REQUEST FOR MSP APPROVAL
(1-STEP PROCEDURE)

TYPE OF TRUST FUND: GEF Trust Fund

PART I: PROJECT IDENTIFICATION

Project Title:	Sharing knowledge on the use of biochar for sustainable land management		
Country(ies):	Global (Ethiopia, Kenya, China, Indonesia, Vietnam, Peru)	GEF Project ID:[1]	5824
GEF Agency(ies):	UNEP (select) (select)	GEF Agency Project ID:	01284
Other Executing Partner(s):	Starfish Initiatives	Re-submission Date:	16 May 2014
GEF Focal Area (s):	Land Degradation	Project Duration (Months)	36 months
Name of parent program (if applicable):		Project Agency Fee ($):	173,516

A. FOCAL AREA STRATEGY FRAMEWORK[2]:

Focal Area Objectives	Expected FA Outcomes	Expected FA Outputs	Trust Fund	Grant Amount ($)	Co-financing ($)
LD1 (select)	**1.2**: Improved agricultural management.	**1.2.** Types of innovative SL/WM practices introduced at field level **1.5**: Information on SLM technologies and good practice guidelines disseminated.	GEFTF	850,000	430,800
LD4 (select)	**4.2:** Improved GEF portfolio monitoring using new and adapted tools and methodologies.	**4.2**: GEF-financed projects contribute to SLM/SFM/INRM knowledge base.	GEFTF	976,484	827,000
		Total Project Cost		**1,826,484**	**1,257,800**

B. PROJECT FRAMEWORK

Project Objectives: To demonstrate and promote the adoption of SLM practices involving the use of innovative organic amendments, based on biochar, that improve the capture and efficient use of nutrients, and enhance productivity, improve climate resilience, support rural livelihoods, and contribute to watershed management.

Project Component	Grant Type	Expected Outcomes	Expected Outputs	Trust Fund	Grant Amount ($)	Cofinancing ($)
1. Evaluation of the role of biochar in sustainable land management.	TA	Increased understanding of the potential of biochar in improving productivity and addressing issues of declining soil fertility and mismanagement of nutrient resources.	1.a) Collation of demonstration results comparing biochar with alternative management practices; 1.b) Evaluation of a range of formulations and application rates of nutrient-enhanced biochar; and 1.c) Collation of	GEF TF	818,500	450,000

[1] Project ID number will be assigned by GEFSEC.
[2] Refer to the reference attached on the Focal Area Results Framework and LDCF/SCCF Framework when filling up the table in item A.

			recommended practices for the use of biochar in SLM.			
2. Knowledge management, dissemination and capacity building.	TA	Knowledge generated and disseminated on the appropriate use of biochar to improve the capture and efficient use of nutrients, while reducing air and water pollution; Increased awareness and improved understanding amongst smallholders, including women's farming groups, and resource managers of the use of biochar to address soil constraints, and most effective application rates and formulations (e.g. mix with other organic and mineral amendments) to achieve agronomic benefits.	2.a) Guidelines for the use of biochar in SLM; 2.b) Networks of demonstration sites and farming groups; and 2.c) At least 36 smallholders and resource managers trained in the use of biochar as soil amendment.	GEF TF	817,484	557,800
		Subtotal			1,635,984	1,007.800
		Project Management Cost[3]		(select)	190,500	250,000
		Total Project Cost			**1,826,484**	**1,257,800**

C. CO-FINANCING FOR THE PROJECT BY SOURCE AND BY NAME IF AVAILABLE, ($)

Sources of Cofinancing	Name of Cofinancier	Type of Cofinancing	Amount ($)
Foundation	Starfish Initiatives	In kind	330,000
Foundation	Starfish Initiatives	Cash	100,000
National Government	Cornell University	In kind	150,000
National Government	Thai Nguyen University of Sciences	In kind	98,000
Private University	Universidad Cientifica del Sur	In kind	80,000
Local Government	NSW Department of Primary Industries	In kind	64,800
National Government	Nanjing Agricultural University	In kind	60,000
National Government	Jimma University	In kind	25,000
GEF Agency	United Nations Environment Programme (UNEP)	In-kind	350,000
Total Cofinancing			1,257,800

[3] PMC should be charged proportionately to focal areas based on focal area project grant amount in Table D below.

