, production, transportation distribution and sale.

*4.2.2.1 Extraction: Quantity and the Price for Purchase and Sale of the Service of Extraction*

Millet and Quillese were the ranges with highest records of extraction. Few of the people interviewed gave comparable data to the levels of production and sale of charcoal in the interview. Moreover few people reported that they were exclusively involved in wood extraction from the forest. Only in Millet and Quillese range reported people engaged exclusively in the charcoal business as an occupation. Quillese recorded 56 and Millet with 62 out of a total of 134 bags of charcoal extracted (Table 37).

Table 37 Wood Quantities Extracted, Prices Purchased and Price Sold for Charcoal

Production

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Range | Extraction quantity standardized (bags) | Extraction Price Purchased standardized  ($) | Extraction Price Sold/Charged  ($) | Production standardized (bags per pit) | Average Production Price Purchased to make 1 charcoal pit ($) | Average cost requested for production of 1 charcoal pit ($) |
| Dennery | 4 | 0 | 0 | 550 | 30 | 0 |
| Millet | 62 | 217 | 1 | 328 | 126 | 1 |
| Northern | 8 | 87 | 37 | 1180 | 47 | 1000 |
| Quillese | 56 | 228 | 1 | 2870 | 213 | 1 |
| Soufriere | 4 | 24 | 0 | 422 | 0 | 0 |
| Total | 134 | 555 | 39 | 5350 | 416 | 1002 |

For selling and buying the service of extraction, Quillese, Millet and the Northern ranges were also the most active ranges. The highest prices paid to someone for extraction was in Millet and Quillese. Quillese recorded the highest average price for extraction of $228, followed by Millet with $217 and then by the Northern range with $87. Northern range was the major range providing the service of extraction at an average cost of $37 dollars (Table 37).

*4.2.2.2 Production of Charcoal*

Using Table 37, one may observe a progressively smaller production of charcoal from the pits in starting with the largest in Quillese, Northern and Dennery Soufriere and Millet ranges. Quillese had the highest sum of production equal to 2870 bags, Northern range with 1180, Dennery with 550 bags, Soufriere with 422 bags and finally with 328 bags in the Millet ranges (Table 37).

The highest cost paid to make pits was in Quillese at a cost of $213, followed by Millet at $126 and Northern range at $47. The highest cost paid to prepare 1 charcoal pit was $1000 in the Northern range (Table 37).

The production of charcoal from pits resulted in the total yearly production of charcoal island-wide of 21279 bags. 955 bags of charcoal were consumed by the producers (Table 39a.) This total represented four percent (4%) of the production [955/21279] X 100.

Related to the size of the pits used for charcoal making was the activity of sale of charcoal on a monthly basis. The Kruskal Wallis test analysis detected significant differences with a probability of 0.002 for the question “how many days per month do you sell Charcoal” (Table 38a.). This statistical significance indicated greater activity in the sale of charcoal on a monthly basis in the Quillese and Soufriere ranges with an average of 16 and 15 days per month respectively in 2002 (Figure 22).

Table 38a. Statistical significance to Questions: Number of Small bags of charcoal

produced; duration of production and Price of charcoal bags sold in- in 5

ranges in 2002 Survey using Kruskal Wallis Test





Figure 22 Number of Days per month that Charcoal is sold in the 5 ranges of St. Lucia

The production of charcoal from pits resulted in the total yearly production of charcoal island-wide of 21279 bags. According to Smith (2000) the average weight of the fifty pound charcoal bag was thirty (30) pounds. He also stated that 35 kilograms of charcoal was equivalent to one (1) cubic metre of wood. Using Smith’s ratio the total quantity of wood consumed for the production of 21279 bags of charcoal was 8290.5 cubic metres. The calculations were represented in Table 38b.

Table 38 b. Production Calculations to convert 21279 bags to metric tonnes of charcoal

and to cubic metres of wood needed to make charcoal.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of charcoal bags | Total weight of 21279 bags of charcoal in pounds (lbs)  (Number of bags X 30) | Total Weight of 21279 bags of charcoal in kilograms (kg) | Total weight of 21279 bags in metric tonnes (tonnes)  (total weight in kilograms/1000) | Total Volume equivalent to 21279 bags of charcoal in cubic metres (total weight in kilograms/35)  (m3) |
| 21279 | 638370 | 290168 | 290.168 | 8290.5 |

Most of the production was in the Northern range and accounted for 11509 bags (54% of the total). Quillese was also featured prominently with a yearly production of 5178 bags equivalent to twenty four percent (24%) of the total production. Soufriere, Dennery and Millet followed with a production of 3213 bags (15%), 1290 bags (6%) and 90 bags (4 %) in Millet (Table 38 c.)

Table 38 c. Duration, Production, Use, and Sale of Charcoal Island-wide in One (1) Year

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Range | Production in 1 year (bags) | Duration of Charcoal production (months) | Quantity of bags used in 1 year  (bags) | Duration of Charcoal Use during the year (months) | Quantity of bags Sold in 1 year  (bags) | Duration of Sale of Charcoal during the year (months) |
| Dennery | 1290 | 12 | 59 |  | 1149 | 8 |
| Millet | 90 | 10 | 52 |  | 445 | 11 |
| Northern | 11509 | 6 | 548 |  | 11986 | 10 |
| Quillese | 5178 | 6 | 112 | 8 | 5344 | 11 |
| Soufriere | 3212 | 8 | 184 | 3 | 2595 | 2 |
| Total (∑ ) / Average(x̄ ) | ∑ =21279 | x̄ = 8 | ∑ = 955 | x̄ = 6 | ∑= 21519 | x̄ = 8 |

*4.2.2.3 Types of Bag and Alternative Containers Used to Sell Charcoal*

*4.2.2.3.1 Small Bags*

Analysis of the mean number of small bags of charcoal produced per month in the Northern, and Soufriere ranges revealed the average monthly production of 30 and 25 “small bags” bags respectively.



Figure 23 Mean Number of Small Bags of Charcoal Sold per Month per Range in the

2002 Survey

This skewed production and sale of more small bags in the Northern range was also detected in the 2009 charcoal survey. One may observe this in Table 39 and Figure 23, Northern range accounted for 67% (2220 out of 3331) bags from production. This production also resulted in the sale of 89% of the total number of small bags proposed to be sold in 1 year [(1110/1253) x 100]. Dennery and Northern registered the highest utilization of small bags both consuming approximately 69% [[(28+27)/80.25] x100] of small bags. Quillese range also had a relatively high production of small bags accounting for 739 of the total of 3331bags (22%). Quillese was the range supplying the either highest or second highest quantity of charcoal bags for all three sizes of charcoal bags.

The Millet range produced and sold mainly small bags of charcoal equivalent to eight percent (8%) of the total production of small sized bags, and in terms of the price of charcoal, significant statistical differences with a probability less than .05 were detected for the prices of small and medium sized bags in the 2009 data (Table 39).

Table 39 Production, Use and Sale of Charcoal according to Bag Type in 5 ranges for the

2009 Survey

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Produce Small bags (50 lbs)/ month | Produce Medium bags 100 lbs) | Produce Large bags | Use Small bags (50 lbs) | Use Medium bags 100 lbs) | Use Large bags | Sell Small bags (50 lbs) | Sell Medium bags 100 lbs) | Sell Large bags |
| Dennery | 45 | 140 | 0 | 28 | 88 | 9 | 8 | 96 | 0 |
| Millet | 227 | 1 | 1 | 11.25 | 1 | 2 | 124 | 1 | 2 |
| Northern | 2220 | 102 | 0 | 27 | 2 | 0 | 1110 | 102 | 0 |
| Quillese | 739 | 175 | 269 | 13 | 7 | 21 | 1 | 26 | 162 |
| Soufriere | 100 | 507 | 0 | 1 | 44 | 3 | 10 | 408 | 0 |
| Total | 3331 | 925 | 270 | 80.25 | 142 | 35 | 1253 | 633 | 164 |

Examination of the price of the small bag of charcoal sold in the five (5) ranges (Figure 23 and Table 39) for the 2002 survey revealed that whereas Northern, Soufriere and Dennery recorded an average price of $26 for a small bag of charcoal, Millet and Quillese registered the lower prices of $25 and $20 respectively.



Figure 24 Mean Price of Small Bags of Charcoal Sold in the Ranges in the 2002 Survey

Examination of Figures 25 from the charcoal survey of 2009, illustrated that just as in 2002, the price of small bags of charcoal continued to be highest in the Northern range. However the average price for a small bag was higher in 2009 than in 2002, from $26 to $33. Northern range recorded the highest average price of thirty three dollars ($33) for a small bag. Soufriere Dennery and Millet also produced small bags with an average price of thirty dollars ($30). The lowest average price registered for small bags of charcoal was in the Quillese range, approximately equal twenty eight dollars ($28) (Table 40 and Figure 25).

Table 40 Price of Bags of Charcoal Produced in the Ranges in 2009 Survey

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Range | Small bag ($) | Medium bag ($) | Large bag ($) | Average price ($) |
| Dennery | 30 | 33 |  | 32 |
| Millet | 30 | 38 | 42 | 37 |
| Northern | 33 | 38 | 44 | 38 |
| Quillese | 28 | 38 | 49 | 38 |
| Soufriere | 31 | 31 | 38 | 33 |
| Average price$ | 30 | 36 | 43 |  |

Table 41 a. Statistical Significance of differences in the Mean price of charcoal bag

produced in the ranges in 2009





Figure 25 Variation in the Price of Small Bags of Charcoal According to 5 ranges

*4.2.2.3.2 Medium Sized Bag*

Relative to the 2002 data, the 2009 data revealed the highest frequencies for the medium sized and large bags produced mainly by the Soufriere and Quillese range respectively. The test of ANOVA revealed statistical difference amongst the ranges with a probability of 0.006. The Soufriere range had an equivalent of 507 out of a total of 925 medium sized bags (55%) and the Quillese range an equivalent to 269 of 270 large bags (99.6%) (Table 46). Dennery also produced mainly medium sized bags equivalent to 15% [(140/925) x 100] of total production of medium sized bags (Table 39). For the medium sized bag, the average price in the Dennery and Soufriere range was thirty three dollars ($33) and thirty one dollars $31. This price was lower in comparison to Millet, Northern and Quillese range where the average price was thirty eight dollars ($38) (Figure 26)



Figure 26 Variation in the Price of Medium Bags of Charcoal in to 5 ranges

*4.2.2.3.3 Large Sized Bags*

Significant differences were not detected for large bags of charcoal produced (Table 41 a.). This was because most of the most of the variability in the data on production of large bags was in the Quillese Range. In the Quillese range, the average price of a large bag of charcoal was $49. In the Soufriere, North and Millet range however, the average prices was $38, $40 and $42 respectively. Dennery did not produce large bags. (Figures 27).



Figure 27 Variation in the Price of Large Bags of Charcoal Sold in the 5 Ranges

*4.2.2.3.4 Forecast of the Price of the Charcoal Using Regression Analysis*

A summary of the prices of the ninety pound charcoal from the 1973 to 2009 revealed the linear increase in charcoal prices (Table 41 b.). As evidenced in figure 28, from 1973 to 1980 there was a rapid increase in the price of charcoal. By the 1990s to 2009, there was a linear increase in the price of the 90 pound bag of charcoal.

The linear function relating the price of charcoal and year was: y = 0.716689 X – 1400 (SPSS output sheet Appendix 6). The utility of this model was determined with the coefficient of determination (r 2) of 0.685 and the coefficient of correlation was .827

Using the linear function in 20 years, the price of this bag would be fifty four dollars ($54) and the observed increase in prices would fall within two (2) standard deviations of the price calculated by multiplying 7.15 by 2 equal to approximately fourteen dollars ($14).

Table 41 b. Summary table of the Prices of the 90 Pound Charcoal bag

|  |  |
| --- | --- |
| Year | Price of a 90 pound charcoal bag ($) |
| 1973 | 7.5 |
| 1976 | 9 |
| 1978 | 18 |
| 1979 | 24 |
| 1984 | 30 |
| 2009 | 36 |

*Source: Data from 1973 to 1984 was from the St. Lucia the Manufacture of Charcoal, 1982*



Figure 28 Output of Regression analysis of the prices of charcoal from 1973 to 2009

Apart from the sale of the small, medium and large charcoal bags, respondents also reported on the types of containers used for the sale of charcoal. In the survey this was reported in terms of the quantity of charcoal used, the price it was sold and the price it was purchased at.

The following list details the measurement and the corresponding prices to alternative forms to charcoal bags that were used for marketing:

1. 1 gallon (4 liters) plastic bucket at the four dollars ($4) used mainly with eight (8) (33%) and nine (9)(34%) respondents in Millet and Quillese ranges respectively. (Table 53)
2. 1 gallon (4 litres) bucket at two dollars ($2.00) used mainly by five (5) (31%) and seven (7) (44%) respondents in the Millet and Northern ranges respectively. (Table 54)
3. 1 Originally 29 kilogram soap bucket-$12 plastic bucket used mainly in the Quillese range with seventeen (17) (84%) of a total of twenty (20) respondents (Table 55)
4. $10 bucket used mainly in the North and Quillese with eight (8) (32%)and fourteen (14) (56%) respondents respectively, out of a total of twenty five (25) respondents. (Table 55)

4.2.2.4 Scheduling of the Production of Charcoal

In reference to charcoal production in 2009, though a total of eighty (80) respondents indicated that they “produce year round”, only five (5) respondents categorically stated that they produced charcoal in the wet season. (Table 49). Four (4) of these respondents were from the Northern range and one (1) from Millet. Conversely, ninety two (92) respondents stated that they sold charcoal in the wet season. Noteworthy was that ninety (90) (98%) of all the respondents who stated that they sold charcoal in the wet season were from the Northern Range (Table 42).

