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METHODS AND APPROACHES TO THE APPLICATION OF BIOCHAR SYSTEM IN GHANA, SIERRA LEONE, ZIMBABWE, ETHIOPIA AND CAMEROON

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Summary

1 AN ANCIENT TECHNOLOGY FOR FACING TODAY'S PROBLEMS IN AFRICA

-Introduction

In the first chapter "an ancient technology for facing today's problems in Africa", I am going to introduce the Biochar technology and system to the readers of this thesis, having regard to explain what is Biochar, how it works taking account the application of a Biochar system in small communities, to investigate which are the positives and the negative peculiarities of Biochar system through SWOT analysis, to understand which are the challenges to face in the introduction of a Biochar system in small communities, the peculiarities of the introduction and acceptation of Biochar system in small communities, the impacts and advantages of biochar systems in energy access, food security, health, environment and socio-economics development.
The areas of study are some territories of western Africa countries such as Ghana, Sierra Leone, and Cameroon, one eastern Africa country, Ethiopia, and one Southern, Zimbabwe.
The aim of the first chapter is to introduce the readers to the properties of a Biochar system so that to ease understanding of the second part of this work that is the description of few Biochar related projects and the analysis of five study cases.

1.1 THE BIOCHAR

1.1.1 What is Biochar

The biochar is a fine-grained and porous substance, similar in its appearance to charcoal produced either by natural burning of bio wastes or in kiln during pyrolysis. (A story of cooperation with Western Africa on biochar technology transfer, Starter srl, 2013).
The conversion of plant to char is an ancient method that was discovered in ancient land of Brazilian Amazon region. The dark earths, called *terra preta de indio* has the faculty to increase the fertility of the soil.
The fertility of terra preta soil is due by:

- higher level of soil organic matter
- holding capacity of nutrients such as nitrogen, phosphorus, calcium and potassium,

- pH values,
- moisture-holding capacity,

compared to the surrounding soils (Sombroek 1966; Smith 1980; Zech et al. 1990).

Picture n.1: Terra preta (source http://philipcoppens.com/terrapreta.html)

Picture n.2: Terra Preta do Indio in Brazil (source: http://philipcoppens.com/terrapreta.html)

Picture n. 3: Terra petra do Indio in Brazil (source: A story of cooperation with Western Africa on biochar technology transfer, Starter srl, 2013)

Biochar could be considered as a sort of remake of the ancient technology of terra preta de Indio. Therefore, the application of Biochar in specific soils has the capacity of improving the fertility of the soil as *terra preta de Indio* had in the Brazilian Amazon region.
The improvement of the fertility of the soil could be an important aspect in regions where the food sourcing is a serious question. This aspect will be taken into account in the third paragraph of this chapter.

1.1.2 How Biochar is produced

Biochar is produced during pyrolysis - the thermal transformation of biomass which occurs in a low oxygen environment at high temperatures (350-700°C). What distinguishes pyrolysis from different ways of converting biomass into energy is that pyrolysis produces syngas and some other products such as biochar and bio-oil (A story of cooperation with Western Africa on biochar technology transfer, Starter srl, 2013).

The main feedstock in the production of biochar are shown in the table n.1:

Table n.1 (source: Positive list of biomass feedstock approved for use in producing biochar, European Biochar Foundation - EBC certificate, 2013)

Origin	Biomass feedstock
Garden waste	Leaves
	Flower Vegetables
	Roots
	Pruning from trees, vines and bushes
	Clippings from nature conversation measures
	Hay, grass
Agriculture and forestry	Harvest leftovers Straw, used straw, husk and grain dust Grain, feedstuffs, fruit
	Grain, feedstuffs, pruning from biomass plantations grown for energy or biomass use (renewable resources)
	Pruning from trees, vines and bushes

	Seeds and plants
	Bark Bark and chippings Wood Sawdust, wood shavings, wood wool
Materials from food and confectionary production	Expired food and confectionary Leftovers from the production of canned food
	Seasoning residues Residues from potato, corn or rice starch production Residues from dairy processing Fruit, grain and potato residues, alcohol distillery residues Brewer's grain, gems and dust from spent hops in beer production, lees and sludge from breweries Marc, wine lees, sludge from the winemaking Tobacco, tobacco dust, slacks, ribs, sludge Tea and coffee grounds Fruit Treacle residues Oilseed residues Mushroom substrates Fish residues Eggshells
Texiles	Cellulose, cotton and vegetable fibres Hemp, sisal and other fibres Wool leftovers and wool dust
Paper production	Paper fibre sludge

Plant-based packaging material origin	Cotton and wood fibres
Biogas plants	Fermentation residues
Local waste collection services with waste separation	Biodegradable waste Biodegradable waste with kitchen waste Biodegradable waste with kitchen waste and leftovers
Kitchens and canteens	Kitchen, canteen and restaurant leftovers
Vegetable production	Material from washing, cleaning, peeling , centrifuging and separation processes Pulp, pips, peelings, shreds or pomace (e.g., from oil mills, spent grain)
Waterway maintenance (vegetable material)	Raked off material, flotsam, fishing residues Harvested material, water plants
Animal by-products	Hides and skins, bristles, feathers, hair, bones

In Sub-Saharian Africa, the process to convert biomass to Biochar is linked to the use of agriculture wastes as biomass.

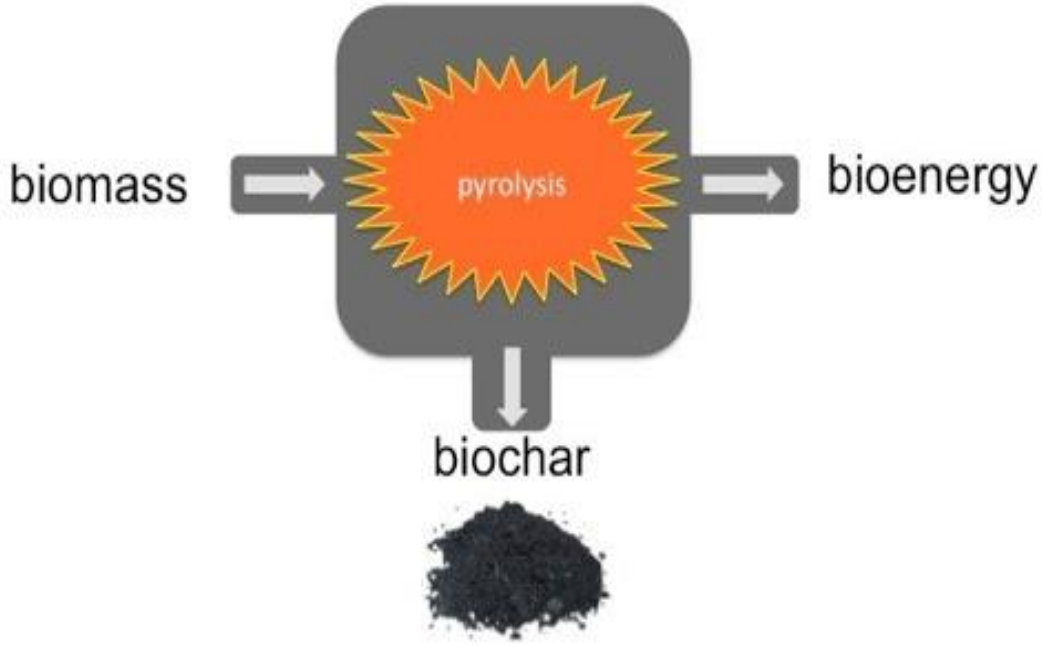
The pyrolysis is the process through which the biomass is converted to biochar. It's a thermal degradation either in total absence of oxygen, or with such a limited supply that gasification does not occur to an appreciable extent or may be described as partial gasification. The pyrolysis starts between the temperatures of 500 to 800 °C, compared to 800 to 1000 °C in gasification. The pyrolysis results are usually three: gas, pyrolysis oil and charcoal, the relative proportions of which depend on three factors: the pyrolysis method, the characteristics of the biomass and the reaction parameters.
Pyrolysis has been used for centuries for production of charcoal. This requires approximately slow reaction at very high temperatures to optimize solid productivity. More recently, researches about pyrolysis have suggested ways of considerably changing the amount of the gas, liquid and solid outcomes by variating the rate of heating, temperature and residence time.

There is a wide range of pyrolysis process conditions to optimize, which influence the quantity and quality of the outcomes. Syngas and bio-oil can be used as fuel for energy, while biochar can be used as soil amendment, thus becoming a C sequestration (C-negative) strategy. Actually, the application of biochar into soil is proposed as a novel

approach to establish a significant, long-term sink for atmospheric carbon dioxide (CO2) in terrestrial ecosystems. Apart from reducing atmospheric CO2 concentration, biochar production and application to soil may deliver a lot of benefits in terms of improved soil fertility and increased crop yield (Lehman, 2007).

In the picture below, there is a simple explanation about the conversion of biomass to Biochar.