D. GEF/LDCF/SCCF/NPIF Resources Requested by Agency, Focal Area and Country[1]

GEF Agency	Type of Trust Fund	Focal Area	Country Name/Global	Grant Amount (a)	Agency Fee (b)[2]	Total c=a+b
UNEP	GEFTF	Land Degradation	Global	1,826,484	173,516	2 000 000
Total Grant Resources				1,826,484	173,516	**2,000,000**

[1] In case of a single focal area, single country, single GEF Agency project, and single trust fund project, no need to provide information for this table

[2] Please indicate fees related to this project.

E. Consultants working for technical assistance components:

Component	Grant Amount ($)	Cofinancing ($)	Project Total ($)
International Consultants	100,000	100,000	200,000
National/Local Consultants	50,000	80,000	130,000

F. Does the project include a "non-grant" instrument? N/A

(If non-grant instruments are used, provide an indicative calendar of expected reflows to your Agency and to the GEF/LDCF/SCCF/NPIF Trust Fund).

PART II: PROJECT JUSTIFICATION

A. PROJECT OVERVIEW

A.1. Project Description. Briefly describe the project, including ; 1) the global environmental problems, root causes and barriers that need to be addressed; 2) the baseline scenario and any associated baseline projects, 3) the proposed alternative scenario, with a brief description of expected outcomes and components of the project, 4) incremental cost reasoning and expected contributions from the baseline , the GEFTF, LDCF/SCCF and co-financing; 5) global environmental benefits (GEFTF, NPIF) and adaptation benefits (LDCF/SCCF); 6) innovativeness, sustainability and potential for scaling up.

A.1.1. Describe the global environmental problems, root causes and barriers that need to be addressed

Land degradation affects about 24% of global land area, and the problem is growing: 24 billion tons of fertile soil and 12 million hectares of productive land are lost each year. Globally, 1.5 billion people live on degraded lands. Furthermore, the world's population is growing, expected to reach 9 billion by 2050. Feeding this growing population will be a major challenge, particularly as climate change is expected to increase rainfall variability, and incidence of climatic extremes such as drought. In addition, productive land area is being lost to urban expansion, transport infrastructure and mining.

Land degradation results from a range of direct and indirect drivers that are inter-linked. Direct drivers include unsustainable cropping practices and overgrazing, which lead to topsoil erosion and decline in soil organic matter levels across vast areas of agricultural lands. Moreover, unsustainable irrigation practices, deforestation and mining reduce land quality.

Indirect drivers of land degradation include:

- population growth and increasing wealth of a significant proportion of the population, leading to increasing demand for food and therefore pressure on the land;

- expansion of urban areas into high quality farmlands, reducing availability of productive land and increasing pressure on remaining land; and
- climate change that may reduce plant growth and thus organic inputs to soil in many locations, reducing soil organic matter levels.

Maintaining soil fertility is fundamental for improving food security and reducing poverty. Yet widespread loss of soil fertility due to unsustainable cropping and grazing practices is causing loss of productivity, putting increasing pressure on agricultural land, and threatening future food production. Thus, agriculture must face the challenge of increasing food production, while per capita land and water resources decrease, and climatic risks escalate. Climate change will exacerbate the stress on agricultural systems, by reducing crop yields and quality of produce, thus raising prices of staple crops and reducing access to food particularly for the poor.

Agro-ecosystems and the human communities that rely on them, have a degree of resilience but degradation of resources beyond a threshold will result in long term loss of productivity and ecological function from which recovery will be slow or impossible. Maintenance of soil organic matter is particularly important for resilience of soil processes, necessary for sustaining nutrient and water cycling and plant production. Thus the decline in soil organic matter must be arrested and reversed.

Increasing food production while per capita resources are decreased will require increased intensity of production. This could have undesirable environmental consequences if achieved through increased use of chemical fertilisers, agricultural chemicals and irrigation. It is critical that sustainable intensification practices are employed, focusing on increased efficient use of water, nutrients and land; protection of soil resources; and minimum off-site impacts - on water yield and quality, and natural systems.