Quillese was the outstanding range in terms of the number of responses to the variables of “year round” production, use and sale of charcoal. Quantitatively for the Quillese range fifty three (53) out of eighty (80) respondents (66%) reported year round production, thirty four (34) out of ninety two (92) respondents (37%) reported year round use, and fifty one (51) out of one hundred and one (101) respondents (51%) reported year round sale (Table 42)

Table 42 Number of Respondents for Production, Use and Sale of Charcoal During the Wet Season, Dry Season and Year Round

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Produce year round | Produce Dry season | Produce Wet season | Use year round | Use Dry season | Use Wet season | Sell year round | Sell Dry season | Sell Wet season | Total |
| Dennery | 7 | 2 | 0 | 31 | 2 | 0 | 9 | 1 | 0 | 52 |
| Millet | 6 | 3 | 1 | 17 | 2 | 2 | 12 | 2 | 1 | 46 |
| Northern | 9 | 10 | 4 | 5 | 3 | 0 | 26 | 6 | 90 | 153 |
| Quillese | 53 | 15 | 0 | 34 | 7 | 0 | 51 | 7 | 1 | 168 |
| Soufriere | 5 | 15 | 0 | 5 | 3 | 0 | 3 | 6 | 0 | 37 |
| Total | 80 | 45 | 5 | 92 | 17 | 2 | 101 | 22 | 92 | 456 |

4.2.2.5 Transportation of Charcoal

The greatest use of transportation and the corresponding highest costs in the charcoal business were in Quillese Soufriere and Millet ranges (Table 43). Tin Quillese, the highest mileage owing to the activity of transporting of charcoal was six hundred and forty five miles (645 miles) equivalent to 47% of total mileage registered for all ranges. Soufriere and Millet then followed with 356 miles representing 26% of total mileage and 275 miles representing 20% of the total mileage respectively. (Table 43)

Table 43 Costs associated with the Transportation of Charcoal

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Range | Transport Quantity (Miles) | Cumulated sum for Transportation cost for transport hired ($) | Cumulated sum for Transportation value Sold/Charged ($) | Average Transport Price Sold/Charged/mile |
| Dennery | 68 |  | 480 | 6 |
| Millet | 275 | 451 | 341 | 4 |
| Northern | 20 | 51 | 160 | 4 |
| Quillese | 645 | 2375 | 482 | 5 |
| Soufriere | 356 | 1 | 2080 | 5 |
| Total | 1364 | 2878 | 3543 | 24 |

Though Quillese range registered the highest price for mileage and hiring of the service of transportation, Soufriere range had more transportation activity. This activity in the Soufriere range was also more costly than the other ranges. This was evidenced by the higher accumulated cost of two thousand and eighty dollars ($2080) for services sold for transportation in Soufriere range. This quantity represented fifty nine percent (59%) of the total accumulated cost of $3543 for all ranges (Table 43). One vendor in the Castries Market disclosed that she did not pay for transportation; instead, the producers paid to transport the coals from island wide to the market. (Personal communication Respondent # 11 from the Northern Range)

*4.2.2.6 Distribution of and Sale of Charcoal*

Distribution of charcoal was done in small 50 pounds, medium 90 pound, large 100 pound bags and smaller containers-of tins and plastic buckets.

The initial response to the question on distribution of charcoal indicated that the dominant prices for distribution of charcoal were $45 and $30. Twenty five of forty seven (25 of 47) respondents (53%) indicated the price of $45. Most of the respondents who stated this price of forty five dollars ($45) were from the Quillese range-thirteen of the total of twenty five (13 of 25) respondents (57%). The second ranking dominant price of $30 was mentioned by only 7 respondents in all the ranges (Appendix 1 Table 1).

A detailed examination of distribution of charcoal confirmed that the main form of marketing charcoal was to “directly market charcoal by a self or with members of family”. There were a total of 513 responses from respondents. The marketing by “wholesaler/middleman” and “market vendor” were the following forms of marketing with a total of 203 and 110 responses respectively (Appendix 1: Table 1, 2, 3, 4a. and b., 5 a. and b., 6 and 7).

The popular prices for the category “directly market charcoal by a self or with members of family” were:

$35 for seventeen percent (17%) of the respondents equivalent to 38 persons;

$30 for fifteen percent (15%)of respondents equivalent to 78 persons;

$40 for 10% of respondents, equivalent to 51 persons. (Appendix 1: Table 2)

The persons using the marketing channel of “directly market charcoal by a self or with members of family” recorded an average mark up in profit of twelve percent (12%) on charcoal sold. This average mark up was reported in the Northern, Millet and Quillese ranges. (Table 5 a. and b.)

There were on average an equal number of responses to the various prices stated for the marketing channel of “wholesaler/middleman” (Appendix 1: Table 6):

1. $45 for twelve percent (12%) of the respondents equivalent to 24 persons;
2. $40 for fifteen percent (15%) of the respondents equivalent to 30 persons;
3. $35 for thirteen percent (13%) of the respondents equivalent to 26 persons;
4. $28 for twelve percent (12%) of the respondents equivalent to 25 persons;
5. $30 for fourteen percent (14%) of the respondents equivalent to 29 persons;
6. $25 for seventeen (17%) of the respondents equivalent to 35 persons;
7. $60 for seventeen percent (17%) of the respondent’s equivalent to 34 persons.

No mark ups in the prices for charcoal sold were reported for “wholesaler/middleman”.

There were three main prices for the category “market vendor” (Appendix 1: Table 7):

1. $25 for thirty percent (30%) of the respondents equivalent to 33 persons,
2. $35 for thirty five percent (35%) of the respondents equivalent to 38 persons,
3. $45 for twenty nine percent (29%) of the respondent’s equivalent to 29 persons.

Mark ups of 25% in profit for the charcoal sold were only reported by one person.

At the range level, Quillese not only represented the range with the most diverse portfolio in the distribution of prices but also had the most respondents for each price category. Quillese recorded 52 %, 59% and 65% of the total responses for the marketing forms “directly markets charcoal by a self or with members of family”, “wholesaler/middleman” and “market vendor” respectively. Soufriere, Northern, Dennery and Millet ranges then followed in terms of abundance of responses to marketing through the aforementioned channels.

***4.3 Site Characteristics***

*4.3.1 Perception why more or less charcoal produced*

Of the sixteen (16) responses of respondents the two (2) most common responses was that there was “less wood available” that there was a “decrease in the demand and Sale of charcoal.” Eighteen (18) respondents expressed that there was less wood available with most of the responses originating from the Dennery (5) and Soufriere (6) ranges. There were 16 respondents who responded that there was a decrease in the demand and sale of wood. Nine of the sixteen respondents were from the Dennery range. (Table 44 and 45)

Table 44 Perception of Why there was more or less Charcoal in the 2002 Survey

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Increase use of charcoal for grilling | Because of issues in charcoal production on Family land | Because of old age | Charcoal only made from land clearing for farming | Cooking gas available | Declining physical health/ health problems | Decreased demand and sale of charcoal | Difficulty in accessing trees far from road | Down turn in the industry |
| **Quillese** | **0** | **0** | **0** | **1** | **0** | **3** | **1** | **0** | **0** |
| **Dennery** | **1** | **0** | **0** | **0** | **2** | **0** | **9** | **0** | **1** |
| **Soufriere** | **0** | **1** | **1** | **0** | **2** | **1** | **4** | **2** | **0** |
| **Millet** | **0** | **0** | **0** | **0** | **1** | **0** | **2** | **0** | **0** |
| **North** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
|  | 1 | 1 | 1 | 1 | 5 | 4 | 16 | 2 | 1 |

Table 45 Perception of why there was more or less Charcoal in the 2002 Survey

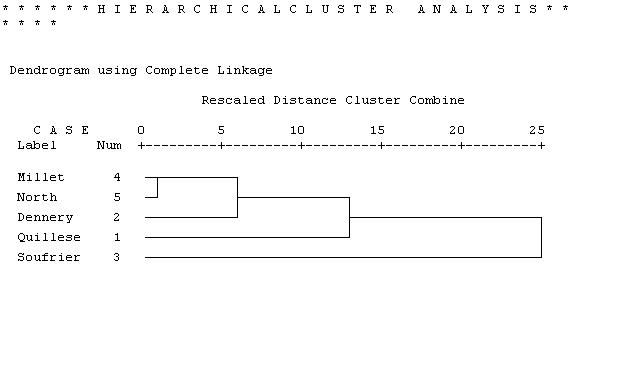
|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | More help available | Increased demand and sale of charcoal | Increased effectiveness in farm management | Interest and liking for coal production | Lack of man power | Less time available/spent on Charcoal production | Less wood available | Less wood available owing to fewer chainsaws operations | More persons are into charcoal production |
| **Quillese** | **1** | **4** | **0** | **1** | **0** | **4** | **1** | **0** | **1** |
| **Dennery** | **0** | **1** | **0** | **0** | **1** | **0** | **5** | **2** | **0** |
| **Soufriere** | **0** | **2** | **1** | **1** | **3** | **1** | **6** | **0** | **0** |
| **Millet** | **0** | **0** | **0** | **0** | **0** | **0** | **3** | **0** | **0** |
| **North** | **0** | **0** | **0** | **0** | **0** | **2** | **3** | **1** | **0** |
|  | 1 | 7 | 1 | 2 | 4 | 7 | 18 | 3 | 1 |

*4.3.2 Types of Woods Used for Charcoal Making*

Savonnèt (*Lonchocarpus heptaphyllus and Lonchocarpus punctatus*), Gliricida (*Gliricidia sepium)* and Logwood (*Haematoxylum campechianum*) were the major tree species used for charcoal making in the 2002 survey.

Savonnèt recorded the highest frequency of responses- 25% (61 of 240) responses. Most of these responses were from the Quillese (32 of 61) Soufriere (18) ranges. Gliricida followed with a 24.5% (59 of 240) with most of the responses coming from the Quillese (33) and Soufriere (17) ranges. Logwood was in the third position with 21% (50 of 240) of the responses. The majority of these responses were from the Quillese range (28). (Table 1 a-e and Figure 24 a, b, c, d and e)

The assessment in terms of wood used for charcoal making determined there were similarities and differences amongst the ranges. The cluster and discriminant analyses for data on the type of wood used confirmed that Quillese and Soufriere were two distinct groups. One third of sub group detected was the Dennery, Millet and the Northern ranges. The two other sub groups were Quillese and Soufriere (Figure 29 and Table 46 and 47).

Figure 29 Dendrogram of Clusters resulting from Similarity of Ranges in terms of Wood

used for Charcoal Making in 2002

Table 46 Results from Discriminant Analysis Showing that Classification of the Clusters

of Ranges terms of Wood used for Charcoal Making are Correctly Classified.



The factor analysis determined that Savonnèt was the variable that differentiated the three subgroups, and that most of the variability in the results was in the responses of Logwood, Gliricida Hardwoods and Various types of wood (Appendix 4: Table 1 and 2)

Table 47 Results from Factor Analysis of the key variable for Wood used for Charcoal

Production

Canonical Discriminant Function Coefficients

1.414

-8.485

Savonnèt

(Constant)

1

Function

Unstandardized coefficients

The analysis of the mean in the response of use of the wood by users indicated that Savonnet was predominantly used in the Soufriere range. The average number of users in the Soufriere range for this question was 17, followed by Quillese, Dennery and Northern range with less than 10 users. No one in the Millet range expressed use of Savonnet for charcoal making (Figure 30 a.).



Figure 30 a. Mean Number of Charcoal Users using Savonnèt Wood to Make Charcoal

Logwood was used mainly in the Quillese range with 20 users and Gliricida in the Soufriere range with 17 users. All other ranges record less than 10 users for these two species (figure 30 a. 30 b.)



Figure 30b. Mean Number of Charcoal Users using Logwood Wood to Make Charcoal

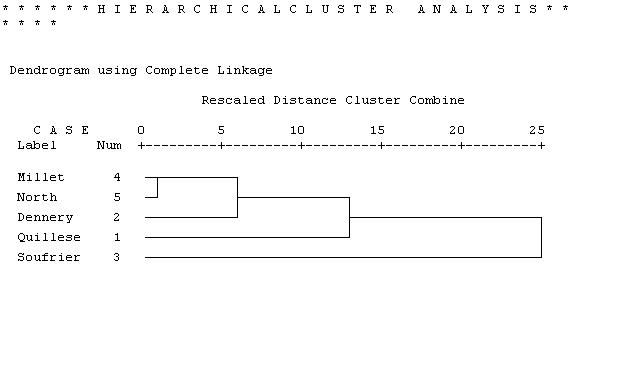


Figure 30c. Mean Number of Charcoal Users using Gliricida Wood to Make Charcoal

*4.3.3 Preferred Type of Wood Used for Charcoal Making*

The results for the preferred wood were similar to the results for “Wood used”.

The cluster and discriminant analyses of preferred wood in the five (5) ranges analyses detected 3 sub-groups as in the analysis for “Preferred Wood used”: a) Quillese, b) Soufriere c) Dennery, Millet and the North. (Figure 25, 26 and Table 65, 66)

Figure 31 Dendrogram of Clusters resulting from Similarity of Ranges in terms of

Preferred Wood Species Used for Charcoal Making

The discriminant analysis confirmed that the subgroups were correctly classified (Table 65 and figure 32) and revealed that the subgroups were differentiated by Logwood and Kakoli (Table 66).

However, though the examination of the total sum of responses revealed Logwood as one of the major species that differentiated the sub groups, two other major species were identified namely Savonnèt 33% (30 of 92) and Gliricida with 23% (21 of 92) (Appendix 77 a. b. c.). The factor analysis revealed that most of the variability in the results to the preferred wood used for charcoal making was for the responses “Logwood”, “Gliricida” “Hardwoods” and “Various types” of wood for making charcoal (Appendix 4: Table 3 and 4) .

Table 48 Results from Discriminant Analysis Showing that Classification of the Clusters of Ranges for the Preferred Wood used for Charcoal Making are Correctly Classified.

Classification Results

a

3

0

0

3

0

1

0

1

0

0

1

1

100.0

.0

.0

100.0

.0

100.0

.0

100.0

.0

.0

100.0

100.0

Classified locations

Millet, North,Dennery

Quillese

Soufriere

Millet, North,Dennery

Quillese

Soufriere

Count

%

Original

Millet,

North,De

nnery

Quillese

Soufriere

Predicted Group Membership

Total

100.0% of original grouped cases correctly classified.

a.

Table 49 Results from Discriminant Analysis for the Preferred Wood used for Charcoal

Making

Canonical Discriminant Function Coefficients

.960

-.279

1.444

1.384

-10.087

.409

Logwood

Kakoli

(Constant)

1

2

Function

Unstandardized coefficients

Canonical Discriminant Functions

Function 1

10

8

6

4

2

0

-2

-4

-6

-8

Function 2

8

6

4

2

0

-2

-4

-6

Group Centroids

Soufriere

Quillese

Millet, Northern,

Dennery

Soufriere

Quillese

Millet, Northern,Dennery

Figure 32 Results from Discriminant Analysis of Similarity of Ranges in terms of

Difficulty in Obtaining Charcoal

In the case of Logwood most of the responses were from the Quillese range (23 of 48) and Dennery (12). In the case of Savonnèt , most responses were in the Soufriere (22 of 30) and Dennery (6). Finally most responses for the preference to Gliricida wood were from the Soufriere (11 of 21) and Quillese (5) ranges (Appendix 4 Table 3 and 4 and Figure 33: a, b, c, and d).



Figure 33 a Mean Number of Charcoal Users who preferred using Gliricida Wood to Make Charcoal



Figure 33 b Mean Number of Charcoal Users who preferred using Hardwood to Make Charcoal



Figure 33 c Mean Number of Charcoal Users who preferred using Gliricida Wood to

Make Charcoal



Figure 34 d Mean Number of Charcoal Users who preferred using Gliricida Wood to

Make Charcoal

*4.3.4 The Method of Harvesting Wood for Charcoal*

The 2002 data investigated the method of harvesting used for charcoal making in the five (5) ranges. There were a total of 101 responses for 101 respondents for charcoal production (Table 50). Sixty eight percent (68%) (69 of 101) of the respondents practiced was Selective Cutting to harvest trees for charcoal (Table 69). Whereas “Selective cutting” was done in all the ranges, “Clear Cutting” of trees was done Quillese Dennery and Soufriere (Figure 28). In this survey three (3) respondents only from Quillese stated a combination in use of selective and clear fell methods for harvestings. No respondent from Millet or the Northern stated that they used clear felling to obtain wood for charcoal (Table 50).