Picture n.4: How biomass turns into Biochar (source: Biochar, Frontline services Australia Pty Ltd, 2015)



1.1.3 Biochar systems

A Biochar system keeps together three aspects:

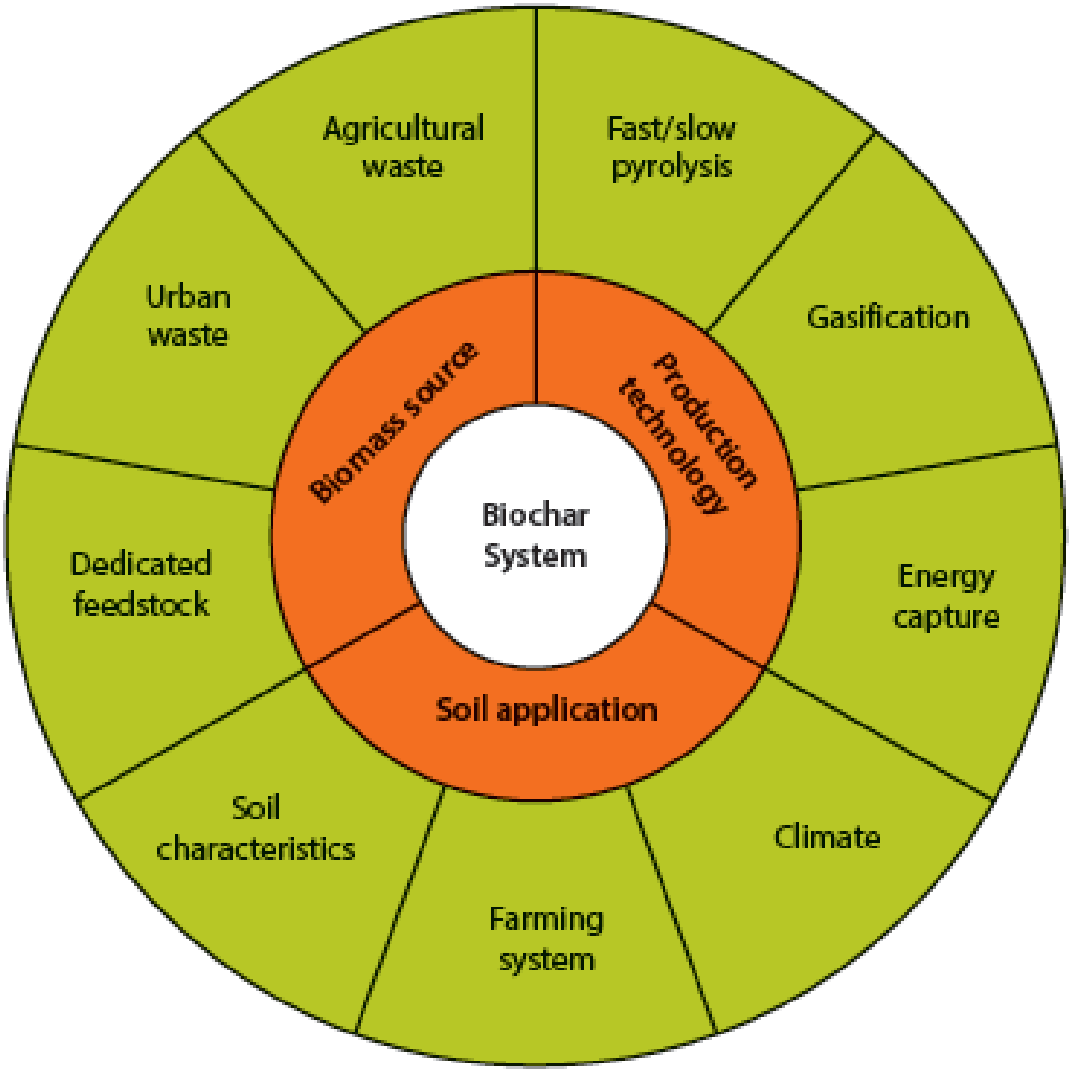
- Biomass source;
- Production technology;
- Soil application;

These aspects match with three main critical aspects:

- The source of biomass;
- The means of biomass production;
- Whether and how its applied to the soil;

The biomass sources could be a wide range of feedstocks, as it is shown the precedent paragraph.
Production systems are basically two: the first is linked to small household cook-stoves, the second is linked to industrial production of energy, that is Biomass energy plants. There are several possibilities in the use of outputs of the pyrolysis process.
Biochar could be burn or it could be applied to the soil.
The Biochar system that I'm going to outline in this research is the biochar system in small communities and the positive aspects of the application of Biochar to the soil.
The components of a Biochar system are shown in the picture below:

Picture n.5: The Biochar system (source: World bank)



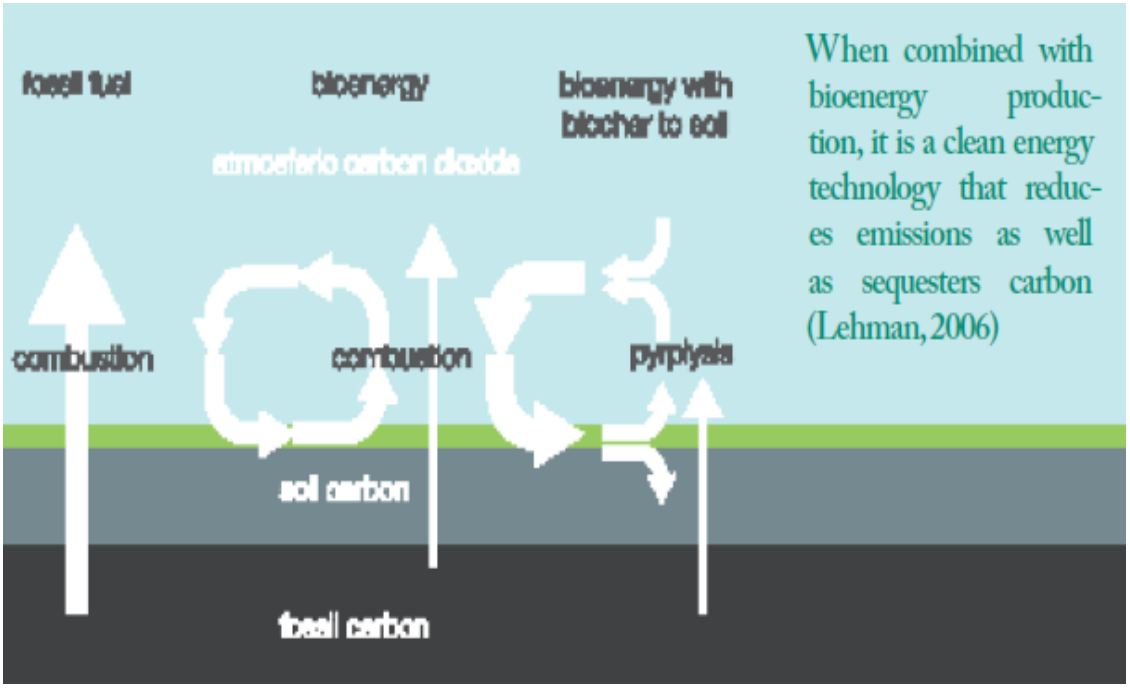
Source: World Bank.

1.2 BIOCHAR SYSTEMS

1.2.1 Biochar system in small communities

The application of a Biochar system in small communities is one of the most important theme in this thesis. For this reason, in the third chapter, the study cases of Ghana, Sierra Leone, Ethiopia, Cameroon and Zimbabwe will be considered. Nevertheless, what it is important to underline about the introduction of Biochar systems in small communities is their advantages for ensuring energy access, food security, environmental restoration, health improvements and socio-economic development.
The advantages of a Biochar System are explained in the chapter 1.3.
In this type of Biochar system the Biochar is applied into the soil. The application of Biochar into the soil helps to improve the crops and it is a carbon negative solution. The picture below explain how applying biochar in the soil is a carbon negative solution.

Picture n.6: Carbon sequestration (source: Lehman)



It's a carbon negative solution because biochar is not burned, therefore the carbon in the biochar is not spread in the atmosphere and it remains stored into the soil.
In small communities of rural areas, biochar can be produced also in household cook-stoves that work as pyrolytic gassifier. The gathering of feedstocks is from agricultural

waste such as crop waste. The biochar is applied to the soil and has the function of improving its fertility.
In the third part of this paragraph the relation between biochar use as fertilizer and the improvement of the crop will be shown.

1.2.1 SWOT analysis

The following table n.2 summarizes some strengths, weakness, opportunities and threats of using biochar system in small communities of rural areas:

Table n.2 (A story of cooperation with Western Africa on biochar technology transfer, Starter srl, 2013)

Strengths	**Weaknesses**
• Clean burning • Use of crop wastes as combustible • Improvement of soil fertility • Carbon negative solution • Adaptability to local uses • Help to reduce deforestation • Low cost of production • Easy access to clean energy	• The improvement of soil fertility depends by the typology of the soil and not by the biochar application itself • The large scale of use of biochar is not easy to assure
Opportunities	**Threats**
• The gathering and the commercialization of the feedstock is a way to start an economic development • The clean burning can reduce health problems • The improvement of the crop can help to reduce food problems in Africa • The use of the heat of the pyrolysis process could be use to create electricity and reduce energy problems in small communities	• The use of wood as biomass could increase deforestation