Sustainable land management (SLM) practices must be promoted to address the decline in productivity and restore fertility to degraded lands. SLM is the use of land in a manner that seeks to maintain or enhance the land condition so that its functions in supporting plant growth are maintained for the future and negative off-site impacts are minimized. It employs practices that build the chemical and physical and biological health of the soil, and use external inputs (e.g. fertilisers, irrigation) strategically to maximize the utilization efficiency of limited resources.

Addressing the problem of land degradation through SLM approaches is truly multi-faceted with challenges on multiple levels of environmental science, social and economic well-being and cultural values.

Currently a large proportion of the world's nutrient resources are squandered, used inefficiently and are not recycled. The manufacture of nitrogen (N) fertilisers is an energy-intensive process, contributing significantly to greenhouse gas (GHG) emissions, and the world's scarce supplies of phosphorus (P) are being depleted. Recycling these nutrients for beneficial use in agriculture is thus a win-win opportunity. Bio-solids and wastewater, for example, contain large quantities of both N and P, and are often discharged to waterways, causing pollution and toxic algal blooms due to excessive levels of nutrients. Runoff and leaching from intensive cropping and grazing systems similarly leads to eutrophication of water resources.

In addition to wasting nutrients, current disposal approaches for agricultural residues lead to air and water pollution and ongoing land degradation. For instance, cereal straw is commonly burned in the field and processing residues such as rice husk may also be burned or dumped in waterways. These are organic matter resources that could be utilized to improve soil health.

Many forested tropical regions are experiencing deforestation as a result of slash and burn subsistence agriculture. For example, the Food and Agriculture Organisation of the United Nations (FAO) estimates that Peru (one of the project countries) loses 224,000 to 300,000 hectares of forest per year partly due to subsistence farming and the use of charcoal as cooking fuel. Subsistence farming practices rapidly deplete nutrient resources, causing sharp decline in productivity that leads to abandonment and further deforestation. Moreover, many tropical soils are affected by contamination with heavy metals. Improved understanding of strategies to maintain or increase fertility of cleared or contaminated land should reduce the rate of deforestation and degradation.

In Peru, the problem of heavy metal contamination in tropical soils is further compounded by the rapid growth of the mining industry. In the region of Madre de Dios, the region of the Amazon with the highest levels of mammal biodiversity in Latin America, informal gold mining is causing deforestation, species loss and serious mercury contamination problems (Asner, 2013). Biochar may be part of the solution to this problem as studies have demonstrated conclusively that biochars can immobilize heavy metals (Uchimiya *et al*., 2011). Coffee production is another example of where biochar could potentially help resolve serious problems. The production of coffee is an important economic activity for some of the most economically disadvantaged people in Peru (Tulet, 2010) and the industry is melt down at the moment because of a rust fungus epidemic (Vandermeer *et al*., 2014). Biochar could be a central component in a strategy to resolve this problem. Biochar can be used to improve the mineral nutrition of crop plants and therefore enable coffee plants to better construct the nitrogen based defense compounds that will allow them to defend themselves against the insect vectors that spread the rust fungus. In this context, there are promising indications that plants growing in biochar amended soils are more resistant to disease (Elad *et al*., 2010).

A.1.2. Describe the baseline scenario and any associated baseline projects

The proposed study countries have growing problems of decline in productivity of land that is managed unsustainably, concerns about contaminated soils with heavy metals and issues associated with disposal of organic residues. These issues have been recognised and each country is undertaking a range of activities to develop SLM practices, and to make better use of organic matter resources. Each project country has identified that biochar may have a role to play in simultaneously addressing the decline in land productivity, contamination of soils with heavy metals and the pollution caused by injudicious disposal of organic residues. Biochar is the term applied to organic matter that is carbonised by heating it under limited oxygen environment, and used as a soil amendment. Biochar can be produced from a wide range of organic sources, including crop and forest residues, food processing wastes, urban green waste, bio-solids, algae and animal manures.