Table 50 Locations of the Survey and the Method of Harvesting of wood for charcoal. *(One person in the Dennery range did not give an answer to this question: this noted in the first column)*

21

7

3

31

1

12

11

24

21

10

31

7

7

8

8

1

69

28

3

101

Quillese

Dennery

Soufriere

Millet

North

Locations

of Survey

Total

Selective

Cutting

Clear Cutting

Clear Cutting

and Selective

Cutting

What Method of Harvesting of Wood: Clear fell or Selective

Total



Figure 35 Locations of Survey and the Method of Harvesting Wood for Charcoal

*4.3.5 Difficulty in Obtaining Wood*

In terms of the perception of the difficulty in obtaining wood for charcoal there were six (6) main reasons given by respondents that was detected by use of Cluster, Discriminant and Factor analysis:

1. “Accessibility to wood”:16 out of a total of 48 respondents, (33%)
2. Wood is “Not Available”:12 out of 48 respondents, (25%)
3. “Scarcity of wood”: 11 out of 48 respondents (23%)
4. “Charcoal is not available on the Producer’s land”:7 out 48 (15%).
5. Wood is only available on “Neighbor’s Land: 1 out 48 respondents from Quillese (2%)
6. “Based on Wood or Charcoal Quality”: 1 out 48 respondents from Quillese (2%)

The output of the cluster analysis- the dendrogram of Figure 36 revealed three (3) subgroups with similar responses: a) Dennery, b) Quillese and c) Soufriere, Millet and the North. The discriminant analysis confirmed that these variables were 100% correctly classified (Figure 36, 37 and Table 51) and the factor analysis revealed that ninety percent (90%) of the variance in the results was explained by the variables of Accessibility, Wood Availability, Scarcity of Wood, Charcoal not available on the Producers land, Wood was available on the Neighbours land that of Wood or Charcoal Quality (Table 52). The two main problems revealed by the summation of occurrence were “Accessibility” and “Availability of wood” (Table 53 and 54).

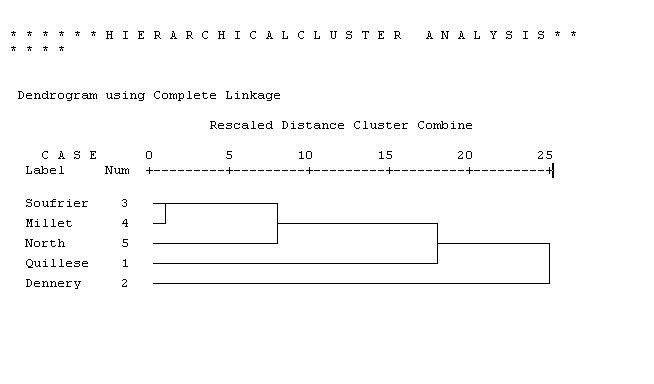


Figure 36 Dendrogram of Clusters resulting from Similarity of Ranges in terms of

Difficulty in Obtaining Charcoal



Figure 37 Results from Discriminant Analysis of Similarity of Ranges in terms of

Difficulty in Obtaining Charcoal

Table 51 Results from Discriminant Analysis Showing that Classification of the Clusters of Ranges in terms of Difficulty in Obtaining Charcoal were Correctly Classified.



Table 52 Results from Factor Analysis key variables Difficulty in Obtaining Charcoal

for Charcoal Production



Table 53 Results from Factor Analysis of responses in the Ranges in terms of Difficulty

in Obtaining Charcoal



Table 54 Issues related to Difficulty in Obtaining Charcoal

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Neighbors land. | Charcoal is not available on producers land | Based on wood / charcoal quality | Not available | Accessi-bility to wood is difficult | Scarcity of the wood | Total |
| Quillese | 1 | 7 | 1 | 3 | 3 | 2 | 17 |
| Dennery | 0 | 0 | 0 | 7 | 1 | 6 | 14 |
| Soufriere | 0 | 0 | 0 | 1 | 7 | 1 | 9 |
| Millet | 0 | 0 | 0 | 0 | 4 | 0 | 4 |
| North | 0 | 0 | 0 | 1 | 1 | 2 | 4 |
| Total | 1 | 7 | 1 | 12 | 16 | 11 | 48 |

Figure 38 a. and 38 b. relate how the responses from the ranges for the variables “Wood is not available” and difficulty in the “Accessibility of wood” confirmed the subgroups identified: the Northern Range, Millet and Soufriere noted the occurrence of wood “Not Available”; the issue of Accessibility was noted predominantly in the Soufriere range, followed by Millet, Quillese, Dennery and then Northern range.



Figure 38 a Mean number of Persons who expressed the Difficulty of Wood Not

Available



Figure 38 a Mean number of Persons who expressed the Difficulty of Accessibility to

Obtain Wood

In Table 55 were presented the similarity amongst the ranges in terms of the difficulty to obtain charcoal. The key issues detected were availability of other forms of employment and the availability of wood to cut (Table 55).

Table 55 Similarity of Ranges in terms of the issues related to the Difficulty of Obtaining

Charcoal

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | More time available | Recently began making charcoal | There is nothing else to do | Other forms of employment available/ engaged in other forms of employment | Other sources of income available | Stopped charcoal production | There is the potential to produce more charcoal | Wood is available | Total |
| Quillese | 2 | 1 | 0 | 0 | 1 | 2 | 1 | 1 | 5 |
| Dennery | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 13 |
| Soufriere | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 3 | 11 |
| Millet | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| North | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 |
|  | 2 | 1 | 1 | 5 | 1 | 2 | 1 | 5 | 32 |

**Limitations of the Methodology and Data in the Charcoal Surveys**

The charcoal surveys of 2002 and 2009 aimed at the collection of data on the challenges and interests of all charcoal producers and other key stakeholders in the charcoal industry. Though an effort was made to ensure the anonymity of the respondents, the influence of the interviewer- all of whom were from the Forestry Department, could have contributed to over, under or not reporting of information. This was evidenced especially for the questions on income where approximately half of the respondents (105 of 214) cited personal reasons or the suspicion that the information would be used for other purposes related to the “payment of tax”. This reluctance to answer questions was also observed to a lesser extent for the questions on the age and sex of respondents. However, given the Forestry Department’s regular patrols, the contact with the personnel in the study and the public especially in rural areas where harvesting and making charcoal is undertaken, the data provides a baseline of the activity of charcoal related activities in the five ranges.

Based on the assumption that the data is valid, the multivariate analyses were employed to determine patterns in the measurements. The multivariate model has the advantage of being rigorous. Yet, in a few cases the method was not suitable because of the few responses in some categories namely- use of Chi Tests for Contingency tables in Age, Education, Experience, Occupation and Income of respondents. As the application of the “Chi tests for Contingency tables” was not applicable given “the assumption that no more that 20% of expected values were less than 5 and none less than 1”, the observed differences between or amongst groups were analyzed based on the mean and the distribution of values (Personal Communication Dr. Bruce Lauckner[[69]](#footnote-69)).

**6. Discussion**

The St. Lucian government has the responsibility of ensuring the well being of its citizens and providing the socio economic means and condition to survive and or thrive in the global economy. This commitment to action by the St. Lucian citizenry is also stated as a goal to reduce poverty in half in the in the United Nation’s Millennium Development Goals.

The charcoal industry is one means which can be used to reduce poverty by the provision of livelihoods. Within the context of the Article 1and 10 of the CBD- the management of the forests which are used for charcoal making must not only be sustainable to provide access for future generations but there must also be equitable sharing of benefits of resources in the country.

Historically, there is familiarity with charcoal production and sale since the early 1800s when charcoal used to be exported from St. Lucia. The trend in the data from the charcoal surveys of 2001 and 2009 indicated that charcoal production has evolved from persons relying exclusively on this occupation as a livelihood, to one of many professions adopted as livelihood. This trend was observed using both the 2001 and 2009 data in which not only did the majority of respondents have more than three years experience in production and sale of charcoal, but also whereas in 2001 87% of respondents of the survey said that charcoal production was their only occupation (90 of the 103 respondents), in 2009 only 9% stated that this was their only occupation (19 of 205 respondents). Moreover this increasing popularity of charcoal production as a profession was evidenced by 186 respondents. This current condition of a diversified business portfolio by the respondents, as in Zambia, may be considered as coping strategy for varied conditions in the availability of water, for income diversification, for money to buy food and to cope with crop losses (NAPA, 2007).

Efforts in the past at resolving the issues related to charcoal supply at the institutional level were not successful. Starting first in 1982 there was a study of the charcoal industry and a feasibility study that determined that the use of kilns would increase productivity up to twice as much when compared to the traditional charcoal pits. Even an energy plan was developed in 1984 by the UNDP OAS project. Though this project included the establishment of woodlots, use of technologies such as kilns to increase the productivity of from charcoal, the recommendation to use coconut shells and stems for charcoal production and an educational component to increase the awareness of the aforementioned, in its majority, the impacts and outputs of the project to realize sustainability in the charcoal industry was not realized. Under this project in Vieux Fort, the Forestry department tried to establish Leucaena woodlots to complement the supply of charcoal to the for the Aupicon Community Charcoal Producers group. CANARI and the Fisheries department also worked with this community group and for one 1 year (Personal Communication Susana Scott) the group was given legal control of the area in the provisions of the Fisheries act of the local management area and in the early eighties was renowned as a successful case study for effective community management. Currently this group has disintegrated, and the mangrove used to supply charcoal is plagued with problems such as uncontrolled harvesting of mangrove for wood, dumping of waste and rubbish and the degradation of the site by the invasion of a vine and decrease in the number of mangrove species. In reference to the Leucaena wood lot project and the Makote charcoal producers Bradley Walters, the national charcoal survey of 2002 and interviews of range officers in the forestry department (Personal communication Ananias Verneiul and Alfred Prospere) revealed the lack of awareness of the Leucaena woodlots by producers. Further, neither was there the promotion of the use of the wood lots for charcoal production.

Given the past failures St. Lucia cannot resort to purely institutional approaches offered by IRIN (2008) in Malawi or in Paraguay (UNDP 1991) to resolve the issues and problems in the charcoal industry. Firstly, the socio economic level of the persons in the charcoal industry were either below the poverty line or at the level of vulnerable- that is easily falling into poverty with the occurrence of unforeseen events. The application of taxes as done in Malawi would not generate funds to reinvest into the charcoal industry given the small number of persons in the industry relative to a population of approximately 160000 persons. Moreover, not only would there be a high cost to monitor and collect revenue from this strategy, approach could further serve as a disincentive to people who not wanting to be taxed may resort to doing business charcoal business less overtly. Such practices were observed in Kenya and the Democratic Republic of Congo where the need for charcoal superseded the institutional controls in place. Even the approach of having a team in at the highest level of political government- in Paraguay’s case of a committee at in cabinet to manage energy including the charcoal industry may not be feasible because of the history of unfamiliarity with management of the industry at that level, because of the failure of past institutional efforts of this nature resulted in project designs and implementation phases that were top down approaches to the government and then to community groups.

The approach of this study was to focus on the interest and issues of key stakeholders in the charcoal industry, to develop recommendations and solutions to resolve the aforementioned issues. In this regard the bottom up approach using the RAPIDO project employed in Europe, and the modeling of results of these opinions as was done in the Philippines, Mexico (UNDP, 1991) and South Africa (IFRI, 2009) was undertaken.

The practical success recorded in Senegal (Fay 2006), Mexico (Newton 2006), Mozambique (Guilhermina 2000), Indonesia (Prasetiamartati 2008) and the theoretical proposition of Kopper (2001) in Tanzania, Ribot (1998) in Senegal and the UNDP energy plan for Jamaica had in common a combination of the top down and bottom up approaches as the best strategies to achieve sustainability in the charcoal industry. The common theme with the three countries where there was success in the managing the charcoal industry was in the documentation of the interests of all stakeholders. Prasetiamartati’s (2008) approach was to first develop a research framework to document the issues of all other stakeholders including doing an institutional analysis. His focus was determination of the formal and informal rules the reliance of charcoal production, and to improve access to local charcoal producers and provision of incentives. Guilhermina (2000) did a SWOT analysis of the stakeholders and then through inventory of natural resources and the development of management plans developed a legal mechanism for charcoal making. Faye (2006) focused on the prevention of conflict by regulation of: quota for harvesting and ensuring equity in the powers of the local chief and institutional leaders. In Mexico the sustainable livelihood approach with the assumption that success in the implementation of projects related to non timber forest products must factor in natural capital, physical capital, human capital, financial capital and social capital had specialist in the fields economics, social science and forest ecology who used participatory methods to develop decision support tools. The people with these tools were then able to measure the impact o different environmental and socio economic and political factors on the availability of the non timber forest products.

An analysis of the management of the natural capital showed the Forestry department’s forest management plans in the past: 1992 to 2002 were managed for the purpose of timber production, soil and water conservation, but were not managed for supplying wood for charcoal (Ministry of Agriculture, Forestry and Fisheries, 1993). A timber inventory of the government forest reserve conducted in 2009 estimated that there are approximately 2.8 million cubic metres of wood. As in Nicaragua Chamorro (1996) demonstrated how to develop a forest management plan for a natural forest that included the supplying of wood for charcoal production. This plan examined not only the geographic location, classification of the land, the route of communication, the legal situation, social aspect, economic situation and biophysical data but with considerations:

1. for classification of volume of timber and charcoal to be produced was presented based on the distribution of diametric classes of existing wood resources,
2. for natural regeneration of species, enrichment planting, and protection against forest fires, growth rates and mortality were factored in the analysis for production
3. for markets of all products including financial analyses of cost benefit analysis, marginal cost and revenue, variable cost, profit and net profit.

With the availability of wood on government reserves, and the assumption that the forest reserve may be sustainably managed to include charcoal as another output, the next step is to the review the human capital. In so doing, as the charcoal studies of both 2002 and 2009 were done according to location, the corresponding actions developed would also inform how and where to devolve the benefits related to a sustainable charcoal industry in St. Lucia.

In general most persons interviewed in this study of the charcoal industry were within the age range of forty one (41) to “more than sixty one (61)” years old: 167 of 214 persons. Sixty one percent of the persons had only primary school level of education, followed by twenty three percent with “No formal Schooling” and twelve percent with only a “Secondary school” level of education. This information is significant for the formulation of education programs to solving the issues. These programs should be targeted at persons with a mainly primary school and no formal school background and within the age range 40 years and greater from rural communities.