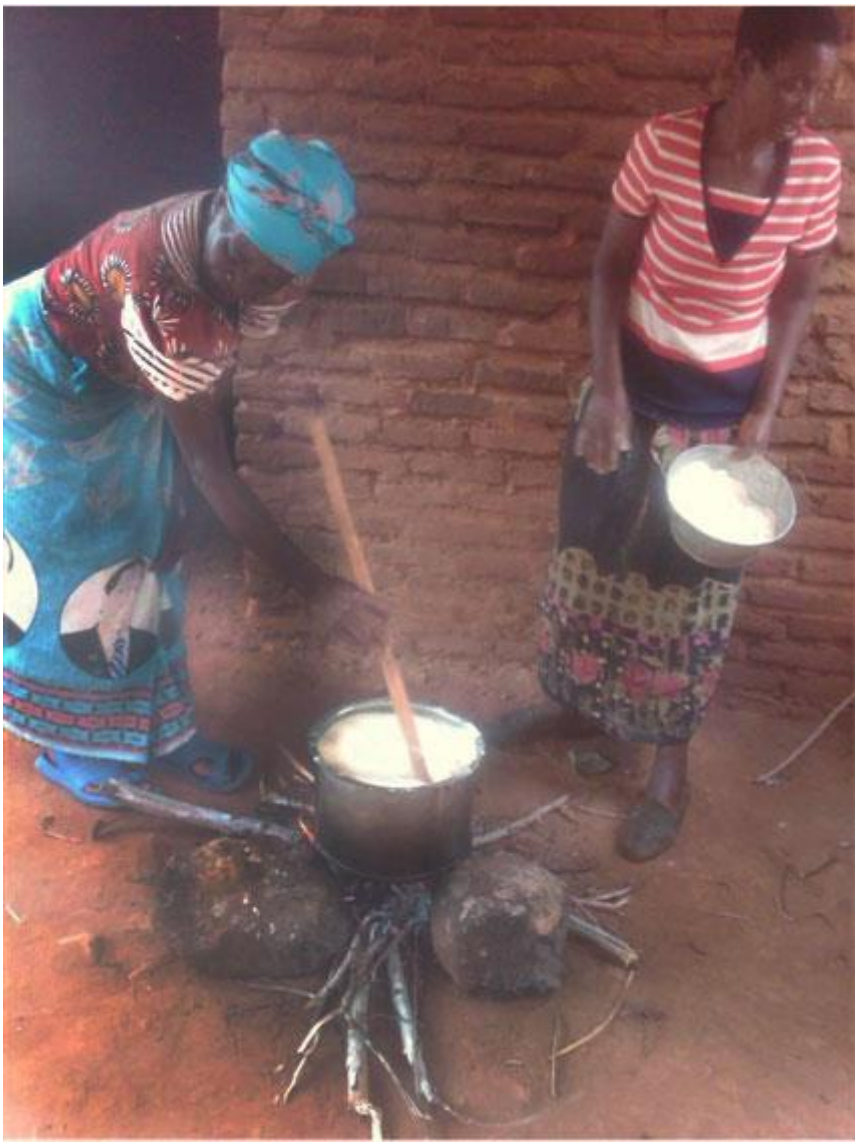
1.2.2 Challenges in the adaptation of Biochar system in small communities of rural areas

One of the main problem in introducing a Biochar system is its acceptability by small communities. In fact, cultural aspects and traditions could be problematics in the achievement of a good result of a biochar system in small communities.

It is important for the working of a biochar system to understand which stakeholders you have to take into account. For example, in the territories of the case studies, if the pyrolysis gassifier is use for cooking, the most important stakeholders are women of the communities. Indeed, traditionally women manage household fires and cooking. This implies also the gathering of the feedstock for making the fuel: before the introduction of the biochar system, the main fuel for the household fire was wood. Nevertheless, this practice is threatening environment, because one of the problems linked with use of wood as fuel for the household fire is deforestation.

Picture n.7: Women collecting fuelwood (source http://newsofthesouth.com/energy-crisis-in-rural-areas-women-bear-the-brunt/)

Picture n.8: Woman cooking in a village, (source: http://www.lstmed.ac.uk/sites/default/files/cooking_african_women.jpg)



Between 1990 and 2010, the forest area in Africa was reduced by 74.819.000 ha, with an annual change rate of -0.5%. It's clear that deforestation in Africa is due to wood harvest. Indeed, growing demand of wood fuel coupled with limited alternative resources has been contributing to intensify tree cutting in order to ensure adequate wood fuel supply. Almost half of the wood harvested worldwide is used as fuelwood and this amount has been increasing since 1990. Moreover, the combustion of used solid fuel in traditional cooking fire is incomplete and inefficient, thus determining an unsustainable consumption of agricultural and forest biomass. Thus has as consequences deforestation, soil erosion and degradation, air pollution and global

warming (Biochar plus, informative brochure, Starter srl; DISA; University of Udine, 2015.).

Therefore, the main challenge in the adaptation of Biochar system in small communities is the introduction of agricultural waste as fuel for a pyrolytic gasifier, appropriate with the production of Biochar. The main issue of this thesis is the investigation of the acceptability of this technology in small rural communities to produce biochar. In fact, it is not only the switching from a traditional household fire and stoves to an improved stove, but more than that the introduction of a “Biochar system”.

1.2.3 Technology and its acceptation in small rural communities

The device introduced in the territories of the study cases is the ELSA burner unit. Elsa is a micro clean cook-stove with a biochar microgassifier burner-unit.

Picture n.9: Elsa stove (Source: http://fuocoperfetto.altervista.org/alterpages/elsa.png)

It can be adjusted to different types of feedstock and adapted to produce the energy necessary for households (Biochar plus, informative brochure, Starter srl; DISA; University of Udine, 2015).

It can be build with few tools and materials, so one of the first characteristic is its flexibility and adaptability to the chooser’s preferences.

It can be produced in about 15 minutes of work. Therefore, it fits very well with locally available manufacturing capacities small communities.

A wide range of feedstock can be used in the ELSA burner unit

- Straw
- Stem
- Stak
- Leaves
- Husk
- Shell
- Peel
- Lint
- Pilp
- Stubble
- Peanuts shelves
- Cereals
- Cotton
- Groundnut
- Jute
- Legumes
- Coffee
- Cacao
- Olive
- Tea
- Fruits

It is cheap to produce, this make accessible and affordable for local population.
ELSA is an “open” product that the communities can modify and adapt to their needs. This adaptation process was identified as the key element to involve and stimulate choosers in the adaptation of the technology (Biochar plus, informative brochure, Starter srl; DISA; University of Udine, 2015).

Elsa stove addresses some obstacles in the introduction of the technology in local communities. In fact, the customers are generally poor, there is not a distribution sector in the villages and generally the majority of the pyrolysis stoves are not tested in-home. ELSA, as said before, is cheap, adaptable and easy to build in place and its peculiarities help to face the problematic of the acceptation of the technology in the small communities.

1.3 IMPACTS AND ADVANTAGES OF BIOCHAR SYSTEMS

1.3.1 Energy access

Substantial parts of the world have issues with energy access, even for the household supply such as lighting, heating and cooking. Many people do not use modern fuel. World Bank reported that 1.6 billion people do not use modern fuel. This is critical because energy access is strongly related to socio-economic development.

As STARTER SRL and UNIUD report in "A story of cooperation with Western Africa on biochar technology transfer": "A growing demand of wood fuel, coupled with the lack of alternative resources, have contributed to increased deforestation in tropical areas. The production of wood fuel and charcoal is the most significant threat for bush and forest ecosystems in the tropics. About 40% of the world's population depends on firewood and charcoal as their primary energy source, and half of wood harvested worldwide is used as fuel. UNDP (2007) calculates that around 2.5 billion people rely on traditional fuels for cooking and heating. Despite fires, main causes of deforestation are the expansion of agricultural areas, wood harvest, other soil uses (i.e. mines); consequently, supplies are diminishing. A recent study in Ghana pointed out that there is a high wood consumption in the area (about 15 kg of wood per day per person), while the highest wood fuel consumption (Charcoal or wood fuel) was observed by the largest households and it may be due to the fact that wood fuel collection does not represent a financial cost to households. Consequently, people do not value energy conservation - for example, after cooking a meal the firewood keeps burning till the next meal is cooked. As long as women's and children's labour is not paid for, wood fuel will continue to be considered as a cheap energy source that does not need to be managed efficiently. Unfortunately, this habit is a serious threat for fuel availability - e.g. it is estimated that in Togo there will not be any wood available in the next 20 years.

How can the approach to fuels be changed? Some options include:

- Using different available biomass as feedstock;
- Improving cooking stoves to reduce the daily amount of used charcoal or wood per family;
- Improving feedstock characteristics (i.e. pellets);
- Studying, developing and applying sustainable forms of forest management which allow forest harvesting, but do not reduce forest area."

Therefore, the introduction of biochar system into the region could drive changes in the accessibility of biomass energy. The process through which the biomass is converted into biochar could be an option to energy access of the regions of the case studies.

Indeed, the heat of the pyrolysis process can be utilized in biomass plant to produce electricity or in small cook-stoves for cooking.

Picture n.10: Biochar plant (Source: http://www.biochar-international.org/profile/Phoenix_Energy)