Biochars have different properties depending on the feedstock and the conditions of production. The production process leads to the stabilisation of the carbon (C) in the organic matter. So biochars are resistant to decomposition and therefore sequester C.

Biochar production and its application to soil has been proposed as a way to stabilise organic C and N in slow cycling forms (Cross and Sohi, 2011; Singh *et al*., 2012; Wang *et al*., 2012), stabilise native and added organic C (Keith *et al*., 2011; Slavich *et al*., 2013), and reduce nitrous oxide (N_2O) emissions from soil (Singh *et al*., 2010a; van Zwieten *et al*., 2009; van Zwieten *et al*., 2010). Application of biochar as a soil amendment has potential benefits in a wide range of agricultural systems, and has been trialed in various field crops and pastures around the world. Studies have found that biochar can improve plant yields, enhance soil water holding capacity and reduce fertilizer requirements, though results vary widely between different biochars, soil types, climates and target crops. Biochar has been shown to drastically improve plant productivity when applied to nutrient poor and degraded soils. Increases in agronomic yields of between 30 and 170% have been observed in tropical agro-ecosystems after the application of biochar.

Biochars produced from woody materials by slow pyrolysis at around 550 °C have high stability, with mean residence times of around 1000 years, followed by herbaceous biomass, while manure-based biochars produced at 400 °C have lower stability, with mean residence times of around 100 years. Poultry litter biochar produced at 550 °C has intermediate stability in the range of a few centuries as it includes manure and bedding material, usually wood shavings. In contrast, composts, raw manure and stubble mulches generally decompose in periods of one to a few years.

Pyrolysis causes volatilization of a significant fraction of the N content in feedstocks, and may reduce the short- to medium-term availability of nitrogen and phosphorus (Wang *et al*., 2012). Nevertheless, not surprisingly, feedstocks with high nutrient contents, such as manures, make biochar with higher fertilizer value than those with low nutrient content, such as wood waste. Furthermore, nutrients may be released relatively quickly upon decomposition of lower stability manure-based biochars compared to the higher stability woody biochars. Biochars made from green leafy material are expected to have intermediate nutrient value.

Application of biochar to soil may reduce the requirement for fertilizer, as biochar can increase nutrient retention (Singh *et al*., 2010b), thus reducing the need for the manufacture of N fertilizer, a GHG-intensive process (Wood and Cowie, 2004). Biochar produced from nutrient dense feedstocks can fertilize without creating the nutrient runoff problems associated with chemical fertilisers (Sarkhot *et al*., 2012). Chemical fertilisers are expensive in terms of energy to produce and diversifying the range of fertilisers / soil amendments available to smallholders will protect against future increases in the cost of energy and therefore fertilizer. Biochar applied at a rate of 150 kg/ha has been compounded with NPK and clay at 350 kg/ha to increase the yield of rice and wheat crops by up to 30% while reducing GHG emissions and increasing N and P uptake efficiency (Joseph *et al*., 2013; Qian *et al*., 2014). Further, the uptake of nutrients in higher plants is closely linked to the uptake of water (McDonald *et al*., 2002). In this context, there are promising indications that biochar limits plant water stress in sandy soils by improving the water holding capacity of the soil (Kammann *et al*., 2011). Therefore if the mineral nutrition of crop plants can be improved through biochar application, their water use efficiency will be improved, making agriculture in dryland regions more resilient to climate change impacts, such as reduced water availability which is expected to occur in Peru as the glaciers melt in the Andes.

Application of biochar to soil may enhance the soil carbon stocks over and above the carbon content in the biochar (Slavich *et al*., 2013), in a process known as “negative priming”. This process may occur due to stabilisation of plant-derived carbon, possibly caused by sorption of labile C on biochar, biochar organo-mineral interactions (Keith *et al*., 2011) and enhancement of plant C input, particularly the belowground compartment. Although there may be increases in native soil carbon turnover (“positive priming”), e.g. due to enhanced soil microbial activity induced by small amounts of more labile C in biochar, such effects are relatively small and short-lived compared to stable C in biochar or stabilisation of native or added soil C by biochar in the long-term (Keith *et al*., 2011; Luo *et al*., 2011; Woolf and Lehmann, 2012; Singh and Cowie, 2014).