For the 109 out of 214 persons who responded to the question on income, the dominant income of respondents was in the range of “less than $500” (34%) to “$500 to $1000” (47%). There were a total of 74% (81 of 109) from both income categories “less than $500” to “$500 to $1000”. The first grouping- with an income of less than $500 were near the poverty line and the other group with an income from $500 to $1000 may be described to fall in the vulnerable group as that may fall below the poverty line. The St. Lucian poverty assessment in 2005-6 calculated the poverty line was Eastern Caribbean dollars $423 or United States dollars (US) $158 and that 40% of the population was deemed to be vulnerable- that is susceptible to falling into poverty as result of unanticipated events. As the majority of respondents to this survey either fall below the poverty line or in the vulnerable group likely to fall into poverty if there are turbulent or drastic changes in the economy, an event more likely given the global trends of recession and economic crises particularly in developing countries, there must be action to minimize or the effect of the attractiveness of the charcoal industry vis-a-vis the popularity of charcoal by consumers (St. Lucia Poverty Assessment 2005-6) and the potential negative impacts of land degradation and loss of livelihood associated with charcoal production as was observed in Zambia, Sudan Haiti and the Democratic Republic of the Congo (Table 15).

Hudson Bret in interviewing charcoal producers in Makote documented that the charcoal producer worked less hours- equivalent to 3 to 5 hours per day than the other available jobs at the same socio economic level. Hudson noted that the charcoal producer had more time to devote to other livelihoods to increase income. In comparison to the charcoal producer the other workers had to work 20 hours for $1000. Klejnot Lee in 2007 stated that whilst the monthly pay in the common tourist sector was between $1300 to $1500, a charcoal producer could receive $1200 to $1500 from one charcoal pit. Both Hudson and Klejnot (2007) referred to the attractiveness of charcoal production to charcoal producers. Given the projection of the increase in the price of charcoal to as much as $54 using the function: y = 0.716689 X – 1400 for a medium sized bag of charcoal in 20 years, there must be interventions with a combination of institutional approaches and bottom up approaches with a focus on people, to ensure sustainable production, to diversify the business portfolio of the charcoal industry and to minimize the impact to the environment from the harvest.

**7. Conclusion**

Review of the literature available at the global level revealed that the main effect from the demand, production and use of charcoal, particularly in developing countries was the loss of the livelihood associated with the charcoal industry and land degradation owing to the practices of harvesting of trees for charcoal production. The desktop analysis revealed the loss of livelihoods in the following countries: Democratic Republic of Congo, Haiti, Kenya, Senegal, Somalia, Sudan and Zambia. Land degradation was noted in Somalia, Haiti, Kenya and Mauritania (Table15). TEEB (2009 ) and the IUCN (2008) also correlated this loss in biodiversity to poverty. The loss in biodiversity was also associated with the loss in livelihoods and the cultural identity of the people.(Fay Patricia)

All efforts in the past at the institutional level to resolve issues in the charcoal industry in St. Lucia were inconsistent and the impact at the national level were largely unsuccessful in achieving long term sustainability as production systems.

Historically since the 1800s, the charcoal industry was in existence in St. Lucia when charcoal was exported. The national surveys of Wilkinson and of the Forestry Department estimated that the yearly consumption of charcoal was 6200 imperial tons.

The national surveys of 1980,1990 and 2001 of the statistics department revealed an exponential decrease in the percentage of households using charcoal from 68% in 1980, to 28% in 1990 and finally to 12% in 2001. However, the distributions of the consumption rates were not uniform for all locations: in the

1. Millet Range- Anse La Raye15 % , Canaries32%,
2. Soufriere Range with Soufriere 17% and Choiseul with 18% of the households surveyed reported charcoal use.
3. Quillese Range with: Laborie 9%, and Vieux Fort 4.6%
4. Dennery Range with: 7.6%
5. Northern Range with: Castries 4.7% and Gros Islet with 3.5%

Though the general trend was a decrease island-wide in consumption, this decrease was in the urban centers of the Northern Range and to a lesser extent in the Quillese range. Using that data, one may observe that the consumptions rates in the other ranges were relatively higher.

In 2001 Allan Alexander[[70]](#footnote-70), in collaboration with the Forestry Department and the FAO did a survey on charcoal consumption and production. The only analysis that was done with the data was by Smith (2002). Smith (2002) focused on the production and consumption of charcoal in the five ranges and calculated in 2001 that the total annual production and consumption of charcoal was 629815 kg and 76229958kg respectively. Smith (2002) then compared the consumption of charcoal in 1980 to that of 2001. The consumption rate in 1980 was 8173132kg . Using a conversion factor that 35kg of charcoal per cubic metre m3 of wood and calculating the prerequisite 217,000 cubic metres (m3) from forests, he concluded that both the 1980 and 2001 “ greatly overestimated” the consumption of charcoal in St. Lucia.

When the 2001 and 2009 surveys were analyzed using the independent variables of location for the five administrative ranges of the Forestry Department, namely- the Quillese, Soufriere, Soufriere, Dennery and the Northern ranges-the data of the charcoal surveys of 2001 and 2009 surveys confirmed that there was a charcoal industry in St. Lucia and but that there were distinct demographic groups, interests, and mode of operations of key stakeholders in relation to the charcoal industry in St. Lucia. Literature review revealed that there were no policy statements or action plans to address sustainability in the charcoal industry.

The 2009 charcoal survey revealed a production of 290168 kilograms (kg) in weight of charcoal produced by charcoal producers. The amount of wood necessary for this production was 8290.5 cubic metres (m3) of wood. On a range level, the production of charcoal was 17591 kilograms (kg) , 1227 kilograms (kg) , 156941 kilograms (kg) , 70609 and 43800 kilograms (kg) in the Dennery, Millet, North, Quillese and Soufriere ranges respectively.

In general most persons interviewed in this study of the charcoal industry were within the age range of forty one (41) to “more than sixty one (61)” years old: one hundred and sixty seven of two hundred and fourteen (167 of 214) persons. Sixty one percent of the persons had only primary school level of education, followed by twenty three percent (23%) with “No formal Schooling” and twelve percent with only a “Secondary school” level of education.

Seventy four (74%) (109 of 214) of the responses to income were in the income categories of “less than $500” (34%) to “$500 t $1000” (47%).

In both the 2002 and 2009 charcoal survey, the persons involved in the charcoal business- of production sale and use were in the category “More than three (3) years” experience. Also coinciding in 2002 and 2009 was the high proportion of farmers who were charcoal producers: in 2002 there were a total of 56 farmers out of 70 respondents (80%) whilst there were 106 farmers out of 160 respondents (66%) in 2009.

In 2002, though many persons were involved exclusively in the charcoal business as a livelihood, there was a shift in 2009, with more persons engaged in other occupations and charcoal related livelihoods. In 2002, 90 of the 103 respondents indicated that charcoal production was their only occupation but in contrast to 2002 in 2009, only 19 respondents stated that charcoal production, sale or use was their only occupation. In 2009, 186 respondents stated that charcoal business was not their only occupation.

The main form of marketing charcoal was “Directly by Self or family member”, followed by “Wholesaler or Middleman and then by “Market Vendor”. The popular prices for charcoal sold “directly to the market by a self or with members of family” were:

1. $35 for seventeen percent (17%) of the respondents equivalent to 38 persons;
2. $30 for fifteen percent (15%)of respondents equivalent to 78 persons;
3. $40 for 10% of respondents, equivalent to 51 persons.

The persons using the marketing channel of “directly by a self or with family members” recorded an average mark up in profit of twelve percent (12%) on charcoal sold. This average mark up was reported in the Northern, Millet and Quillese ranges. (Table 56 a. and b.)

There were on average an equal number of responses to the various prices stated for the categories of prices sold for charcoal by the marketing channel of “wholesaler/middleman” (Table 57):

1. $45 for twelve percent (12%) of the respondents equivalent to 24 persons;
2. $40 for fifteen percent (15%) of the respondents equivalent to 30 persons;
3. $35 for thirteen percent (13%) of the respondents equivalent to 26 persons;
4. $28 for twelve percent (12%) of the respondents equivalent to 25 persons;
5. $30 for fourteen percent (14%) of the respondents equivalent to 29 persons;
6. $25 for seventeen (17%) of the respondents equivalent to 35 persons;
7. $60 for seventeen percent (17%) of the respondents equivalent to 34 persons.

No mark ups in the prices for charcoal sold were reported for the wholesaler or middleman.

There were three main prices for charcoal sold by the “market vendor” (Appendix 1 Table 10):

1. $25 for thirty percent (30%) of the respondents equivalent to 33 persons,
2. $35 for thirty five percent (35%) of the respondents equivalent to 38 persons,
3. $45 for twenty nine percent (29%) of the respondents’ equivalent to 29 persons.

A mark up of twenty five percent (25%) in profit for the charcoal sold was only reported by one market vendor.

*Socio-economic Characterization of the Charcoal Industry in the Quillese Range*

Quillese range was one of the major locations for the charcoal business in St. Lucia. In comparison to other ranges, most of the respondents of the survey were from the Quillese range. Hence most of the responses for all categories of questionnaire were dominated by the Quillese range. This range was characterized with the greatest proportion and frequency of males (61 of 122) than females (11 of 81). The dominant age range consisted of older sub-groups of “41 to 50”, “51 to 60” and “Greater than 61” years. The educational levels of the persons involved were dominated by “Primary” (48 of 132) and “No Formal Schooling” (21 of 50). The 2009 data indicated the dominant income level of the respondents was “$1000 to $2000” (11 to 15), “$500 to $1000” (22 of 51) and “Less than $500” (6 of 37). Both the 2002 data and the 2009 data indicated that most of the persons involved in the charcoal business had more than three years experience in production, distribution and sale of charcoal and the majority were farmers.

In terms of production in 2002, Quillese and also Soufriere registered the highest number of days per month that charcoal bags per month (16 and 15 days per month respectively) and in 2009 Quillese produced the second highest quantity of production of charcoal in bags per year (5178 bags or 155340 kg) . Further, in reference to the bags used for sale of charcoal, in 2009 Quillese recorded the highest cost to produce a charcoal pit-$213. Three types of bags were marketed in this range: large, medium and small bags. Though three (3) types of bags were produced, this range was the main producer of large bags of charcoal.

At the range level, Quillese not only represented the range with the most diverse portfolio in the distribution of prices but also had the most respondents for each price category stated. Quillese range recorded the lowest price for small bags of charcoal sold ($28), but the highest prices for large and medium bags produced:$49 and $38 respectively. Charcoal was also sold in the market using the twenty nine (29) kilograms soap bucket for ten dollars ($10).

Quillese recorded 52 %, 59% and 65% of the total responses for the marketing forms “directly markets charcoal by a self or with members of family”, “wholesaler/middleman” and “market vendor” respectively.

Quillese also recorded the highest use and cost of vehicular transport ($645).

The main type of wood that users used for charcoal making was Logwood, Savonnèt and Gliricida. The preferred wood for charcoal for users was Logwood. Users referred to year round production, sale and use of charcoal and using both clear felling and selective felling of trees to obtain trees for charcoal making.

Finally the main difficulty expressed by charcoal producers is accessibility to areas with wood for charcoal making.

*Socio-economic Characterization of the Charcoal Industry in the Northern Range*

Northern range was another major location for the charcoal business in St. Lucia. This range was characterized with the greater proportion and frequency of males (26 of 122) than females (14 of 81). The dominant age range consisted of the older sub-groups “41 to 50”, “51 to 60” and “Greater than 61” years. The educational level of the persons was dominated by “Primary School” (26 of 132) level of respondents. The 2009 data indicated the dominant income level of the respondents was “$500 to $1000” (7 of 51) and “Less than $500” (10 of 37). In terms of production in 2009, Northern recorded the highest production level of 11509 bags of charcoal and the third highest cost to produce a charcoal pit. Further, Northern range was involved in the production, distribution and sale of medium and small bags of charcoal. This range was also the main range that registered production in the wet season and sale of charcoal in the wet season. Moreover this range recorded the highest prices for the sale of the small and medium bag of charcoal at $33 and $38 respectively. Charcoal was also marketed using the twenty nine (29) kilograms soap bucket for ten dollars ($10). The main type of wood used by producers for charcoal making was Savonnèt . Northern range was similar to Dennery and Millet range in the low number of respondents who preferred wood specific wood species for charcoal making. Users referred to using only selective felling of trees to obtain trees for charcoal making. Finally the main difficulty expressed by charcoal producers was the unavailability of wood and accessibility to areas with wood for charcoal making.

*Socio-economic Characterization of the Charcoal Industry in the Soufriere*

Soufriere range was another major location for the charcoal business in St. Lucia. This range was characterized with the greater proportion and frequency of males (12 of 122) than females (3 of 81). The dominant age range was “Greater than 61” years. The educational level of the persons involved was dominated by “Primary” (8 of 132) and “No Formal Schooling” (10 of 50). The 2009 data indicated the dominant income level of the respondents was “$500 to $1000” (9 of 51) and “Less than $500” (4 of 37). In terms of production in 2009, Soufriere range recorded the highest price paid and mileage for vehicular transportation. Further, Soufriere range was involved in production, distribution and sale of mainly medium sized bags of charcoal. Moreover this range recorded the lowest prices for medium and large of $33 and $37 respectively. The main type of wood that producers used for charcoal making was Savonnèt , Gliricida and Logwood. The preferred wood species noted was Gliricida. Producers referred to using clear felling of trees to obtain trees for charcoal making. Finally the main difficulty expressed by charcoal producers was the unavailability of wood and accessibility to areas with wood for charcoal making.

*Socio-economic Characterization of the Charcoal Industry in the Dennery Range*

This range was characterized with the greatest proportion and frequency of female (27 of 81) than male respondents (10 of 122). The dominant age range was younger in comparison to the other ranges- “31 to 40”, and “41 to 50” years. The educational level of the persons involved in the survey was dominated by “Primary” (29 of 132) graduates. The 2009 data indicated the dominant income level of the respondents was “$500 to $1000” (4 of 51) and “Less than $500” (12 of 37). Soufriere and Dennery range had the second most abundant number of farmers and labourers. It was also the range with a relatively higher number of food vendors who used charcoal in food preparation (26). The main type of wood that producers used for charcoal making was Savonnèt . The preferred wood for charcoal was Logwood. Producers referred to year round production, sale and use of charcoal and using both clear felling and selective felling of trees to obtain trees for charcoal making. Finally the main difficulty expressed by charcoal producers was accessibility to areas with wood for charcoal making.