1.3.2 Food security

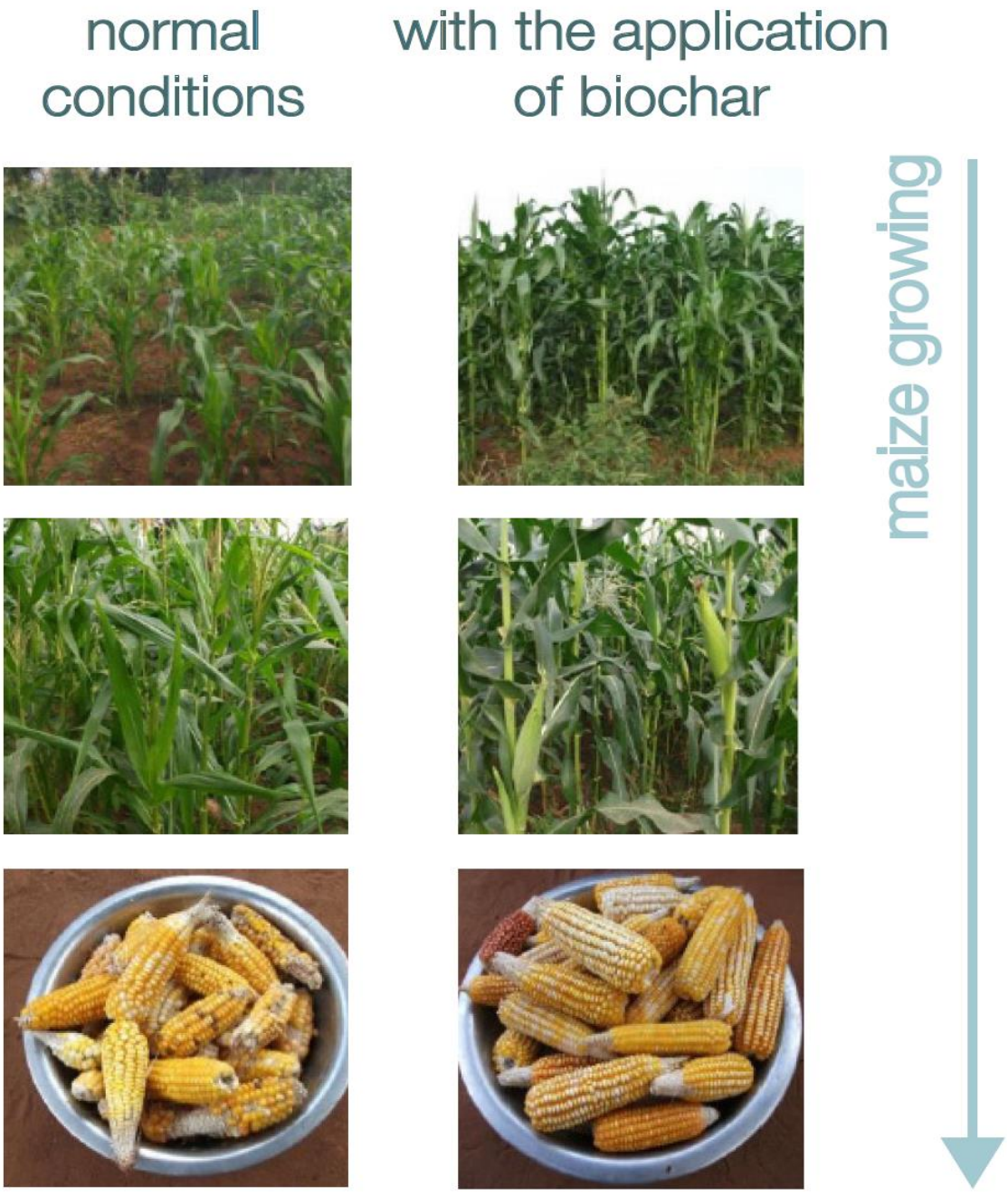
A single application of Biochar to the soil helps to improve the soil fertility. Indeed, a single application could provide benefits for many years.

It is proven that Biochar benefits due to its application to the soil are:

- reduced leaching of nitrogen into ground water
- possible reduction of nitrous oxide and methane emissions from soils
- increased caption exchange capacity (CEC) resulting in improved soil fertility
- moderation of soil acidity
- enhancement of water retention, filtration and infiltration
- Increased abundance and diversity of beneficial soil microbes (Concept note ABP, 2016).

The improvement of the soil fertility is linked to the crop yield. It is demonstrated that the crop is yield is improved of 10% if the plants grow in a soil where biochar is applied (A story of cooperation with Western Africa on biochar technology transfer, Starter srl, 2013)

Picture n.11: Improvement of crop yield (Source: A story of cooperation with Western Africa on biochar technology transfer, Starter srl, 2013)



This characteristic could help to face the problematics of food security in regions such as them of the study cases.

1.3.3 Health

The advantage of a smokeless combustion in regions where the indoor household fire is a tradition can help directly to address health issue.

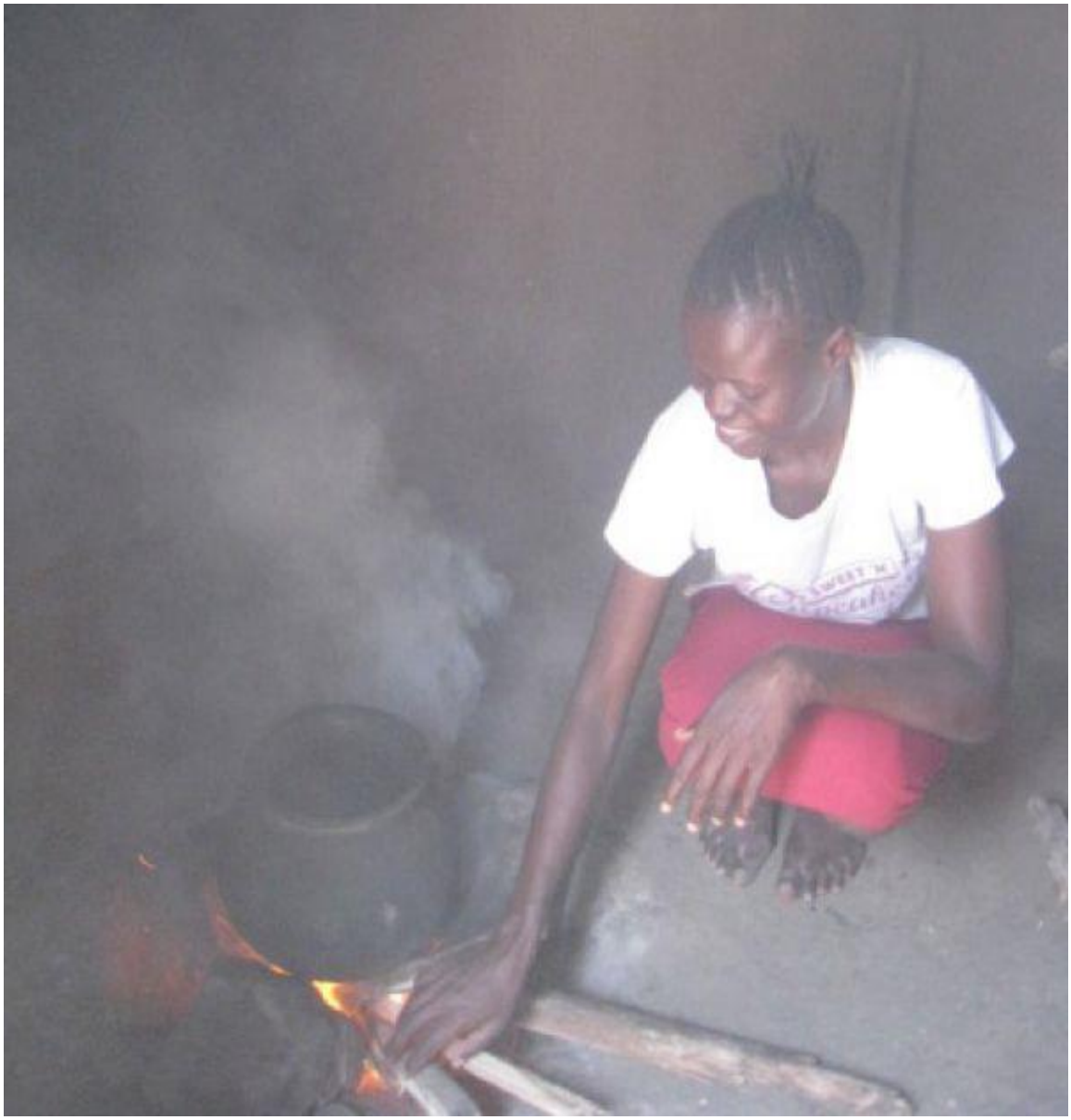
The use of wood fuel cause a large amounts of pollutants that are linked to respiratory system problem, especially to women and children. It has bene showed that high level of indoor air pollution is due to inefficient burning and its outcome are:

- Particulate matter
- Carbon monoxide
- Hydrocarbons formaldehyde,
- Benzene exceeding safe levels

It has been showed that there is a connection between these toxic gasses and particulate matter and serious illnesses like acute respiratory infection and cancer that lead to death.
The most exposed to pollution from indoor fire are women and children. Indeed, these two categories are exposed to a pollution 20 times higher than the levels advised by the World health organisation.
About 211.500 premature deaths are because of smoke from biomass or coal cooking fuel in ECOWAS countries, more than that from malaria and tuberculosis (Biochar plus, educative Brochure, 2015).

Picture n.12: Indoor air pollution
(Source:http://www.eufeco.org/images/indoor%20air%20pollution.JPG)

Picture n.13: Indoor cooking
(Source:http://practicalaction.org/media/download/25251/WyI2MDB4NjAwIiwiY3JvcCJd)



1.3.4 Socio-economics development

The introduction of a Biochar system could start a value chain. Indeed, one of the purpose of the introduction of a Biochar system is the improvement of market opportunities that will help to support socioeconomic development and to improve the standard of living of the population.

In both biochar system, from the use of small cook-stoves to the creation of biomass plants, entrepreneurs and SMEs have a great opportunity to develop their activities and have advantages on the hand of socio-economics development.

The advantages that have been described are structural to the socio-economics development of the case studies territory. Indeed, energy access, food security and health improvement could help to face basilar issues and prepare the ground to a real sustainable development.

2 BIOCHAR PROJECTS

-Introduction

In the second chapter two Biochar projects will be exposed:

1. BeBi – Agricultural and environmental Benefits from Biochar use in ACP Countries
2. BIOCHAR PLUS – Energy, health, agricultural and environmental benefits from biochar use : building capacities in ACP Countries

The aim of this chapter is to describe these projects, that are linked each other, in the logic of creating background of the activities performed and the results achieved in the introduction of a Biochar system in the territories of the study cases.
In order, the Beneficiaries of the project, the project's partners and a brief description of the goals and of the action plan will be introduced.

2.1 BEBI- AGRICULTURAL AND ENVIRONMENTAL BENEFITS FROM BIOCHAR USE IN ACP COUNTRIES

Picture n.14: BeBi logo

The beneficiaries of the project are:

- University of Udine, department of agricultural and environmental sciences (Coordinator)

The project's partners are:

- Université de Lomé and Sauve Flore (Togo)
- Njala University and Counterpart in Rehabilitation and Development in Sierra Leone (Sierra Leone)

- University of Cape Coast and ASA Initiative (Ghana)
- IBIMET-CNR (Italy)

The project aims to reduce the pressure of ACP population on their forested area to face the deforestation issue, increase soil fertility of croplands and to endure an integrated sustainable growth. The project is focused on the goal of an efficient use of crop residues and, at less extent, wood, adopting pyrolysis process in innovative, low-cost, biochar producing cooking stoves. In particular, a slow pyrolysis system, suitable for several feedstock and adapt to produce the energy necessary for household (5-10 people per household), will be developed and tested. This typology of pyrolysis system offers the main advantage that process conditions can be optimized for the recovery of biochar and syngas. Furthermore, the process temperature parameters under slow pyrolysis are such that it avoids the formation of poly- aromatic hydrocarbons in the biochar product (http://www.bebiproject.org/info/project-description).