To ensure that biochar production does not contribute to air pollution and GHG emissions, biochar must be produced in a facility that captures and combusts the gases released when biomass is heated. The heat produced through combustion of these gases can be used as a form of renewable energy. Biochar production can occur at scales ranging from a cook stove to large engineered industrial-scale plants. Slow pyrolysis could be used in intensive animal production systems as a waste management solution, delivering renewable energy and converting manures to valuable stable carbon-based soil amendments that facilitate nutrient recycling. The stabilisation of C through slow pyrolysis has also been shown to reduce substrate availability for denitrifying organisms, thus contributing to reduction of N_2O emissions associated with the land application of manures.

Application of biochar may reduce availability of heavy metals, thus providing an affordable means of remediating such soils, and enabling the continued utilization of contaminated soils for food production. Much of the research into biochar has utilized high rates – e.g. around 10 t/ha – of freshly produced biochar. However, it is recognised that such high rates of application will be prohibitively expensive for many land holders and that there is insufficient biomass resource to enable such high rates to be applied broadly. Recently improved understanding of biochar effects, particularly the chemical reactions occurring at the biochar surface, has led to the proposition that more potent biochar treatments could be created through enhancement of biochar – such as by composting biochar with manure and ash – and that such nutrient-enhanced biochar formulations may be more effective in stimulating plant growth and/or immobilizing heavy metals at much lower application rates (Joseph *et al*., 2013). However, the evaluation of the efficacy of such enhanced biochars in field trials has just started (Nielsen *et al*., 2014). Baseline projects in some participating countries, such as China and Vietnam, include the assessment of biochar formulations designed to enhance the properties of biochar, enabling positive effects from low application rates. As a result of this global project, the knowledge obtained will be disseminated to other countries.

Biochar systems can deliver a range of co-benefits, which may include waste management, destruction of pathogens and weed propagules, avoidance of landfill, ease of handling, management of odors, renewable energy generation, reduction in environmental N pollution, avoidance of decomposition, protection of waterways and soil remediation. Recent economic and life cycle analyses indicate that biochar production using urban biological waste streams could be a central component in strategies for the management of urban biological waste that could also provide a source of carbon neutral energy (Roberts *et al.*, 2010).

Before biochar systems can be promoted it is important to understand the whole life cycle impacts of biochar, by assessing the net effects of biochar systems on fossil energy use, fertilizer use, soil and biomass carbon stocks, and GHG emissions from soil. Some of the baseline studies (e.g. in Vietnam and Peru) are undertaking life cycle assessment (LCA) of biochar systems at different scales, and knowledge and experience will be shared among other countries.

Baseline projects

Peru: Building human capacity and knowledge of biochar in Peru (AUSAid, AUD 380K)

In Peru, a series of baseline projects are coordinated by Universidad Científica del Sur in Lima and the Peruvian Ministry of Environment. The baseline project 'Building Human Capacity And Knowledge Of Biochar In Peru' (AusAid, AUD 380K) focusses on the demonstration and evaluation of biochar production at household level amongst poor peri-urban communities, and capacity building for women researchers, to enable them to evaluate the use of biochar in the Amazon and in the coastal desert region of Peru. The project partners include research and extension staff from the NSW Department of Primary Industries (DPI), the University of New South Wales (UNSW), La Universidad Científica del Sur in Lima and the Peruvian Ministry of Environment.