*Socio-economic Characterization of the Charcoal Industry in the Millet Range*

The total number of respondents in the Millet range was 37 , the majority of which were distributors and middle men. Soufriere and Millet then followed with 356 miles representing 26% of total mileage and respectively. Like Dennery, this range was characterized with the second highest proportion and frequency of females (26 of 81) than males (11 of 122). The dominant age range was “41 to 50”, “51 to 60” and “Greater than 61” years. The educational levels of the persons involved in the charcoal industry were dominated by “Primary” (21 of 132) and “No Formal Schooling” (10 of 50). The 2009 data indicated the dominant income level of the respondents was “$500 to $1000” (6 of 51) and “Less than $500” (8 of 37). In 2009 Millet recorded the second highest cost to produce a charcoal pit- $126. Further, mainly small bags of charcoal were produced in this range. Charcoal was also marketed using the plastic bucket for four (4) and two dollars ($4 and $2). One female respondent from the Millet range stated obtaining 100% profit when the equivalent of a small bag of charcoal was sold in four (4) litre plastic containers at four ($) per container dollars. Relative to the other ranges, Millet also recorded a high use equivalent to 275 miles that was 20% of the total vehicular transport recorded. The main type of wood that producers used for charcoal making was Gliricida and the method for harvesting of trees for harvesting was clear felling. Finally the main difficulty expressed by charcoal producers was unavailability of wood, and accessibility to areas with wood for charcoal making.

As there was no policy or strategic plan in the charcoal industry in St. Lucia of the government non-governmental or other civic groups to minimize the impact of harvesting, overharvesting and to ensure sustainability in the charcoal, just like Jamaica’s charcoal industry in the 1984 UNDP report, the charcoal industry may be described as unplanned uncontrolled.

Given that the general trend of uniform increase in the prices of charcoal from 1970 to 2009 using linear function y = 0.716689 X – 1400 for a medium sized charcoal bag , that the NBSAP identified charcoal production as a main cause of biodiversity, that charcoal production was increasingly more attractive as a livelihood because of the fewer hours of work that were necessary to produce a charcoal pit (Klejnot, 2007 and Hudson) in comparison to the higher or equivalent salary to professions with persons with same socio economic and educational background (Klejnot, 2007 and Hudson), and even the popularity of charcoal use as was documented in the St. Lucia Country Poverty Assessment (2005-6)- where it was stated that “in many St. Lucian households where gas stoves were used, charcoal was being used extensively for cooking” either because of the “inability to afford gas or as a strategy to save”, there is a need to have planned actions and interventions to benefit the communities and to maintain plant biodiversity in relation to charcoal production. This threat is more likely when the charcoal alternative is cheaper or affordable than alternative energy sources.

Notwithstanding that this threat exists, a forest inventory in 2009 in St. Lucia determined the existence of 2.8 million cubic metres of wood available on forest reserves (Ministry of Agriculture, Lands, Forestry and Fisheries, 2009). Traditionally Forest management in the past had no focus on supply of charcoal. Forests were only managed for the purpose of biodiversity soil and water conservation, timber, recreation and tourism. Further, though Leucaena woodlots were established in the 1970s and 1980s to supply charcoal there was no action to incorporate these woodlots to supply charcoal. This lack of mobilization or action by the Forestry department may have caused the lack of awareness of Leucaena as an alternative for charcoal making. This was evidenced in the charcoal survey the 2001 survey where only one (1) producer out of one hundred and five (105) knew of the use of Leucaena for charcoal making. This producer was from the Dennery range where there are to date 20 acres of Leucaena woodlots in Louvet and 10 acres at Fon Dor.

In addition there are currently Leucaena woodlots in three other ranges- namely Quillese, Soufriere and Northern under the jurisdiction of the Forestry Department that were not managed or planned to be managed. The opportunity now exists to use the existing woodlots, and forest reserves to not only complement the supply of charcoal but to demonstrate especially to privately owned land owners with forests, how forests may be used sustainably with multiple objectives that include charcoal production alongside the traditional objectives of biodiversity, soil and water conservation, timber, recreation and tourism. It is important to work with private land owners as they have on average half the land available under forest cover in relation to government owned lands. In addition the methodology developed by the IUCN World Commission on Protected Areas (WCPA) can be applied to increase the value of the forests and hence contribute to more effective management of the areas.

Though the charcoal industry was in existence since the 1800s, using the product cycle model, the industry could be characterized as in the growth phase and currently unplanned and uncontrolled from the point of view government policy and interventions to ensure sustainability in the livelihood and in biodiversity conservation. The key competitive factors to the development of the industry are quality, price, advertising, research and development and service. The commonly used channel intermediaries to the consumer were: the producers and or their family, wholesalers, distributors, and retailers. The key for effective management would be to ensure integrated and sustainable production systems involving the harvesting of trees used for charcoal production, agriculture and to create marketing objectives that convert charcoal from the low involvement product to high involvement products such as specialized packaged bags of charcoal to segments of the market, biochar and wood vinegar.

***8. Recommendations***

*8.1 Recommendations at the National, Regional and International Level*

According to Evans (2008) to address the biodiversity loss trend effectively, it was necessary to have strategic, operational and tactical aspects of management that were iteratively discussed and an agreed sequence of actions related to management at the international and the national level. This would result in the development and implementation of actions plans that are flexible to the risks of global biophysical change and to local and international politics of governments and multilateral organizations.

If these actions would be sequenced, the approach used by Kopper (2001) in Tanzania, Ribot (1998) and Faye (2006) in Senegal, Guilhermina (2000) in Mozambique and Prasetiamartati (2008) in Indonesia are applicable to achieve sustainability in the charcoal industry in St. Lucia.

The first step is to develop a management plan for sustainable harvesting of wood from forests under the jurisdiction of the Forestry Department. The forester’s role in the technical component in forest management is the determination of and advising of the silvicultural treatments for sustainable harvesting and production of charcoal. The Forestry department’s role would also involve conducting research on the mean annual increment of trees in the forest, to inform the decisions in the formulation of management plans. The strategy for sustainable charcoal production would also involve the use of government lands to demonstrate sustainable use and then to try to influence owners of private lands to adopt sustainable practices to manage forest 43% of natural forest is in private lands and 56% is forest reserve (Biodiversity Country Study Report of St. Lucia, 1998).

The second step is then to unite the secondary stakeholders- that is the government and non governmental institutions. In St. Lucia this would be the Forestry Department, Extension, Fisheries, Crown Lands, National Trust Research and Development, Sustainable Development of the Ministry of Planning, the Attorney General’s Office, Social Transformation, Ministry of Finance, and Credit Unions, to unite with an agreed agenda, a system for collection of data and monitoring system, and how to collaborate effectively and efficiently. The solution is to develop a charcoal policy, to have financial requirement and sources; have an implementation plan for the policy developed by the government and other agencies. As in Paraguay the solution may also involve having a committee at Cabinet to manage energy issues. Though at the national level the Sustainable Unit is the lead agency for energy issues such as geothermal and wind energy source, based on the literature review, the Forestry Department should be the lead agency for charcoal production.

The next step is to inform the general public of the issues. Discussions should be based on the financial cost benefit of the current system versus the financial cost benefit of the proposed system. There should also be the provision of legal information on the forest policy, tree cutting regulations, legal powers and co-management opportunities.

The biodiversity surveys in the past determined that St. Lucians were receptive to educational campaigns and that persons are aware of the concept of biodiversity and issues relating to the environment. Though that was the case, the recommendations of the UNDP to the energy sector in 1984 to have an educational component in creating awareness for charcoal production was not followed up to date. Hence there should be a creation of awareness, negotiations and discussions with key persons involved in the charcoal industry with a focus on charcoal production and producers. There should be an effort on trying to work with registered groups or village associations and then interested individuals in the charcoal industry. The aim is to prepare an agreement for sustainable charcoal production and marketing that includes logistics to provide access to the public- to groups, associations or individuals- at the forestry level. Access should be based on the design, implementation and monitoring of management plans.

One limitation to sustainable charcoal production in St. Lucia is that as 43% of natural forests, 99% of mangrove and 95% of scrub forest are private lands. Therefore it is necessary is to increase the number of protected lands and provide greater value for ecosystems. The opportunity now exists to demonstrate to land owners with private forest how to sustainably use forests for the purpose of charcoal production within the limits of biodiversity, soil and water conservation. The IUCN’s methodology to assess protected or proposed protected private lands can be used to evaluate private lands so that the forestry department can determine the increased value and demonstrate how to optimize use forest for timber, tourism, charcoal and other objectives.

Similar to Europe with the RAPIDO project, there is also the opportunity to exploit the business function of innovation by the production of biochar- a special type of charcoal which when mixed with organic matter increases the productivity of soils. This opportunity if undertaken can, as in the Amazon with the Inca, used contribute to increasing the productivity of especially 59% of cultivation is under agriculture marginal soils which represents more than 50% of the soils available in St. Lucia. The use of this technology is environmentally friendly by can also be used in branding of products produced. Further proponents of biochar such as Dr. Johannes Lehmann[[71]](#footnote-71), stated that the production of biochar and its in-cooperation into the soil traps carbon in the soil and hence reduces the quantity of carbon dioxide in the air. This relation of trapping of carbon dioxide was then- by cause and effect correlated to a solution to global warming. In so doing the second function of a business –innovation, can be realized and can be exploited in the agricultural sector. This can be achieved by farmers incorporating biochar technologies to increase the quality and quantity of plants and reduce the cost of production from inputs such as fertilizers and pesticides. This solution can create employment and further reduce levels of poverty in St. Lucia. This opportunity is feasible as most of the persons producing charcoal were farmers, as St. Lucia traditionally has an agricultural economy and as agriculture continues to be a prominent feature of the economy for food security and income generation and maintaining livelihoods of rural people. Further as in Zambia with the NAPA (2007), the combination of agriculture, charcoal production and other livelihoods would serve as a coping strategy for varied conditions and income diversification for money generated. Further revenue could be generated from the sale of wood vinegar, charcoal or biochar.

Though the solution is to have realistic targets for sustainable charcoal production with the associated legal provisions of forest policy and laws, the challenge is also how to pay for the additional cost of labour time and money that producers would have to invest to manage sustainable systems of production. For this reason research should be done to confirm the inputs of labour time money and incentives for compensation for efforts and investment for sustainable charcoal production.

At the local level, efforts at addressing the issues related to the charcoal industry may involve seeking funding and technical assistance through:

1. the Poverty Reduction Fund, the Basic Need Trust Funds, St. Lucia Farmers Credit Union and the National Insurance Scheme Folk Research Centre.
2. The Youth Enterprise Development is another option to incorporate younger persons into the charcoal industry to ensure succession of the livelihood to younger generations.
3. The Ministry of Social Transformation, the National Emergency Management Organization (NEMO) and the Forestry Department should have a framework for cooperation and making available equipment such as kilns to optimize use of trees damaged from hurricanes.
4. As done in Indonesia: The Bureau of Standards and the Forestry Department in St. Lucia can be involved in doing studies and development of standards for various classes of charcoal sold for example:
5. Class A Complete cylinder 6-20 cm with length 30 cm
6. Class B Incomplete cylinder with a length of 9 cm
7. Class C broken charcoal.

At the regional and international level, funding for these programs through:

1. The Caribbean Disaster Emergency Management Agency (CDEMA) formerly called the Caribbean Disaster Emergency Management Agency (CDERA), can be sourced to facilitate reforestation of disaster prone areas to soil erosion, landslides and with wood species that can be used for charcoal making and also minimize soil erosion. The OECS’s secretariat through the framework of St. Georges Declaration and the Barbados Plan of Action should be factored as a donor for decision making , preparation for land use plans and administration, formulation and enforcement, sustainable and integrated use and support for the appropriate afforestation and reforestation.
2. As the Makote mangrove is a Ramsar site and there is funding available under the Ramsar Strategic Plan 2009 to 2015, the issues currently affecting the site that include: invasive alien species management, wetland restoration and increasing environmental awareness, can be developed into project proposals for more effective management of the mangrove. The CEPA Communication Participation Awareness Programs funds may also be accessed for environmental and educational awareness, educational resources and to obtain update to date information, technological support and advice on internationally accepted standards in wetland management.
3. In addition within the framework of climate change with the effect of hurricanes and the rise in sea level that would destroy mangroves, the UNFCC is another MEA that can be strategically used for funding or training to address the issues in all mangroves in St. Lucia. In reference to climate change, projects involving biochar at the site may also be directed to funding by the UNFCC as the proponents of biochar claim that it is a strategy that absorbs carbon from the air and can effectively diminish global warming. In addition the gas emitted may be collected and condensed to produce wood vinegar that could in turn be used for agricultural purposes by the land owner or sold to the public.
4. In the Soufriere area given the presence of the world heritage site of the Pitons, as in the Congo, the World Heritage Sites treaty can be highlighted to facilitate funding and capacity building to make up for either sustainable use or not harvesting forests for charcoal making on lands of communities dependent on this livelihood in the Soufriere range.
5. The Convention on biological Diversity is another convention to source funding through the development of projects in terms of culture, diversity and sustainable use. In addition funding may be sourced based on article 7 dealing with the identification and monitoring of biodiversity, and article 12, 13 and 14 deal with research, training and the assessments of the impact threats, article 8 and 9 focus on “in and ex situ” conservation for the purposes of rehabilitation and restoration of ecosystems, and development of incentives, presented in articles 11, 15 and 16 of this convention
6. Another UN convention that may be exploited is the Millennium Development Goals within the pursuit of reduction in poverty and even through the use of gender to improve gender equality in the ranges.
7. For land degradation in or near the area where there is a high probability of impacts to biodiversity resulting from charcoal production, funding may also be sought form the UNCCD for improved productions systems of management.

*8.2 Recommendations at the Range Level*

Based on the country poverty assessment of St. Lucia (2005-6) the ranges with the most poverty were:

1. Millet Range with the location-Anse La Raye 5.3% indigence.
2. Quillese Range with the locations of Micoud, and Vieux Fort with 4.1% and 4.8% indigence and Laborie with 42 % poverty.
3. Soufriere Range with the locations of Soufriere and Choiseul with the rates of poverty of 44% and 38% respectively.

Therefore, priority to alleviate poverty using the charcoal industry should begin in the Millet, Quillese and Soufriere ranges.

*Millet*

Relative to the other ranges, Millet range was not a major range in the charcoal industry. It recorded the highest number of females involved in the charcoal industry. As such the issue of poverty alleviation using gender equality is one approach that can be used to seek funding from donors. For the high cost of transportation incentives should be developed or sourced to make it easier to obtain a transport. This should be made available to individuals but at cheaper rates for cooperatives or associations of persons involved in the charcoal industry. The charcoal industry should target the hotels and food vendors in the range especially for festive occasions such as the Anse la Raye Fish Fry done every Friday. Specific to the hotels, branding of the charcoal as sustainably produced, and certification of this brand by the Forestry Department and the Bureau of Standards is one way to ensure a guaranteed market and to have a desired impact on the on the environment by all stakeholders. Consideration should also be made to encouraging middlemen to source medium and large charcoal bags from the Soufriere range as Soufriere range recorded the lowest prices islands for the mentioned bag types. In addition, there is the opportunity to channel the sale of charcoal in the Northern range in the wet season as this range is the most active range, with the highest prices in the purchasing charcoal during that period. Consideration may also be given to storage of charcoal before, for sale in that period. As Gliricida was mentioned as the used and preferred wood species, research should be done on the adaptation and productivity of this species in the Millet range and incorporate the findings into management plans. The research work should be done on private and on government lands. To address the issues of unavailability of wood and accessibility to areas for charcoal making there should be collaboration with the Crown Lands, Forestry Department and National Trust and private land owners can develop co-management arrangements, rent or leasing of lands based on contracts or agreements based on forest management plans.