The main project's goals are:

- Fight the desertification and deforestation
- Improve the fertility of the soil and the crop yield
- Reduce the health problem related to the smoke emission during the cook activities and contribute to the GHG mitigation (http://www.bebiproject.org/info/project-description).

The work programme is divided in four parts:

1. Study of the territories where the project takes place, having regard of the priorities and the request of the stakeholders.
2. Distribution of 10.000 cook-stoves and showing of the advantages of a biochar system to the stakeholders.
3. improve the local partners competence level and support their process to become poles of attractions on this technology at regional, ACP countries and, at more widely International level.
4. Ensure the availability of the updated knowledge to the project partnership provides with an efficient flow of information within the partnership and assures the transfer of relevant project results outside the partnership to other ACP countries and to stakeholders (http://www.bebiproject.org/info/project-description).

2.2 BIOCHAR PLUS – ENERGY, HEALTH, AGRICULTURAL AND ENVIRONMENTAL BENEFITS FROM BIOCHAR USE: BUILDING CAPACITIES IN ACP COUNTRIES

Picture n.15: Biochar plus logo

The project's partners are:

- University of Udine (Italy) - Coordinator
- Starter srl (Italy)
- ECOWAS Centre for Renewable Energy and Energy Efficiency ECREEE (Cape Verde)
- ASA Initiative (Ghana)
- University of Lomé (Togo)
- CORD-SL (Sierra Leon)
- Jimma University (Ethiopia)
- Bindura University of Science and Education (Zimbabwe)

The associated partners are:

- African Union (Ethiopia)
- UNIDO (Austria)
- Cornel University (USA)

Biochar Plus is a follow-up on a previous ACP S&T project: BeBi- Agricultural and environmental Benefits from Biochar use in ACP Countries.

The project aims to introduce a Biochar system for small communities in some territories where there are serious fuel sourcing issues. A large amount of biomass, especially crop wastes, can be turned to biochar using the ELSA stoves. ELSA is cheap and in household cooking helps to reduce indoor pollution. Not secondary it is the aim to increase

awareness, in the local population, of the advantages of starting a value circle linked to the use of more efficient fuel than wood or charcoal.

The most important stakeholders of the project are farmers and landowners, entrepreneurs, women.

The goals of the project are:

- Institutional capacities to formulate, manage, monitor, evaluate and disseminate biochar-related activities
- The development of energy clusters based on pyrolysis / biochar, providing an impetus for the growth and socio-economic development of local communities
- The application of biochar to soil promoted, improving soil productivity for farmers and land owners
- Energy access and efficiency ensured for local communities, achieving at the same time health and environmental benefits
- Reduced impact on the local environment through the sustainable use of available biomass. This means support for sustainable forestry management and the exclusion of food or feed from fuel production, since only residues and biomass wastes can be used as fuel
- Enhanced participation of the African scientific and educational community in existing biochar-related networks (https://sites.google.com/site/biocharplusproject/home/project-description)

3 BIOCHAR PLUS- ENERGY, HEALTH, AGRICULTURAL AND ENVIRONMENTAL BENEFITS FROM BIOCHAR USE: BUILDING CAPACITIES IN ACP COUNTRIES

The third chapter is about the project “Biochar Plus- Energy, health, agricultural and environmental benefits from biochar use: building capacities in ACP countries”.

The chapter is focused on the project's objectives and the countries where the project is operating such as Ghana, Sierra Leone, Zimbabwe, Ethiopia and Cameroon. Every single country is a case study and all the information about how the project is taking place in the countries have been collected during skype conferences or through specific tools such as questionnaires or tables that the respondents have filled with the data requested.

I faced several issues during the phase of the collection of the data such as the low quality of the internet connection of some Africans partners due to infrastructure problems of their countries that has delayed the transmission of the information.

The purpose of this methodology is to find the points of strengths and weakness in the application of the project in every single country that I have taken into account, with the aim of extrapolate a sort of good practice that could be useful to the partners to achieve their expected results.

The tools I have used to collect information are shown below and are:

- A questionnaire of 23 questions
- A Table for the collection of data

ACP-EU Cooperation Programme in Science and Technology II G.C. FED/2013/330-236

BiocharPlus *Energy, health, agricultural and environmental benefits from biochar use*

Interview

Part 1
The aim is describing the case and the methodology

1. Can you describe your working plan starting from the beginning of the project?
2. Which stakeholders did you address to introduce biochar in your territory?
3. How did you involve them?
4. Which are the geographical areas did you consider?
5. Can you tell me the crucial elements that help you introduce biochar system successfully ?
6. Were there any changes after the introduction of biochar system in your territory? Can you mention the most important changes?
7. Which were the main driver for those changes?
8. Are those changes durable and sustainable in your opinion?
9. How do you monitor and evaluate your activities? What type of information do you collect and how?
10. How often do you communicate with your project partners? For what purposes? On what occasions?
11. How do you evaluate cooperation with your partners? Do you think they help you improve? In what fields?(technology, cooperation, management, networking)

Part 2

The aim is analysing strengths and weakness of the case study

1. Which was the best result that you achieved and in your opinion what contributed to reach it?
2. Which are the average results of your activities?
3. Which are the expected results in the application of biochar system?
4. Do the achieved results match with the expected results? If no, why? if yes, why?
5. Did you face any problems in your activities, and in your opinion what caused them? Could you describe them? How did you solve them?
6. Is the technology accepted by the stakeholders? Do they use it? In your opinion why?
7. Do policy makers appreciate the project?
8. Do the policy makers contribute to improve the project? How?
9. Which were the problematics on the field of comprehension in the introduction of the project in the villages?
10. There were some cultural opposition to the project?
11. There were active opposition to the project?
12. How much is important the opinion of the women in the adoption of ELSA stoves in the villages?

Data collection

Number of ELSA cook-stoves introduced	ELSA sold
	ELSA given for free
	Elsa built by PPs
	Elsa built by local enterprises

Number and name of villages involved in the project	Number of people involved in the project	Farmers
		women
		entrepreneurs
		landowners
		others

Informative kits distributed	Types of stakeholders who received them	Educative kits distributed	Types of stakeholders who received them
On what occasion did you distribute them?		On what occasion did you distribute them?	

Number of consultation meetings	Types of stakeholders involved	Roles	Reason for their involvement

Name of local partners (organisations that helped you to reach/ work with the stakeholders groups)	Roles
	Resources (staff/financial/tools)

3.1 OBJECTIVES

The objectives of Biochar plus Project could be synthesized in three main goals:

- energy supplying problems addressed
- Food supplying problem addressed
- Improvement of the local economy through the use of the ELSA stove as main pillar of local biochar systems

What appears from the interviews is that not all the main goals have the same importance. Indeed, there are project partners that are more focused on the energy supplying problems than on the other issues. For example, Cameroon is one of them who appreciate the Biochar plus project because of the capacity of the technology to turn a waste in a fuel.

The differences of approach to the project depends on the geographic, morphological and climate characteristic of every single country.

Probably one of the key for the success could be a preliminary study on the zone of application of the project both the social side and the morphological and geographical side.

3.2 WHERE THE PROJECT TAKES PLACE

The Biochar Plus project takes place in five countries:

- Ghana
- Ethiopia
- Sierra Leone
- Zimbabwe
- Cameroon

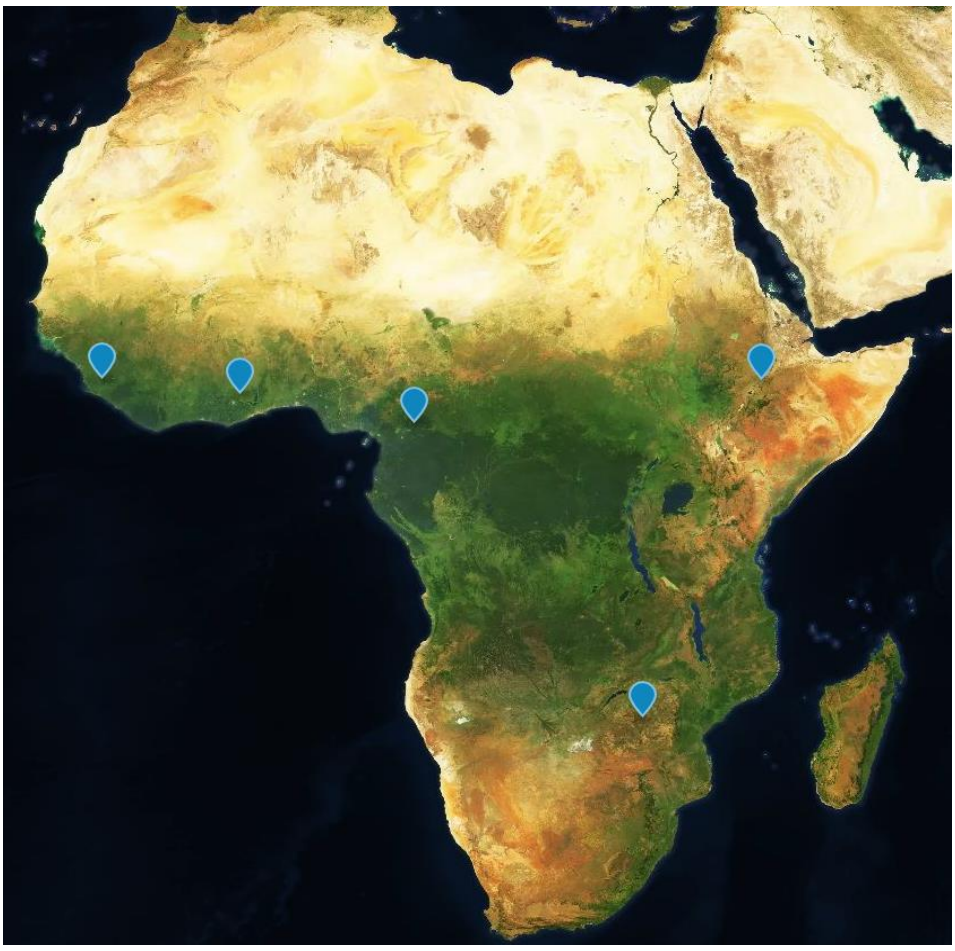
What appears complicated is the creation of a sort of good practice in the application of the biochar system in all of these countries. That depends on the peculiarities of each country.