In Lima, the capital of Peru where urban green waste is currently landfilled, the baseline project is trialing the pyrolysis of green waste, to produce biochar for application in greening Lima's urban slums. Lima is a poor mega city located in a coastal desert, with over 9 million inhabitants, many of whom lack access to potable water. Urban parkland is limited to the richer suburbs located on the rich alluvial valleys that receive water runoff from the Andes. The poorer suburbs are built on hillsides where access to water is extremely limited. For this reason there is an acute shortage of green space in the poorer neighborhoods of Lima, in which there is less than $3m^2$ of green space per habitant. The World Health Organisation recommends having $8\text{-}15m^2$ of green space per habitant. The situation is obviously worse in Lima's poorer suburbs, which has obvious implications for the city's poorest people. Therefore the baseline project is investigating the use of biochar to improve plant growth and water use efficiency in water limited desert soils. The use of biochar is being demonstrated at the 'Special Project National Ecological Park Antonio Raimondi (PEPENAR)', which aims to create 8,259 ha of green space on the poverty stricken northern fringe of Lima. Biochar is being produced from a mixture of municipal green waste, crushed volcanic rock and FE bearing clay and discarded and rusted iron extracted from the city's waste stream.

The use of biochar as a soil amendment to enhance the productivity of the Aeolian soils of arid areas in Northern Peru will also be assessed. Light, fine grained soil particles are entrained in the atmosphere over the Andes and are then re-deposited in the arid North of Peru. The fine grained nature of Aeolian soils could limit diffusion of essential nutrients, and the lack of soil structure could also mean that limited habitat for soil biota is available. Biochar may improve soil structure of Aeolian soils due to its highly porous structure and so could improve the mineral nutrition of plants by promoting bulk diffusion of essential nutrients through the soil profile, and also indirectly by creating suitable conditions for the soil biota. Amino sugars will be used as markers (gas chromatography) to quantify the relative abundance of fungal and bacterial residues in soil, before and after, and with and without biochar applications to soil to test this possibility. The effect of biochar on water holding will also be assessed in this environment.

In the tropical Amazon, where slash and burn agriculture is common, the baseline project is assessing the capacity of biochar to retain nutrients. Improving the nutrient retention capacity of Amazonian soils will mean that cleared patches of land retain soil fertility for longer, negating the necessity to abandon these patches and then clear new patches of forest for agriculture every few years. Developing a strategy that removes the need to move every few years not only reduces the deforestation rate, it also implies less work and a better quality of life for poor farmers.

Experiments are also underway to provide proof of concept that composting conventional N fertilizer with biochar can limit the losses of chemical N that usually occurs via leaching when N fertilizer is applied to agricultural fields. Demonstrating a viable strategy that may prevent leaching of N could in turn provide the knowledge needed to develop strategies for the protection of water quality in Peru.

A project is also currently underway in which the capacity for Peruvian made biochars to immobilize heavy metals and therefore limit plant uptake of contaminants is being assessed. This study includes a small scale trial in which plant uptake of heavy metals is being measured and also in which a range of different biochars produced from a range of locally available feedstocks are being trialed. Furthermore, as part of the Ausaid project, 30 ecological cookstoves have been given away to poor women on the urban fringe of Iquitos, Peru's largest Amazonian city (<http://www.biochar-international.org/profile_women_in_Peru>). The stoves were designed by Dr. Stephen Joseph [the University of New South Wales (NSW), Australia] and D.D. Khoi of Vietnam and employ pyrolysis, a chemical process that produces biochar as a by-product. These stoves are now being commercially produced in Vietnam. Testing by Aprovecho Research Institute and the University of NSW has shown that wood fuel consumption and emissions of toxic gases can be reduced by approximately 50% with these cookstoves. These ecological cookstoves can replace the open fire hearths currently used most typically by poor rural women, community kitchens, and low-budget restaurants in Peru. The cookstoves have an innovative design which reduces the consumption of wood by over 50%. The fact that the stoves employ pyrolysis is important in this context, and so is the fact that these stoves can operate with leaf litter and small twigs, resources freely available to poor women living in the amazon. Moreover, the fact that the fuel needed to power these new stoves is freely available close to where rural women live also means that they can reduce the distances they need to travel (walk) to collect fuel wood for cooking.