*Soufriere Range*

Soufriere Range registered the oldest number of persons involved in the charcoal industry equal to greater than 61 years old. Hence for sustainability of the livelihood, it is necessary to have public education of the opportunities and impacts of charcoal production on the younger generations. As clear felling was noted in this range the education efforts should explore creating awareness of the need for plant diversity and the dangers to soil conservation with bare soil. Educational awareness is also in reference to the Leucaena woodlot at Vieux Lite and the availability of forest designated for production in the Soufriere range. Hotels may also be targeted for sale of charcoal. They also recorded the highest costs for transportation of charcoal but the lowest prices for medium and large bags of charcoal. With transport, the personnel in sale can target the locations that are further-such as the Northern range to get the best prices for charcoal produced. In this regard they can also specialize in the production of small bags to sell charcoal specifically in the Northern range. Given the preference expressed for Gliricida and Savonnèt for making charcoal, the populations of these plants should be monitored in the range. Research plots can also be established with these plants and the growth rates monitored and determined. Thereafter, the data from growth can be factored into the management plans of these species in the range. To address the issues of unavailability of wood and accessibility to areas for charcoal making there should be collaboration with the Crown Lands, Forestry Department and National Trust and private land owners can develop co-management arrangements, rent or leasing of lands based on contracts or agreements based on forest management plans. There is also the availability of Leucaena woodlots in this range in Forest reserves at Saltibus.

*Quillese Range*

This range is the most complex offering the three categories of bags of charcoal for sale, with the highest levels of production island-wide. In this site the availability of a least one kiln would increase productivity in terms of quantity of charcoal and the time to produce a given quantity. This kiln should be made available only under the supervision of the Forestry Department. In addition there must be high vigilance of forest cover in this range on a monthly basis. This can be done remotely and through patrols. Similar to Soufriere range owing to the preference expressed for Gliricida and Savonnèt and specifically Logwood for making charcoal, the populations of these plants should be monitored in the range. Research plots can also be established with these plants and the growth rates monitored and determined and the information collected and in cooperated into the management plans. To address the issues of accessibility to areas for charcoal making there should be collaboration with the Crown Lands, Forestry Department and National Trust and private land owners can develop co-management arrangements, rent or leasing of lands based on contracts or agreements based on forest management plans. There is also the availability of Leucaena woodlots in this range in Forest reserves at Vieux Lite.

*Dennery*

Dennery range had a higher proportion of females than males when compared with the other ranges. This was the only range with a younger range of persons involved in the charcoal industry. As such programs involving innovation with the current persons in the charcoal industry may begin here. As the preferred or used wood species were Savonnèt and Logwood respectively, these plants should be incorporated in reforestation and research programs to monitor the growth rates and the formulation of forest management plans for the sustainable of these forests. One main goal should be to supply the charcoal needs of the community and of the Dennery Friday Night every weekend. Hotels can also be targeted in other ranges. There is also the availability of Leucaena woodlots in this range in Louvet.

*Northern Range*

This range had the highest consumption, sale and prices of small bags of charcoal. Therefore monitoring systems should be put in place to know the source of the charcoal- from who and where. This is also the most active range during the wet season for the sale of charcoal. Given the specialty of this range, charcoal can be packaged to appeal to specific segments of the market namely:

1. Standards in the weight of charcoal and branding of sustainably harvested and certification by the Forestry Department and the Bureau of Standards.
2. Packaged with a plastic glove with an additional cost for upper and middle class.
3. Specifying the wood used- for charcoal making would appeal to the more savvy consumer
4. Establishment and expansion of facilities for storage, especially just before the wet season is another measure that would contribute to exploiting the market in the Northern range.

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Appendix Number 1

Marketing and Sale of Charcoal

Table 1 Distribution Prices for Charcoal Sold in the 5 Ranges

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Price Sold/  Charged  $7 | Price Sold/  Charged $40 | Price Sold/  Charged $35 | Price Sold/  Charged $30 | Price Sold/  Charged $25 | Price Sold/  Charged $20 | Price Sold/  Charged $15 | Price Sold/  Charged $10 | Price Sold/  Charged $50 | Price Sold/  Charged $45 | Total | % |
| Dennery | 1 | 1 |  | 2 |  |  |  |  |  | 3 | 7 | 15 |
| Millet |  |  | 1 | 1 |  |  |  |  |  | 5 | 7 | 15 |
| Northern |  | 1 | 1 | 1 | 1 |  |  |  |  | 1 | 5 | 11 |
| Quillese | 2 | 1 |  | 2 |  |  | 1 | 1 |  | 13 | 20 | 43 |
| Soufriere |  | 1 |  | 1 |  | 1 |  |  | 2 | 3 | 8 | 17 |
| Total | 3 | 4 | 2 | 7 | 1 | 1 | 1 | 1 | 2 | 25 | 47 | 100 |
| % | 6 | 9 | 4 | 15 | 2 | 2 | 2 | 2 | 4 | 53 | 100 |  |

Table 2 Sale in terms of the Quantity and price of charcoal sold in the 2009 Survey

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Sale Quantity (1 gallon) $4 bucket | Sale Quantity $12 biscuit bucket | Sale Quantity $7 bucket | Sale Quantity 25 bag | Sale Quantity 30 bag | Sale Quantity 35 bag | Sale Quantity 40 bag | Sale Quantity 45 bag | Sale Price Purchased $3 bucket | Total | Mark up in price sold % |
| Dennery | 1 |  |  |  |  | 1 |  |  |  | 2 | 2.1 |
| Millet | 8 | 1 | 1 | 1 | 5 | 2 | 1 | 1 | 2 | 22 | 23.2 |
| Northern | 2 |  | 1 |  | 1 | 1 |  |  |  | 5 | 5.3 |
| Quillese | 9 | 16 | 2 | 2 | 3 | 3 | 4 | 3 | 2 | 44 | 46.3 |
| Soufriere | 4 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 22 | 23.2 |
| Total | 24 | 19 | 6 | 6 | 12 | 9 | 7 | 6 | 6 | 95 | 100.0 |
| % | 25 | 20 | 6 | 6 | 13 | 9 | 7 | 6 | 6 | 100 |  |

Table 3 Price at Which Charcoal was Purchased in the 2009 Survey

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Sale Price Purchased $20 | Sale Price Purchased $25 | Sale Price Purchased $30 | Sale Price Purchased $35 | Sale Price Purchased $50 | Sale Price Purchased $70 | Sale Price Purchased $45 | Sale Price Purchased $40 | Sale Price Sold/Charged $2 per gallon bucket | Sale Price Sold/Charged $2.25 per Nido Tin | Total | % |
| Dennery |  |  |  |  |  |  |  |  |  | 1 | 1 | 1 |
| Millet | 1 | 2 | 5 | 3 | 1 | 1 | 1 | 1 | 5 | 1 | 21 | 15 |
| Northern |  |  | 2 | 10 | 8 |  | 7 | 2 | 7 |  | 36 | 25 |
| Quillese | 3 | 18 | 13 | 11 | 3 | 3 | 2 | 6 | 2 | 2 | 63 | 44 |
| Soufriere | 2 | 3 | 5 | 3 | 2 | 2 | 2 | 2 | 2 |  | 23 | 16 |
| Total | 6 | 23 | 25 | 27 | 14 | 6 | 12 | 11 | 16 | 4 | 144 | 100 |
| % | 4 | 16 | 17 | 19 | 10 | 4 | 8 | 8 | 11 | 3 |  |  |

Table 4a. Price at Which Charcoal was Sold in the 2009 Survey

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Sale Price Sold/Charged $2.5 per gallon bucket | Sale Price Sold/Charged $10 per bucket | Sale Price Sold/Charged $12/bucket | Sale Price Sold/Charged $9/ bucket | Sale Price Sold/Charged $8/ bucket | Sale price $15/ bucket | Sale Price Sold/Charged $7 /bucket | Sale Price Sold/Charged $6 /bucket | Sale Price Sold/Charged $5 /bucket | Sale Price Sold/Charged $4 /bucket | Total | % |
| Dennery |  |  |  |  |  |  |  |  |  |  |  |  |
| Millet | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 11 | 9 |
| Northern | 1 | 8 |  | 6 | 8 |  | 3 | 7 | 7 | 1 | 41 | 33 |
| Quillese | 2 | 14 | 17 | 3 | 2 | 3 | 2 | 2 | 4 | 2 | 51 | 41 |
| Soufriere | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 21 | 17 |
| Total | 6 | 25 | 20 | 12 | 14 | 6 | 8 | 12 | 14 | 7 | 124 | 100 |
| % | 5 | 20 | 16 | 10 | 11 | 5 | 6 | 10 | 11 | 6 | 100 |  |

Table 4 b. Price at Which Charcoal was Sold in the 2009 Survey

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Sale Price Sold/Charged 35 | Sale Price Sold/Charged 30 | Sale Price Sold/Charged 20 | Sale Price Sold/Charged 25 | Sale Price Sold/Charged 40 | Sale Price Sold/Charged 45 | Sale Price Sold/Charged 50 | Sale Price Sold/Charged 60 | Total | % |
| Dennery | 4 | 8 |  |  | 1 |  | 1 | 7 | 21 | 11 |
| Millet | 3 | 11 | 1 | 1 | 3 | 1 | 2 | 1 | 23 | 12 |
| Northern | 11 | 8 |  | 4 | 4 | 1 | 3 | 3 | 34 | 18 |
| Quillese | 17 | 11 | 2 | 4 | 11 | 2 | 12 | 16 | 75 | 39 |
| Soufriere | 4 | 13 | 1 | 4 | 6 | 2 | 3 | 4 | 37 | 19 |
| Total | 39 | 51 | 4 | 13 | 25 | 6 | 21 | 31 | 190 | 100 |
| % | 20.5 | 26.8 | 2.1 | 6.8 | 13.2 | 3.2 | 11.1 | 16.3 |  |  |

Table 5 a. Marketing of Charcoal Directly by the Charcoal producer or a member of family.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Directly by yourself or a member of your family. Price sold 60 | Directly by yourself or a member of your family. Price sold 50 | Directly by yourself or a member of your family. Price sold 40 | Directly by yourself or a member of your family. Price sold 35 | Directly by yourself or a member of your family. Price sold 30 | Directly by yourself or a member of your family. Price sold 25 | Directly by yourself or a member of your family. Price sold 20 | Directly by yourself or a member of your family. Price sold 15 |
| Dennery |  | 1 | 1 | 4 | 7 | 2 |  |  |
| Millet |  | 2 | 2 | 5 | 12 | 4 |  |  |
| Northern |  | 10 | 14 | 26 | 19 | 6 |  |  |
| Quillese | 6 | 24 | 26 | 46 | 31 | 22 |  | 1 |
| Soufriere |  | 6 | 8 | 7 | 9 | 10 | 2 |  |
| Total | 6 | 43 | 51 | 88 | 78 | 44 | 2 | 1 |
| % | 1 | 8 | 10 | 17 | 15 | 9 | 0 | 0 |

Table5 b. Marketing of Charcoal Directly by the Charcoal producer or a member of family

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Directly by yourself or a member of your family. Price sold $2 | Directly by yourself or a member of your family. Price sold $1.5 | Directly by yourself or a member of your family. Price sold $2.5 | Directly by yourself or a member of your family. Price sold $4 | Directly by yourself or a member of your family. Price sold $10 bucket | Directly by yourself or a member of your family. Price sold $12/bucket | Directly by yourself or a member of your family. Price sold $ 7 | Total | % | Directly by yourself or a member of your family. Profit made  (%) |
| Dennery | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 29 | 6 |  |
| Millet | 4 |  |  | 4 | 3 | 3 | 3 | 42 | 8 | 13 |
| Northern | 4 |  |  | 5 | 5 | 5 | 6 | 100 | 19 | 11 |
| Quillese | 17 |  |  | 24 | 24 | 23 | 24 | 268 | 52 | 13 |
| Soufriere | 6 | 1 | 1 | 6 | 6 | 6 | 6 | 74 | 14 |  |
| Total | 33 | 2 | 4 | 41 | 40 | 39 | 41 | 513 | 100 | 12 |
| % | 6 | 0 | 1 | 8 | 8 | 8 | 8 | 100 |  |  |

Table 6 Marketing of Charcoal by a Wholesaler

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | To a wholesaler (middleman) Price sold $45 | To a wholesaler (middleman) Price sold $40 | To a wholesaler (middleman) Price sold $35 | To a wholesaler (middleman) Price sold $28 | To a wholesaler (middleman) Price sold $30 | To a wholesaler (middleman) Price sold $25 | To a wholesaler (middleman) Price sold  $60 | Total | % | To a whole-saler (middleman) Profit made |
| Dennery | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 16 | 8 |  |
| Millet | 2 | 3 | 4 | 2 | 4 | 3 | 3 | 21 | 10 |  |
| Northern | 2 | 2 | 2 | 3 | 3 | 4 | 2 | 18 | 9 |  |
| Quillese | 14 | 19 | 14 | 14 | 15 | 22 | 22 | 120 | 59 |  |
| Soufriere | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 28 | 14 |  |
| Total | 24 | 30 | 26 | 25 | 29 | 35 | 34 | 203 | 100 |  |
| % | 12 | 15 | 13 | 12 | 14 | 17 | 17 |  |  |  |

Table 7 Marketing of Charcoal by a Market Vendor

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | To a market vendor Price sold- $25 | To a market vendor Price sold- $30 | To a market vendor Price sold- $35 | To a market vendor Price sold-$40 | To a market vendor Price sold-$45 | Total | % | To a market vendor Profit made (%) |
| Dennery | 2 |  | 5 |  | 2 | 9 | 8 |  |
| Millet | 2 | 1 | 3 |  | 2 | 8 | 7 |  |
| Northern | 3 |  | 3 |  | 3 | 9 | 8 |  |
| Quillese | 21 | 3 | 23 | 3 | 21 | 71 | 65 | 25 |
| Soufriere | 5 |  | 4 |  | 4 | 13 | 12 |  |
| Total | 33 | 4 | 38 | 3 | 32 | 110 | 100 | 25 |
| % | 30 | 4 | 35 | 3 | 29 | 100 |  |  |