Different culture, ethnic groups, climate, ground and political situation make difficult the application of a good practice for the introduction of a biochar system in these territories. However, there are some issues that these countries share:

- Health problems because of the smoke of the household fire
- Energy supply problems
- Economic problems
- Food supply problems

Indeed, the project focus on contributing to these issues through the introduction of a new and free biochar producing technology: the ELSA stove.

Picture n.16: Africa (source: Mapbox, www.mapbox.com)



3.3 GHANA

Picture n.17: Ghana (source: https://it.wikipedia.org/wiki/Ghana#/media/File:Location_Ghana_AU_Africa.svg)

The project's partner of Biochar plus project in Ghana is ASA INITIATIVE. It's an FNGO (financial non-governamental organisation) whose aims are fighting unemployment, underemployment and promoting woman empowerment through microfinance project (http://www.asainitiativegh.org/).

ASA INITIATIVE was supported in his work on the territory by others organisations such as:

- ECREEE (ECOWAS Centre for Renewable Energy and Energy Efficiency)
- Local governament

The information about the implementation of Biochar plus project have been collected through a skype conference with a member of ASA INITIATIVE.

There were some issues in collecting the information because of the lack of a good internet connection. However, the willingness of the member of ASA INITIATIVE helped to collect all the information I need to accomplish with my research.

3.3.1 How the Biochar system was introduced

What appears from the interview is that the project was introduced in five steps:

a. Mainstreaming and dissemination

I. Project awareness creation meetings

II. Community demonstrations

III. Organisation of Focus Group meetings

IV. Bottom up Meetings

V. Contribution to website update

b. Participation in local and international events organised by :

i. Ghana Alliance for Clean Cook Stove (GHACCO)

ii. Global Alliance for Clean Cook stoves (GACC),

iii. Ministry of Energy and Energy Commission,

iv. US See4All Missions,

v. Farmers Day by the Ministry of Agriculture,

vi. WACCA

vii. Local Government

c. Project presentation through Power point presentation and technology demonstration to Researchers and Universities.

d. Capacity buildings for:

i. Farmers in biochar application

ii. Artisans in stove building

iii. Households in stove use for adoption

e. Preparation of Ghana Action Plan

The stakeholders involved in this plan that were crucial for the introduction of the biochar plus project were: Farmers and Extension Officers, consultants supporting farmers in agricultural value chain households, community leaders, researchers and Universities, entrepreneurs and investors media, NGOs, waste producing companies and policy makers.

The bottom-up meetings with the stakeholders were crucial for the introduction of the project.

There have been several activities in these bottom-up meetings and their aim were three:

- Teach how to use the ELSA stove and improve the stove following the request of the users.
- increase the knowledge about the biomass to use
- Use properly the biochar as fertilizer.

3.3.2 Field approaches and relationships with the communities

The bottom-up methodology was crucial for the introduction of the project in Ghana. Meetings, cooperation, exchange of knowledge are the crucial elements for the success in the introduction of Biochar plus in these territories.

The main drivers to the adoption of the project and its success are:

- Poor soil fertility and crop yield;
- Devastating deforestation;

- Clear communication of project benefits and opportunities to stakeholders;
- Evidence of good stove performance, less fuel needed, long cooking period ensured; 1.5kg fuel used to cook for 2hours.
- Efficiency and evidence of the Elsa Barrel in making quality biochar;
- Clearly defined sustainability plan and involvement of stakeholders;
- Increasing fuel cost;
- Need for clean cooking;
- Good grounds work within the first project, BeBi which enables reference for project sustainability;

Biochar Plus project in Ghana is accepted by the stakeholders and works because it helps to solve issues such as crop productivity, deforestation, health problems related to a not clean cooking, and climate change.

What that really helped was the methodology of work. Communication, monitoring, evaluation, exchange of information with the project's partners and the stakeholders were crucial for the positive results.

Another key of the success of the methodology to introduce biochar plus project in Ghana was the awareness that the opinion of the women of the villages could have been crucial. Indeed, women are who manage the household fire and collect the wood to use it as fuel for the fire. They are the final users of the stoves.

The women of the village helped to improve the technology and develop the ELSA stove contributing to modify the stove to the needs of the final users.

3.3.3 Results

What appears form the interview is that the best results achieved are:

- Elsa stove adoption by households;
- Elsa Barrel adoption by researchers;
- Acceptance of biochar application to the crop land by farmers;
- Motivation of farmers about the biochar technology;
- Project information dissemination to researchers;
- Capacity building on stove use;
- Successful focus group meetings;
- Wider dissemination of project in Ghana and Africa.

The contributing factors are:

- effective project dissemination;
- Strong Project Team commitments;
- Political capital built during the first project (Bebi Project);
- Strong Farmers Associations with dedicated leadership;
- Strong women groups and ability to organise them for meetings;
- The ASA Initiative Institution already working with women groups, Farmers Associations, micro enterprises, communities and Forum for small scale enterprises for development assistance.
- High cost of fuel for domestic cooking;
- Biomass availability within the communities;
- Efficiency of the Elsa biochar technology;
- The value additions of the Biochar Value Chain and the Biochar Systems for socio economic development and clear communication to the intended stakeholders.

The expected results in the application of biochar plus project in Ghana are:

- Reducing deforestation
- Improving soil fertility
- Increasing crop yield
- Improving waste management
- Offering industrial development
- Employment creation
- Reducing the number of use of chemical fertilizer and water
- Adoption of the technology by households for their use for example use of stove for cooking, etc
- Improving indoor and outdoor air quality through clean cooking and efficient burning of biomass into char to replace slash and burn system

The results match with the expected results because the application of the technology solves the main problems of the territory such as health problem, fuel problem, economic development problem and what that is clear to the user is that the technology works.

What appears from the interview is that the keys of the success in the adoption of the technology are:

- Elsa is easy to use
- Elsa matches with the cooking way of the users
- Elsa helps the user to manage the household production of wastes
- The technology is perceived by the stakeholders as a possible solution to the numerous challenges they are facing in agriculture, fuel for cooking and its cost.
- The stakeholders have seen the evidence of the ground results themselves for example how the stove is functioning, the effect to the biochar and organic fertilizer on the performance of the crops within the joint farms.
- The stakeholders have been highly involved in all the activities hence feel part of the progress of events and the way forward. These evidence are very promising and motivating by the stakeholders.

All these good aspects allowed that the policy maker started to appreciate the project and as consequences they helped the project partner to improve the project with suggestion and information meetings.

The main issues that slowed down the implementation of the project in Ghana were:

- The ebola virus plague, that reduced the possible communication from the stakeholders because of the way of incubation and spread of the virus
- The storage of the biomass during the rainy season

In the table n.3 there are the most important data of Biochar plus project in Ghana collected thanks to the main project partner of this territory.

Table n.3

	Number of ELSA cook-stoves introduced	ELSA sold ***3609 by the end of the second year of the project.***
		ELSA given for free ***None***
		Elsa built by PPs
		Elsa built by local enterprises ***3709 by the end of the second year of the project. 100 Elsa Stoves were in the process for distribution.***

Number and name of villages involved in the project Number of Villages ***23*** ***Name of Villages*** ***Wawase; Twifo Praso; Ajumako;*** ***Hemang; Gold Coast Camp; Ayitey;*** ***Abura Asebu; Esikumah; Krofoforodo; Jukwa; Breman; ; Apam;*** ***Mempeasem; Egyeri Krom; Nyankrom;*** ***Sabina; Awomasi; Ofabi; Moree; Efutu;*** ***Atimpoku; Efutu Koforidua, Cape Coast (Town);***	Number of people involved in the project ***444 plus 12 specifically for land owners. =456*** ***Grand total =456 +women in stove adoption =4,202+51*** **=4,253**	Farmers *231* Women 137 =focus group meeting (Women directly involved for Elsa stove adoption =3,609 **Total women =3, 7 46** Entrepreneurs 14 artisans ***51 young student graduate artisans*** (*27 women stove distributors who are included in the stove adoption).* Landowners **5 landowners in joint ownership under one kingship = approved because they have vast land and are ready to release the land for freehold sale for the development of the biochar system in Ghana.** **7 landowners in joint ownership under one kingship**

		= disapproved due to litigation
		Others 62

Informative kits distributed **Yet to be distributed**	Types of stakeholders who received them	Educative kits distributed **15**	Typesof stakeholders who received them **Artisans**
On what occasion did you distribute them?		On what occasion did you distribute them? **It was not during any occasion. It was through individual direct contact.**	

Number of consultation meetings **17**	Types of stakeholders involved • *Farmers and Extension Officers* • *Consultants supporting farmers in Agricultural Value Chain* • *Households* • *Community leaders* • *Researchers and universities* • *Entrepreneurs / investors*	Roles • *Contribution to the identification of their needs;* • *Participated in Action Plan Problem definitions;* • *Supported in the formulation of Action Plan objectives.* • *Involved in the Budgeting for implementing Action Plan ;* • *Action Plan validation*	Reason for their involvement *The stakeholders are the direct beneficiaries and actors of the biochar systems applications.* *For project awareness creation and:*

	• *NGO'S* • *Media* • *Policy Makers* • *Waste producing companies*	• *Adoption of the technology eg stove use, stove sales, biochar application* • *Biochar Information disseminations* • *Building of stoves;* • *Technology Adoption ;* • *Waste collection/management*	*To ascertain their needs, problems and the development of Action Plan Objectives, strength and criticalities, budget for Action Plan with eventual participatory Action Plan development for successful Action Plan implementation*. *Technology adoption.*

Name of local partners (organisations that helped you to reach/ work with the stakeholders groups)	Roles
• Farmers Association • Forum of Small Business Association (FOSBA) • National Board for Small Scale Industries (NBSSI) • Women Association • Local Government • Ghana Alliance for Clean Cook stove (GHACCO) • Global Alliance for Clean Cook stoves (GACC)	• Farmers Association-organisation of farmers for meeting/workshops /events • FOSBA-Organisation of Artisans for events and built their capacity to produce stoves. • NBSSI-Support for community contacts and participations in some community demonstrations. • Women Associations- organisation of women for events. • Local Government- invitation for participation in events such as Farmers Day and introduction of project during these events. Making suggestions for project improvements such as development of Elsa Stove for fish smoking, gari frying etc. Facilitated political contacts, contact with university/research institutions in biochar.

	• GHACCO and GACC- National and International workshop invitations and participations. Assisted contact with stakeholder groups like the policy makers, investors, researchers, media, women etc during exhibitions and workshops.
	Resources (staff/financial/tools) • Staff • Working tools • Meeting places • Land for demonstration

3.4 ZIMBABWE

Picture n. 18: Zimbabwe (Source: https://it.wikipedia.org/wiki/Zimbabwe#/media/File:LocationZimbabwe.svg

The project partner is Bindura University of Science and Education. The University is located in the North East of the country.

The implementation of the project in this area was strongly helped by the policy makers such as the Ministry of Agriculture.

The information about the implementation of Biochar plus project have been collected through a skype conference with a member of the Bindura University.

There were some issues in collecting the information because of the lack of a good internet connection. However, the availability of the member of Bindura University helped to collect all the information I need to accomplish my research.

3.4.1 How the Biochar system was introduced

What appears from the interview is that the project was introduced in five steps:

i. Dissemination of biochar technology

ii. Elsa stove production training

iii. Field and pot experiments using biochar

iv. Commercialise production of Elsa stoves

v. Capacity building in use of biochar technology for different stakeholders

The stakeholder involved in this plan and that have been crucial for the introduction of the biochar plus project were policy makers, Universities, research institutes, media, technical institutes, polyclinics, entrepreneurs, householders, farmers and extension agencies.

In this case, the methodology to introduce the project was Top-down and the role of the policy makers were crucial.

The typical activities top-down meetings were about:

- Dissemination of the biochar technology to the policy makers
- Dissemination of the biochar technology to the media
- Collaborative research on biochar technology
- Demonstration about how to use the biochar technology to increase the crop productivity

3.4.2 Field approaches and relationships with the communities

The collaboration with the policy makers were crucial in the application of the project. The most important element that allowed the collaboration of the political institutions was the energy access issue in Zimbabwe. Indeed, as appears from the interview, “the country has serious challenges in providing electricity. More than 90% of the rural population is not connected to the electricity grid. For those connected to the grid, there is unscheduled load shedding”.

Moreover, what that was helpful for the introduction of Biochar plus project in the pilot area of Zimbabwe, was that the biochar system outcomes could perfectly match with the Zimbabwe Agenda for Sustainable Socio-Economic Transformation (ZIMASSET), because this agenda highlights as energy could be a prerequisite for socio-economic development of the country and for regional integration.

As could easily understood, this match between biochar plus and ZIMASSET agenda was crucial for the acceptance of the biochar technology in this country.

At the beginning of the introduction of the project the dissemination and the demonstration of the technology were lead by the Universities that received precise instructions from the political institutions.

Another crucial element for the acceptance of the biochar technology was that the ELSA stove doesn't produce smoke in the indoor cooking and helps to recycle the biomass wastes as fuel.

Monitoring and communication with the stakeholder helps to match the peculiarities of the stoves with the needs of the users. Suggestions, exchange of opinion and experiences were crucial to achieve the results.

The opinion of the women in this case was very important because they are usually the final users of the stove. Indeed, for this project more than 80% of the participating farmers are women.

3.4.3 Results

As appears from the interview the most important result for the Zimbabwe's project partner is the dissemination of the technology. It was achieved because of the willingness of the farmers to improve their livelihoods.

The training session, supported by the University of Udine, was a success.

What that the project partner expect from the project is to set up a small to medium plant that produces electricity from biochar systems and production of biochar fortified fertiliser.

The main issue in the achievement of the results was the economic situation of the country related to the political scenario. Zimbabwe is currently under economic sanctions by the international community. This affects the development of the project because there were issues in receiving funds that are fundamental to achieve what was planned.

In the table n.4 there are the most important data of Biochar plus project in Zimbabwe collected thanks to the main project partner of this territory.

Table n.4

Number of ELSA cook-stoves introduced	ELSA sold 50
	ELSA given for free 5
	Elsa built by PPs
	Elsa built by local enterprises 50

Number and name of villages involved in the project 2 Villages Ward 11 and Ward 26 in Madziwa	Number of people involved in the project 80	Farmers 58
		Women 40 (of the farmers)
		Entrepreneurs
		Landowners 58 (all farmers are land owners)
		Others: Researchers and students (22)

Informative kits distributed 50	Types of stakeholders who received them Policy makers, entrepreneurs, researchers, NGO employees,	Educative kits distributed 50	Types of stakeholders who received them Farmers, students, lecturers and researchers
On what occasion did you distribute them? We started at the Action planning workshop and send others by email as softcopies. A few were taken in person to policy makers		On what occasion did you distribute them? We started at the Action planning workshop and send others by email as softcopies. A few were taken in person to policy makers	

Number of consultation meetings 3	Types of stakeholders involved Farmers, policy makers Researchers, NGO employees	Roles Participants	Reason for their involvement We wanted to share experiences on using the biochar technology and map the way forward

Name of local partners (organisations that helped you to reach/ work with the stakeholders groups) Practical Action, Harare Polytechnic, Rumeki Engineering	Roles Practical Action assists by providing venue for workshops, Rumeki Engineering has started cutting stove parts for farmers, Harare polytechnic provides rollers for training workshops
	Resources (staff/financial/tools)

3.5 CAMEROON

Picture n.19: Cameroon (Source: https://en.wikipedia.org/wiki/Cameroon#/media/File:Location_Cameroon_AU_Africa.svg

Cameroon is the most recent country that started to introduce the biochar in its territories.

In this case, there were not any issues in collecting the information. The quality of the connection was good and the project partner was very helpful in giving the information to me.

This case is singular, because the most important reason that convinced the project partner to start Biochar Plus in his territories was the lack of funds from another project linked to a palm oil mill.

3.5.1 How the Biochar system was introduced

In this case, what appears from the interview is that in Cameroon was not introduced a proper biochar system. Infact, the introduction of the ELSA stove was because of the need to turn the wastes of the production of the oil palm to an energy resource.

Crucial for the introduction of the project were:

- Students
- Farmer organisations
- Women associations
- Teachers
- Councillors

The Elsa stoves was introduced during workshops, where the stakeholders were educated to use and build the stoves. Another important activity related to the workshop was the explanation of the effects that could have the biochar on the crop productivity.

The territory near the oil palm mill is a volcanic zone, very fertile but the use of chemical fertiliser in the time is decreasing the fertility of the ground. This issue, that could be catastrophic for the agriculture in the future, could be managed by the substitution of biochar as fertiliser. However, at the moment it seems that the stakeholders adopt the technology because of the need of energy and the big amount of biomass.

3.5.2 Field approaches and relationships with the communities

What was truly important was the collaboration with the equipe of the University of Udine. Indeed, they introduced a methodology of work successfully because of the trust between the equipe and the stakeholders.

Evaluation, monitoring and sharing of the information with the partners had a crucial role.

Monitoring and Evaluation were done by a specific team that did comparison among the stoves and among different kind of application of biochar to the soil.

The results of the researches about the stoves and the application of biochar in the soil is communicated with the partner two times at week. The communication with the partner helped also to understand how to find funds to finance the project.

The role of the political institutions was marginal but they are very interested in a technology that turn wastes in fuel.

What that is clear is that, in this case, the final use of the ELSA stove in Cameroon is to reduce the energy problem.

3.5.3 Results

Biochar Plus project was introduced in Cameroon in March 2016, so there are not measurable results yet. Anyway what appears from the interview is that the quality of methodology for the introduction of the project is increasing thanks to the collaboration with the partners.

The expectations in Cameroon at the moment are linked to the contribution to the project from the Government. It is expected that the government will help with funds and using the extension officers to continue the information campaign about biochar system to reduce the use of the chemical fertilizer. A top down strategy will be introduced in Cameroon.

In the table n.5 there are the most important data of Biochar plus project in Cameroon collected thanks to the main project partner of this territory.