Appendix 2

Scientific Names of Used and Preferred Wood Used for Charcoal Making

Table 1 Common Names and Scientific Names of tree species used for Charcoal

|  |  |
| --- | --- |
| Common Name | Scientific Name |
| Gliricida, Glory cedar | *Gliricidia sepium*  (Jacquin) Kunth ex Walpers |
| Logwood Kanpèch | *Haematoxylum campechianum*L. |
| Bwa Madanm | *Guettarda scabra* (Linnaeus) Lamarck |
| Bwa patat. Bwa (lyenn) myan | *Calliandra tergemina* (Linnaeus) Bentham |
| Bwa gwiyé . Blackberry. | *Myrcia citrifolia* (Aublet) Urban |
| Pwa dou. (Kakoli) | *Inga laurina* (Swartz) Willdenow |
| Mango | *Mangifera indica* Linnaeus |
| Bwa Den Bwaden. Bay leaf. | *Pimenta racemosa* (Miller) J. W. Moore |
| Bwa tan (si) | *Byrsonima spicata* (Cavanilles) de Candolle |
| Bwa Lamoye. Bwa lanmowi. Wézinyé) | *Coccoloba swartzii* Meisner in A. de Candolle |
| Ponm woz | *Syzygium jambos* (Linnaeus) Alston |
| Savonnèt gwan fey | *Lonchocarpus heptaphyllus* (Poiret) Kunth ex de Candolle |
| Ti savonnèt. | *Lonchocarpus punctatus* Kunth *Lonchocarpus heptaphyllus* |
| Red mangrove | *Rhizophora mangle* Linnaeus |
| Ti bonm blan | *Croton bixoides* Vahl |
| Bwa Kwéyòl | *Myrcia deflexa* (Poiret) de Candoll |
| Kakoli | *Inga ingoides* (Richard) Willdenow |
| Bwa Canoe  Bwa kannon | *Cecropia schreberiana* Miquel |
| White cedar, Pòwyé | *Tabebuia heterophylla* (de Candolle) Britton |
| Bwa flambo | *Koanophyllon celtidifolia* (Lamarck) R.M. King & H. Robinson |
| Sea grape  Wézen. Siwiz | *Coccoloba uvifera* (Linnaeus) Linnaeus |
| Leucaena | *Leucaena leucocephala* (Lamarck) de Wit |
| Tamarind | *Tamarindus indica* Linnaeus |
| Gmelina | *Gmelina arborea* Roxburgh ex Smith |
| Maho piman | *Daphnopsis americana* (Miller) J. R. Johnston |
| Coconut | *Cocos nucifera* Linnaeus |
| Bwa léza | *Vitex divaricata* Swartz |
| Chatannyé | *Sloanea caribaea* Krug &Urban ex Duss |
| Casuarina | *Casuarina equisetifolia* Linnaeus |
| Balata | *Manilkara bidentata* (A. de Candolle) A. Chevalier |
| Bwa djét | *Guettarda odorata* (Jacquin) Lamarck |
| Blue mahoe | *Talipariti elatum* (Swartz) Fryxell |
| Honduras Mahognay | *Swietenia macrophylla* King |
| Zo bef Bwa zo bèf | Margaritaria nobilis Linnaeus f |
| Citrus | *Citrus aurantiifolia* (Christmann) Swingle |
| Bwa dimas Bwa dimas | *Licania ternatensis* Hooker f. ex Duss |
| Red Cedar. Acajou | *Cedrela odorata* Linnaeus |
| Le -peneux Lépini | *Zanthoxylum monophyllum* (Lamarck) P. Wilson |
| Bwa lonm | *Guazuma ulmifolia* Lamarck |
| Cocao | *Theobroma cacao* Linnaeus |
| Bwa bleu | *Symplocos martinicensis* Jacquin |
| Laurier lowyé gwi | *Nectandra coriacea* (Swartz) Grisebach |
| Bwa laum | *Guazuma ulmifolia* Lamarck |
| Kako. Cocoa | *Theobroma cacao* Linnaeus |
|  |  |

Appendix Number 3

Used and Preferred Wood Species Used for Charcoal Making

Table 1a. Wood Species Used for Charcoal Making

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Hardwoods | Various types | Gliricida | Logwood | Bwa Madanm | Bwa myan | Bwa gwiyé | Sweet Peas | Mango | Bwa Den |
| Quillese | 5 | 4 | 33 | 28 | 2 | 2 | 0 | 3 | 27 | 1 |
| Dennery | 4 | 2 | 2 | 4 | 8 | 1 | 0 | 1 | 8 | 1 |
| Soufriere | 5 | 0 | 17 | 8 | 0 | 2 | 0 | 3 | 12 | 1 |
| Millet | 0 | 2 | 5 | 4 | 0 | 0 | 0 | 0 | 2 | 0 |
| North | 0 | 0 | 2 | 6 | 1 | 0 | 0 | 0 | 4 | 0 |
|  | 14 | 8 | 59 | 50 | 11 | 5 | 0 | 7 | 53 | 3 |

Table 1 b. Wood Species Used for Charcoal Making

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Bwa tan (si) | Bwa Lamoye, | Ponm Rose | Savonnèt | Red mangrove | Ti Bom Blanc | Bwa Kwéyòl | Kakoli | Bwa Canoe | White cedar |
| Quillese | 15 | 2 | 0 | 32 | 1 | 14 | 4 | 9 | 0 | 15 |
| Dennery | 0 | 0 | 0 | 6 | 0 | 6 | 4 | 1 | 3 | 10 |
| Soufriere | 6 | 0 | 0 | 18 | 1 | 6 | 0 | 6 | 0 | 1 |
| Millet | 1 | 1 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 |
| North | 2 | 0 | 0 | 5 | 0 | 0 | 2 | 0 | 0 | 7 |
|  | 24 | 3 | 0 | 61 | 2 | 30 | 10 | 16 | 3 | 33 |

Table 1 c. Wood Species Used for Charcoal Making

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Flambo | Sea Grape | Leucaena | Termarind | Gmelina | Bwa poule | De Basse | Maho piman | Coconut |  |
| Quillese | 0 | 0 | 0 | 1 | 2 | 1 | 2 | 1 | 4 |  |
| Dennery | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |  |
| Soufriere | 0 | 0 | 0 | 1 | 2 | 1 | 0 | 1 | 3 |  |
| Millet | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |  |
| North | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |
|  | 2 | 1 | 1 | 2 | 4 | 2 | 3 | 2 | 7 |  |

Table 1 d. Wood Species Used for Charcoal Making

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Bwa léza | Chatannyé | Casuarina | Balata | Bwa djét | Blue mahoe | Mahogany | Zobeff | Citrus | Bwa dimas |
| Quillese | 1 | 2 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| Dennery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Soufriere | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 |
| Millet | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| North | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
|  | 2 | 3 | 6 | 3 | 3 | 3 | 3 | 3 | 3 | 5 |

Table 1 e. Wood Species Used for Charcoal Making

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Red Cedar | Le -peneux | Bwa laum | Cocao | Bwa bar | Bwa bleu | Laurier | Bwa laum | Cocao | Bwa bar | Bwa bleu | Laurier | Total |
| Quillese | 3 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 125 |
| Dennery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 |
| Soufriere | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 53 |
| Millet | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 15 |
| North | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 17 |
|  | 5 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 240 |

Table 2 a. Preferred Wood Species Used for Charcoal Making.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Hardwoods | No preference | All | Awali | Bwa Bom | Gliricida | Logwood | Coubaril | Bwa Madanm | Bwa myan | Kakoli |
| Quillese | 0 | 0 | 1 | 0 | 0 | 5 | 23 | 1 | 1 | 0 | 0 |
| Dennery | 8 | 1 | 2 | 1 | 0 | 0 | 12 | 0 | 1 | 0 | 0 |
| Soufriere | 3 | 0 | 0 | 0 | 1 | 11 | 4 | 0 | 0 | 1 | 1 |
| Millet | 0 | 0 | 0 | 0 | 0 | 2 | 6 | 0 | 0 | 0 | 0 |
| North | 0 | 0 | 0 | 0 | 1 | 3 | 3 | 0 | 0 | 0 | 0 |
|  | 11 | 1 | 3 | 1 | 2 | 21 | 48 | 1 | 2 | 1 | 1 |

Table 2 b. Preferred Wood Species Used for Charcoal Making b

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Bwa gwiyé | Sweet Peas | Mango | Bwa Den | Bwa tan (si) | Waizeya | Savonnèt | Red mangrove | Ti Bom Blanc | Bwa Kwéyòl | White cedar |
| Quillese | 6 | 3 | 0 | 3 | 2 | 1 | 1 | 1 | 0 | 0 | 0 |
| Dennery | 0 | 0 | 0 | 0 | 1 | 0 | 6 | 0 | 4 | 0 | 0 |
| Soufriere | 0 | 1 | 2 | 0 | 2 | 0 | 22 | 0 | 2 | 0 | 0 |
| Millet | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| North | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 |
|  | 6 | 4 | 2 | 4 | 7 | 1 | 30 | 1 | 6 | 1 | 1 |

Table 2 c. Preferred Wood Species Used for Charcoal Making c.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Bwa Creole | Sea Grape | Bwa Patat | Leucaena | Coconut | Bwa léza | Balata | Bwa dimas | Red Cedar |  |
| Quillese | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 31 |
| Dennery | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 25 |
| Soufriere | 0 | 0 | 1 | 0 | 2 | 1 | 0 | 1 | 1 | 21 |
| Millet | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| North | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 7 |
|  | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 92 |

Appendix 4

Results from Factor Analysis of Total Variance Explained for the Species of Wood Used for Making

Table 1 Results from Factor Analysis of Total Variance Explained for the Species of

Wood Used for Making in Charcoal in the 5 Ranges

Table 2 Results from Factor Analysis the key variable for Wood used for Charcoal

Production



Table 3 Results from Factor Analysis of Total Variance Explained of the key variable for

the Preferred Wood used for Charcoal Production



Table 4 Results from Factor Analysis of the key variable for the Preferred Wood used for

Charcoal Production

Component Matrix

a

.238

-.453

.828

.229

-9.59E-02

-.613

.761

.190

-.438

-.262

.817

.270

-9.59E-02

-.613

.761

.190

.691

6.272E-02

-.523

.495

.638

.750

-8.60E-02

.151

-.750

.460

.461

.115

-.684

.703

.112

.159

-.637

7.346E-02

.713

.285

.876

.456

.127

8.989E-02

-.684

.703

.112

.159

-.403

.880

.159

.195

.876

.456

.127

8.989E-02

-.714

.594

-.147

.341

7.803E-02

.686

.387

-.612

-.684

.703

.112

.159

.870

.323

.324

.183

-.684

.703

.112

.159

.342

-.385

.824

.235

-3.01E-02

-.379

-.767

.517

.876

.456

.127

8.989E-02

-3.01E-02

-.379

-.767

.517

-9.59E-02

-.613

.761

.190

-.684

.703

.112

.159

.876

.456

.127

8.989E-02

-.684

.703

.112

.159

.876

.456

.127

8.989E-02

.876

.456

.127

8.989E-02

.876

.456

.127

8.989E-02

-3.01E-02

-.379

-.767

.517

.637

-.129

.725

.229

.876

.456

.127

8.989E-02

Hardwoods

No preference

All

Kakoli

Bois Bom

Gliricida

Logwood

Coubaril

Bois Madam

Bois Mayan

Bois Gwiye

Sweet Peas

Mango

Bois Den

Bois Tan

Waizeya

Savonnet

Red mangrove

Ti Bom Blanc

Bois Kweyol

Awali

White cedar

Bois Creole

Sea Grape

Bois Patat

Leucaena

De Basse

Coconut

Bois lezard

Balata

Bois De Masse

Red Cedar

1

2

3

4

Component

Extraction Method: Principal Component Analysis.

4 components extracted.

a.

Appendix 5

Alternative Employment of Charcoal of Producers in the 2002 and 2009 Charcoal Surveys.

Table 1 a. Alternative Employment of Charcoal Producers a for the 2002 Survey a.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Masonry | Farming | Quarry worker | Surveying | Temporary Work | Trades man | Carpenter | Steel bender |
| Quillese | 3 | 19 | 0 | 0 | 2 | 1 | 3 | 0 |
| Dennery | 1 | 14 | 0 | 0 | 0 | 0 | 0 | 0 |
| Soufriere | 2 | 14 | 0 | 0 | 0 | 0 | 0 | 1 |
| Millet | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 |
| North | 0 | 5 | 0 | 0 | 0 | 0 | 1 | 0 |
|  | 6 | 56 | 0 | 0 | 2 | 1 | 4 | 1 |

Table 1 b. Alternative Employment of Charcoal Producers a for the 2002 Survey b

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Construction | Retired Civil Servant | Fisherman | Vendor | Shopkeeper | Baker | Welder | Bee keeping |
| Quillese | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dennery | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 |
| Soufriere | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| Millet | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| North | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|  | 0 | 1 | 2 | 1 | 1 | 1 | 1 | 1 |

Table 1 c. Alternative Employment of Charcoal Producers a for the 2002 Survey.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Black smith | Security | Tailor | Chainsaw operator | Joiner | Caretaker | Labourer | Total |
| Quillese | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28 |
| Dennery | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 15 |
| Soufriere | 2 | 0 | 0 | 0 | 0 | 1 | 4 | 17 |
| Millet | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| North | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 6 |
|  | 2 | 1 | 1 | 1 | 1 | 1 | 9 | 70 |

Table 2 a. Alternative Employment of Charcoal Producers for the 2009 Survey

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| Range | farmer | Trucker | Janitor | Chainsaw operator | Painter | Seamstress | shopkeeper | food vendor | fisherman | housekeeper |  |
| Dennery | 7 | 0 | 0 | 0 | 0 | 0 | 1 | 26 | 0 | 0 |  |
| Millet | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 |  |
| Northern | 15 | 1 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 |  |
| Quillese | 60 | 0 | 1 | 0 | 2 | 1 | 2 | 1 | 1 | 1 |  |
| Soufriere | 16 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |  |
|  | 106 | 1 | 1 | 1 | 2 | 1 | 5 | 41 | 1 | 1 |  |

Table 85 b Table 2 b. Alternative Employment of Charcoal Producers for the 2009 Survey

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | carpenter | baker | mason | painter | vendor | taxi driver | hotel worker | labourer | tradesman | Total |
| Dennery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 34 |
| Millet | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21 |
| Northern | 0 | 0 | 3 | 0 | 2 | 0 | 1 | 5 | 2 | 19 |
| Quillese | 1 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 69 |
| Soufriere | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 17 |
|  | 1 | 2 | 3 | 1 | 4 | 1 | 2 | 6 | 2 | 160 |

Appendix 6

Text Output Summary from SPSS program Regression Analysis

Text Output Summary from SPSS program Regression Analysis

\_

Dependent variable.. PRICE Method.. LINEAR

Listwise Deletion of Missing Data

Multiple R .82772

R Square .68512

Adjusted R Square .60640

Standard Error 7.15248

Analysis of Variance:

DF Sum of Squares Mean Square

Regression 1 445.24310 445.24310

Residuals 4 204.63190 51.15797

F = 8.70330 Signif F = .0420

-------------------- Variables in the Equation --------------------

Variable B SE B Beta T Sig T

YEAR .716689 .242934 .827720 2.950 .0420

(Constant) -1400.563930 481.788089 -2.907 .0438

\_

Dependent variable.. PRICE Method.. LOGARITH

Listwise Deletion of Missing Data

Multiple R .82872

R Square .68678

Adjusted R Square .60848

Standard Error 7.13357

Analysis of Variance:

DF Sum of Squares Mean Square

Regression 1 446.32344 446.32344

Residuals 4 203.55156 50.88789

F = 8.77072 Signif F = .0415

-------------------- Variables in the Equation --------------------

Variable B SE B Beta T Sig T

YEAR 1429.461520 482.675046 .828724 2.962 .0415

(Constant) -10832.339266 3664.678584 -2.956 .0417

Appendix 7

Questionnaires for the Charcoal Surveys of 2009 and 2002

Questionnaire for Charcoal Production, Use and Sale 2009

Questionnaire no… Date ………… Range…………………………

Place of Interview…………… Time………..