Table n.5

Number of ELSA cook-stoves introduced	ELSA sold 9
	ELSA given for free 55
	Elsa built by PPs
	Elsa built by local enterprises 100

Number and name of villages involved in the project: Bokwango; Lysoka, Ekona	Number of people involved in the project 400	Farmers 200
		Women 70
		Entrepreneurs 15
		Landowners 145
		Others 128

Informative kits distributed 10	Types of stakeholders who received them Ministries; Territorial administration, Embassy, International organization	Educative kits distributed 200	Types of stakeholders who received them Farmers; agricultural organizations and public officials
On what occasion did you distribute them? During the conference and during the one on one meetings with the different offices		On what occasion did you distribute them? During the conference in Buea attended by more than 200 people	

Number of consultation meetings 4	Types of stakeholders involved Embassy, International organization, Ministry, territorial administration, Local council, Cameroon Broadcasting Station	Roles/ Minister, Vice Ambassador, Country representative, Governor, Mayor. They were met so as to understand how the Elsa stove could be better vulgarised in Cameroon, which was the best method of collaboration and also for sensitization	Reason for their involvement/ Some were partners like the council of Muyuka and the Ministry of agriculture, the others were just promoters

Name of local partners (organisations that helped you to reach/ work with the stakeholders groups) Ekona Oil Pam CIG, Ekona rural women for development CIG, Muyuka Council, Ekona traditional council, Opportunities industrialization centre, Regional delegation of agriculture and rural development	Roles : Ekona Oil Pam CIG, Ekona rural women for development, Muyuka Council, Ekona traditional council did Sensitization Opportunities industrialization centre, Regional delegation of agriculture and rural development gave Training
	Resources (staff/financial/tools) Those for Sensitization used their staff: about 500euros Those for Training contributed financially and in kind with their tools and staff. About 7000euros

3.6 SIERRA LEONE

Picture n.20: Sierra Leone (Source: https://it.wikipedia.org/wiki/Sierra_Leone#/media/File:Location_Sierra_Leone_AU_Africa.svg

The project partner is CORD-SL, an NGO from Sierra Leone.

There were several issues in collecting information, probably related to the internet connection and to the agenda of the project partner. However, the information were successfully collected by email. The interviewed simply answered to my questions that I sent her by email.

3.6.1 How the Biochar system was introduced

What appears from the interview is that the biochar plus project introduction was strongly linked to the BeBi project.

The project was launched involving:

- Government officers
- NGOs
- Technical institutes
- University
- Policy makers
- Community membres

The partners from the University of Udine helped to train the stakeholders in building the stoves.

The ELSA stove qualities were shown, during some meetings, to the people of the villages with the purpose of show its benefits.

The stakeholders were invited to a consultation meeting where project partner and stakeholders discuss about the project after a brief description of the project itself.

The project affect the rural area near the villages of Brama, Crossing and Kwama.

3.6.2 Field approaches and relationships with the communities

What was crucial for the impact of the project on the territories was the high availability of feedstock for making fuel, such as the shells of the palm oil fruit.

The evaluation and the monitoring of the activities were done by the use of questionnaires, field visits and community meetings. The interaction with the stakeholder was crucial for the evaluation and the monitoring of the progresses.

The communication is monthly and is about sharing the information collected to the project partners. The sharing of information was done during the field visits and the community meetings.

What appears from the interview is that the communication was crucial to understand which areas need to improve.

3.6.3 Results

The technology of the ELSA stove is accepted by the community because is easy to use, clean and the biochar is used as fertilizer in the house garden, but what that appear is that one of the issues is the low distribution of the stove to the local communities.

The main challenge and the main issue that affect the achievement of the expected results was the Ebola virus plague that strongly slowed down all the dissemination activities in the rural communities.

The women were a key actor in the dissemination of the biochar system because they are the final users of the stoves and they are the collector of the feedstock for the household fire.

In the table n.6 there are the most important data of Biochar plus project in Sierra Leone collected thanks to the main project partner of this territory.

Table n.6

Number of ELSA cook-stoves introduced	ELSA sold None
	ELSA given for free 33
	Elsa built by PPs 35
	Elsa built by local enterprises 6

Number and name of villages involved in the project Active for now 3 but 40 communities will be on board by October 2016	Number of people involved in the project 340	Farmers 33
		Women 90
		Entrepreneurs 3
		Landowners 3
		Others 211

Informative kits distributed 9	Types of stakeholders who received them Government officials NGO UN Agencies	Educative kits distributed 3 There is training for 20 community members later in the year ,the kit is kept to be used then.	Types of stakeholders who received them Technical institute Entrepreneur Farmers Association
On what occasion did you distribute them? Meeting them at place of work		On what occasion did you distribute them? Meeting them at place of work	

Number of consultation meetings	Types of stakeholders involved	Roles	Reason for their involvement
2	Policy makers	To have knowledge of the Biochar project in Sierra Leone and to enhance alternative energy provision in the country	For attestation and informing policy issues.
Several at least 10	Community leaders	Practical implementation of ELSA Stove and application of Biochar and collection of biomass 'Discussion on biochar value chain relating it to climate change, deforestation, energy, health, agriculture and poverty reduction and economic growth.	They are entry point to communities.They are major decision makers at community level

Name of local partners (organisations that helped you to reach/ work with the stakeholders groups) Community Leaders ,These include women leaders, youth leaders , councilors ,farmers and religious leaders. Technical Institute staff , Government Line Ministries of Energy, Agriculture and food security and Finance. The media	Roles linking to community members, technical staff and professional staff. Resources (staff/financial/tools) Human resources :6 Logistics support ; Vehicle and motor 2 bikes, computer and accessories Financial support as indicated by Biochar project budget Tools used :Focus group meetings. Participatory demonstrations Structured interviews. Consultative meetings

3.7 ETHIOPIA

Picture n. 21: Ethiopia (Source: https://en.wikipedia.org/wiki/Ethiopia#/media/File:Ethiopia_(Africa_orthographic_projection).svg)

The project partner is the University of Jimma.

The information for this research have been collected during a meeting at the University of Udine. This is the only interview not made through skype or email. Indeed, the collecting of the information were easy to do and obviously there were not any kind of issues related to the quality of the audio. However, until today, the tables of the data collection have not been sent despite the several solicitations.

3.7.1 How the Biochar system was introduced

Biochar plus project was approved about two and half years ago.

The principal action for the introduction of the biochar system were:

- Introduction of the ELSA stove in the local communities
- Train session to teach to the communities how to use the ELSA stove, how to cook and how to do soil amendment with biochar successfully
- Distribution of the ELSA stoves to the farmers
- Train the farmers to use the ELSA stove
- Comparison of the crop productivity with and without biochar

The stakeholders involved in the introduction were:

- Farmers
- Researchers
- Entrepreneurs
- Students
- Extensions staff from the minister of agriculture
- Energy and soil development enterprises
- University

The project affects the south-east part of Ethiopia, more precisely the area around Jimma.

3.7.2 Field approaches and relationships with the communities

What appears from the interview is that the methodology for the introduction and implementation of Biochar plus in Ethiopia is Bottom-up.

Infertility of the ground, energy issues, health issues related to the smoke of the household fire are the issues that the project could address in the country.

Monitoring and evaluation are in order to understand how biochar works in the soil.

The results are monitored every two weeks through field visits. The evaluation consists in checking how much the crop productivity raise with the application of biochar.

Communication with the partner is about sharing reports and sharing the results during the annual meeting.

The sharing of information between the University of Udine and the University of Jimma help the project partner to use properly the Biochar as fertiliser.

3.7.3 Results

The technology is accepted by the end users but they are working to understand how to use it properly. There were differents level of understanding of the technology among the stakeholder.

What that appear is that the best result is the creation of a team work among the partners. Communication and evaluation are crucial to introduce in the best way the Elsa stoves in the local communities and are also crucial to understand how to make the biochar working properly as fertiliser.

However, there are issues about funds. There are too many people and the funds are not sufficient to introduce all of them to the project. Another issue is related to the wet

season that affect in a negative way the quality of the available biomass. Indeed, a wet biomass doesn't make the ELSA stove work properly.

4 CONCLUSIONS

What is clear in the end of my research is that all the countries involved in the project have a different approach to Biochar system introduction. In my opinion the differences in the approach rely on the needs of every single country. Indeed, it appeared that not all the partners are interested in the overall biochar system, infact, there are partners that prefer a single part of the system such as the possibility to address the energy problem as described in the case of Cameroon and Zimbabwe.

Probably the partner who has implemented completely the model of a biochar system is ASA Initiative in Ghana.

It is important to underline the several issues that I faced in collecting my information for this research. It shows the difficulties in the communications among the partners. Sometimes, these issues depended by the lack of proper internet infrastructures in the Africans countries, on the other hand my suspect is that there are huge differences between the European philosophy of work and the African one. I think these differences derive from cultural aspects, especially in the management of the time. Indeed, the time between the request of information and the answer to them was significant to me. Some request of information never had an answer. Communication is a field to improve to have better results. However, it would be better if I could have been on the field to collect the data I needed, but it was not possible for several reasons.

The issues that the partners underline were the lack of funds and in some cases the Ebola virus plague. In different ways these two problematics slowed down the implementation of the project.

Therefore, the differences among the single interest of every single study case and the ways of introduction of the biochar system make hard the activity of comparison. Especially the needs of every single territory involved make impossible the creation of a best practice. Every country has its peculiarities and it would be very helpful if before the introduction of the project there was a social research to understand the way of thinking of every single culture involved in the project. In the end as it's impossible create a best practice to the introduction of the project and its technology as impossible is find out what country had better results compare to the others. The study cases are too different to be compared.

In the end I want to thank all the partners that helped me to do this research. A special thanks goes to Starter s.r.l. that gave me all the tools and information to work on this research.

5 ATTACHMENT N.1

INTERVIEWS

(July 2016/ August 2016)

N.	Day of the interview	Country	Project Partner
1	20/06/2016	Ghana	ASA initiative
2	04/07/2016	Zimbabwe	Bindura University
3	13/07/2016	Cameroon	Mrs Siri Nangah Spora
4	20/07/2016	Ethiopia	Jimma University
5	16/09/2016	Sierra Leone	CORD-SL

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