Sex……. Male or female

Age… 5 to 20 21 to 30 31 to 40 41 to 50 51 to 60 More than 61

Education No Formal Schooling Primary Secondary Tertiary

At what level are you involved in use of charcoal- tick all options that are applicable: How much you buy and sell charcoal or how much you charge for your service

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Activity | Extraction | Production | Exchange | Transport | Distribution | Sale |
| Quantity Unit |  |  |  |  |  |  |
| Price Purchased |  |  |  |  |  |  |
| Price Sold/charged for service |  |  |  |  |  |  |

Unit-a) size of tin b) size of bag c) Load (number and size of bags)

How long have you been produce/use/sell Charcoal?

|  |  |  |  |
| --- | --- | --- | --- |
|  | Produce | Use | Sell |
| Less than 1 year |  |  |  |
| 1-3 yrs |  |  |  |
| Over 3 yrs |  |  |  |

Is this your only occupation? Yes …. No ….. If No state other(s)……………………………………………………………………………………………………….

When do you Produce/use/sell Charcoal? Year round Dry Season Wet Season

|  |  |  |  |
| --- | --- | --- | --- |
|  | Produce | Use | Sell |
| Year Round |  |  |  |
| Dry Season |  |  |  |
| Wet Season |  |  |  |

How many bags of charcoal do you produce/use/sell per week/ month? (Put answer next to size bag used).

|  |  |  |  |
| --- | --- | --- | --- |
|  | Produce | Use | Sell |
| Small bags(50lbs)……… |  |  |  |
| Medium bags(100lbs)……. |  |  |  |
| Large bags…….. |  |  |  |

How much charcoal do you produce/use/sell in 1 year? …How long during the year? ……….Months

|  |  |  |  |
| --- | --- | --- | --- |
|  | Produce | Use | Sell |
| 1 year |  |  |  |
| How long during the year (months |  |  |  |

How do you normally sell your charcoal? To whom and at what price sold? How much profit made on sale?

(a).Directly by yourself or a member of your family.

(b) To a wholesaler (middleman)…………….

(c) To a market vendor…………….

Other seller (specify)………………………………………..

How much do you sell each of the following bags of charcoal for?

Small bag……

Medium bag……

Large bag………

Total average monthly income:

Less than $500

Greater than $500 but less than $1000

Greater than $1000 but less than 2000

Greater than $2000

Questionnaire for Charcoal Producers 2002

Questionnaire no… Date …………

Place of Interview…………… Time………..

How long have you been producing Charcoal?

Less than 1 year

1-3 yrs

Over 3 yrs………….

How much charcoal do you produce every month ? ………….

Is this your only occupation? Yes …. No …..

If no, state other occupation(s)……………………………..

Where do you normally produce your charcoal?…………………………

How and why was this site selected……………………………………..

How frequently do you fire pits ?...................

How many bags of charcoal do you produce per week/month ? (Put answer next to size bag used).

Small bags(50lbs)………

Medium bags(100lbs)…….

Large bags……..

How do you normally sell your charcoal?

Directly by yourself or a member of your family

To a wholesaler (middleman)…………….

To a market vendor…………….

Other seller (specify)………………………………………..

How much do you sell each of the following bags of charcoal for?

Small bag……

Medium bag……

Large bag………

Do you use any of the charcoal you produce? Yes………. No………….

If yes how much……………………………………………………………………

What type of wood do you use to produce charcoal?……………………..

………………………………………………………………………………………

What type(s) of wood do you prefer to use to produce charcoal? ………………………………………………………………..

Is there any difficulty in obtaining your preferred wood? Yes……… No………

If Yes then state Why……………………………………………………………..

What method of harvesting wood do you use

Selective cutting in an area

Clear cutting of an area

Since you began producing charcoal, are you producing more, or less than before? And why do you think so?.........................................................................................

1. Gabriel Charles served as the Chief Forest Officer from 1972 to 1989 [↑](#footnote-ref-1)
2. Michael Andrew is the current Chief Forest Officer who was appointed to the position in 2007 [↑](#footnote-ref-2)
3. The pass through mechanism came into effect in September 2009 and was as articulated as a policy by the government in the Budget address speech of the Prime Minister Stephenson King [↑](#footnote-ref-3)
4. Definition of Biodiversity: a broad term that refers to all the life forms found and the ecological roles they perform ( Convention on Biological Diversity Website: <http://www.cbd.int/forest/definitions.shtml> [↑](#footnote-ref-4)
5. Definition of Poverty: Source http://en.wikipedia.org/wiki/Poverty [↑](#footnote-ref-5)
6. Absolute Poverty: is the measurement of the minimum requirements needed to survive (Dudley, 2008). [↑](#footnote-ref-6)
7. [http://news.bbc.co.uk/1/hi/business/7934405.stm March 10 2009](http://news.bbc.co.uk/1/hi/business/7934405.stm%20March%2010%202009) [↑](#footnote-ref-7)
8. A recession is the state of the economical decline associated with a widespread decline in the gross domestic product (GDP) and employment and trade lasting from six months to a year. [wordnet.princeton.edu/perl/webwn](http://www.google.com/url?sa=X&start=0&oi=define&ei=Ds3PSfqaBMvLjAfiwoHJCQ&sig2=TA-7IHN9g9qB8tVUPS3Lcg&q=http://wordnet.princeton.edu/perl/webwn%3Fs%3Drecession&usg=AFQjCNFLkh7NXSMFp0uNkiEBUP0k0TOjDg). [↑](#footnote-ref-8)
9. <http://en.wikipedia.org/wiki/Economic_crisis_of_2008> December 2008 by the International Monetary Fund) [↑](#footnote-ref-9)
10. <http://www.irinnews.org/Report.aspx?ReportId=79148> [↑](#footnote-ref-10)
11. Inflation definition: A general increase in prices, normally expressed as the annual rate of growth in the consumer or retail price index Source the Financial Times Lexicon-<http://lexicon.ft.com/term.asp?t=inflation> [↑](#footnote-ref-11)
12. The Motley Fool is a commercial website about stocks, investing, and personal finance [↑](#footnote-ref-12)
13. SciNET <http://www.scidev.net/en/editorials/haitis-lessons-for-managing-the-global-environmen.html> [↑](#footnote-ref-13)
14. World Focus, February 18, 2009, Haitians destroy environment in struggle to survive <http://worldfocus.org/blog/2009/02/18/haitians-destroy-environment-in-struggle-to-survive/4103/> [↑](#footnote-ref-14)
15. World Focus, February 19, 2009 Dirt poor Haitians eat cookies made of mud, <http://worldfocus.org/blog/2009/02/19/dirt-poor-haitians-eat-cookies-made-of-mud/4120/> [↑](#footnote-ref-15)
16. Jahto Mahal Social Transformation Officer in the Millet Range [↑](#footnote-ref-16)
17. Ananias Verneiul Retired Forest Officer for the Dennery Range [↑](#footnote-ref-17)
18. <http://www.uwic.ac.uk/icrc/issue010/articles/05.htm> [↑](#footnote-ref-18)
19. The Year of the publication was not available [↑](#footnote-ref-19)
20. [↑](#footnote-ref-20)
21. IRIN issue “Malawi Charcoal is a burning issue.” Blantyre October 8 2008 [↑](#footnote-ref-21)
22. The Author and year of publication was not available. [↑](#footnote-ref-22)
23. Social capital refers to the resources that people draw upon to help meet their livelihood objectives (Newton, 2006). [↑](#footnote-ref-23)
24. RAPIDO was a project in Europe, done to analyze the current best practices concerning the development of innovation in agriculture, forestry, the food sector and the wider rural areas as well as to analyze methods to transfer knowledge to different target groups: Source: <http://www.rapido-fp6.eu/> [↑](#footnote-ref-24)
25. A commodity chain is a series of interlinked exchanges through which a commodity and its constituents pass from extraction or harvesting through production to end use. [↑](#footnote-ref-25)
26. Access is the freedom or ability to obtain or make use of an item or resource. [↑](#footnote-ref-26)
27. Control is defined as the “ability to mediate access” or the ability to exercise power over others (Ribot, 1998) [↑](#footnote-ref-27)
28. Definition of Pluralist management: Management to achieve consensus and long-term stability in worker relations to balance the demands of competing groups, to minimize the frustration and anger associated with conflict Source Pluralistic Perspective Management- <http://www.bola.biz/unions/pluralistic.html> [↑](#footnote-ref-28)
29. The year was not specified in the literature consulted [↑](#footnote-ref-29)
30. The year of publication was not specified [↑](#footnote-ref-30)
31. The year of publication was not specified [↑](#footnote-ref-31)
32. Definition of added value: is an action to increase the utility and appeal of a product to the consumer [↑](#footnote-ref-32)
33. Year not specified [↑](#footnote-ref-33)
34. <http://www.rain-tree.com/campeche.htm> [↑](#footnote-ref-34)
35. <http://www.foodnet.cgiar.org/market/Tropcomm/part2jo.htm> [↑](#footnote-ref-35)
36. MEA: [Multilateral Environment Agreements](http://www.gdrc.org/uem/mea/index.html) [↑](#footnote-ref-36)
37. Source <http://www.unesco.ca/en/activity/culture/heritagesites.aspx> Date Consulted November 1 2009 [↑](#footnote-ref-37)
38. A cabinet is a body of the most senior ministers in a government, who meet regularly policies of a country (Collin, 2001) [↑](#footnote-ref-38)
39. The National Wildfire Plan was approved by Cabinet in May 2009. [↑](#footnote-ref-39)
40. Martinique- an island that is a French department located approximately 40 kilometers to the north of St. Lucia is similar in topography and soil formation as St. Lucia [↑](#footnote-ref-40)
41. Marginal soils: Land that is not good for growing crops or grass for animals (Collins, 2001) [↑](#footnote-ref-41)
42. Definition of biodiversity hot spot: the richest and most threatened reservoirs of plant and animal life biodiversity [↑](#footnote-ref-42)
43. Definition of Head-count Number of persons present (Collin, 2001) [↑](#footnote-ref-43)
44. The indigent are persons whose daily average consumption is too low to guarantee adequate nutrition to maintain good bodily health- (St. Lucia Poverty Assessment ,2005) [↑](#footnote-ref-44)
45. Vulnerability measures the proportion of the population that would be susceptible to falling into poverty as a result of an unanticipated event such a natural disaster or adverse economic shock, (St. Lucia Poverty Assessment ,2005) [↑](#footnote-ref-45)
46. The HPI-1 measures severe deprivation in health by the proportion of people who are not expected to survive to age  [↑](#footnote-ref-46)
47. <http://hdrstats.undp.org/countries/country_fact_sheets/cty_fs_LCA.html> [↑](#footnote-ref-47)
48. Oprah Winfrey: Oprah Winfrey was named one of the 100 Most Influential People of the 20th Century by Time magazine and Forbes magazine published its list of America's billionaires for the year 2003-it disclosed that Oprah Winfrey was the first African-American woman to become a billionaire- Source- Academy of Achievement: <http://www.achievement.org/autodoc/page/win0bio-1> [↑](#footnote-ref-48)
49. Doing Business 2008 is A Project Benchmarking the Regulatory Cost of Doing Business in 178 Economies Doing Business Project, World Bank Group, The International Bank for Reconstruction and Development Washington DC [↑](#footnote-ref-49)
50. Definition of Crown Lands: other than Forest Reserves in St. Lucia is another designation for land belonging to the Government of St. Lucia under the jurisdiction of the Crown Lands Department. The forest reserves are also government lands under the jurisdiction of the Forestry Department. [↑](#footnote-ref-50)
51. Price inelastic goods are those where the price of something does not change very much when the supply or the demand for it increases or decreases: Source The Financial Times Lexicon <http://lexicon.ft.com/term.asp?t=price-inelastic> [↑](#footnote-ref-51)
52. K8- Was a Leucaena hybrid that was introduced in St. Lucia for establishment in woodlots for the purposes of Charcoal production [↑](#footnote-ref-52)
53. Year of the study was not specified in the literature [↑](#footnote-ref-53)
54. The NEP and NEMS were approved by Cabinet in 2005. [↑](#footnote-ref-54)
55. Zando is the local name for the endemic species of the lizard reptile *Cnemidophorus vanzoi*  [↑](#footnote-ref-55)
56. Jacquot is the local name national parrot which is also an endemic species: the *Amazona versicolor* [↑](#footnote-ref-56)
57. TREES Teachers for the Restoration of the Environment and Educational Society [↑](#footnote-ref-57)
58. Crawford (2008) [↑](#footnote-ref-58)
59. World Focus, February 18, 2009, Haitians destroy environment in struggle to survive [↑](#footnote-ref-59)
60. Integrated Regional Information Networks, IRIN, Kenya KILIF Nov 12 2008 [↑](#footnote-ref-60)
61. Integrated Regional Information Networks, Mauritania NOUAKCHOTT December 8 2008 [↑](#footnote-ref-61)
62. Faye 2006 [↑](#footnote-ref-62)
63. Integrated Regional Information Networks, Ziguinchor Senegal, December 13 2007 [↑](#footnote-ref-63)
64. Integrated Regional Information Networks, HargeisaNovember 17 2008 [↑](#footnote-ref-64)
65. Integrated Regional Information Networks, November 2008 [↑](#footnote-ref-65)
66. Integrated Regional Information Networks November 2008, [↑](#footnote-ref-66)
67. Integrated Regional Information Networks, October 22 2008 [↑](#footnote-ref-67)
68. Integrated Regional Information Networks, October 1 2008 [↑](#footnote-ref-68)
69. Dr. Bruce Lauckner is a Biometrist at the regional agency for agricultural research in the Caribbean- Caribbean Agricultural Research and Development Institute (CARDI). [↑](#footnote-ref-69)
70. Allan Alexander was the student pursuing a masters degree in natural resource management at the University of the West Indies in 2001. [↑](#footnote-ref-70)
71. Dr. Johannes Lehmann is a Professor from Cornell University and is the Chairman for the International Biochar Initiative [↑](#footnote-ref-71)