The improved stoves could provide a significant economic benefit to poor women by reducing their need to either purchase or collect tropical hardwood, which, at present, is the preferred source of fuel for cooking in the Peruvian Amazon. These cookstoves could therefore play a key role in decreasing the rate of deforestation in the region. Also, the amount of smoke emitted and indoor air pollution could be reduced and so the stoves could provide health benefits to the region's poor. The ecological cookstoves have two chambers. In the (small volume) inner chamber there is a standard fire which is fed with small twigs (5-20 cm in diameter). The outer chamber is packed with small twigs and leaf litter. The ingress of air into the outer chamber is limited. When the fire in the inner chamber reaches 200° Celsius the material in the outer chamber begins to combust via pyrolysis. The gas produced via pyrolysis enters the inner chamber via small holes in the wall separating the two chambers, and the gas unifies with the flame that exists within the inner chamber. When this occurs, the smoke that is emitted is reduced significantly. Results from experiments in Vietnam indicate that the cookstoves reduce emissions of carbon monoxide (CO) by 36% and the emission of particulate matter by 73%. These stoves also produce biochar as a by-product which can be used as a soil enhancer for the region's tropical soils.

A number of thesis students are involved with these baseline activities, which are reinforcing the capacity for research in the next generation of natural resource managers and/or researchers in Peru. The results of these baseline activities will be communicated to the wider scientific community via the production of scientific articles and to natural resource managers in Peru through attendance at local workshops and through own professional networks in Peru.

Kenya: Biochar for improving nutrient cycling and soil fertility at the watershed scale

Since 2004, a series of experiments examining the persistence of biochar, its effects on carbon dioxide (Kimetu and Lehmann, 2010), methane and nitrous oxide emissions (Fungo *et al*., 2014) and on soil fertility (Kimetu et *al*., 2008) have been conducted in Western Kenya. In addition to these focused research activities on biochar effects on soil functions, the group, consisting of academic institutions from Kenya and the U.S.A., private companies and CG research organisations, has been instrumental in quantifying life-cycle GHG emissions that include the energy and mass balances of biochar production, biomass procurement and biochar use (Whitman and Lehmann, 2009; Whitman *et al*., 2010, 2011; Torres *et al*., 2011). These activities are ongoing, and are now including effects of biochar on diseases in beans (funded by USDA-NIFA in collaboration with IITA through 2016), and the use of biochar as inoculant carriers (funded by NSF-BREAD in collaboration with ICRAF through 2016).

Since 2007, the long-term plot and household trials have been expanded to include watershed trials that assess the changes in soil fertility losses and carbon and nutrient export from headwaters as a result of forest conversion to agriculture for varying lengths of time up to 50 years after deforestation (Recha *et al*., 2012, 2013). Seven years of data on carbon and nutrient exports have been collected in two sets of four watersheds, showing dramatic losses of productivity through nutrient fluxes in streams. This provides a unique opportunity to examine the effects of biochar on carbon and nutrient exports on a watershed scale. It seems that this has not been done anywhere else in the world.

Ethiopia: The potential of biochar to improve soil functions and resource use efficiency

Since 2012, the project group, consisting of Ethiopian and US universities, Ethiopian research organizations and international NGOs, has investigated the effects of biochar and biochar-based fertilisers on soil productivity, resource use efficiency, and carbon sequestration with soils from four ecoregions in Ethiopia, and with on-farm research in Jimma and Awasa regions. Using greenhouse studies, significant crop growth increases through biochar additions in acid soils of the Jimma region were observed, as well as lower benefits in high-pH soils of Ethiopia's drylands. Economic studies complement the biophysical studies to examine the viability of this new technology in smallholder farming systems. The projects are ongoing to concentrate on farm-based research (funded by The McKnight Foundation in collaboration with Jimma University and CARE-Ethiopia through 2017) and on building business models for large and small biochar businesses (funded by ATA in collaboration with CARE-Ethiopia and Jimma University through 2016). In addition, the group is starting a project on climate-smart agriculture to investigate the GHG balances and food security opportunities throughout Ethiopia (first phase funded by The World Bank in collaboration with CARE-Ethiopia and Jimma University through 2015). These projects and the preliminary data from the first two years of field studies demonstrated the urgent need for long-term data using field-based experiments, since the persistence of biochar provides benefits for which returns have to be assessed over longer periods of time.

China: Sustainable management of crop residues and demonstration of the use of biochar for soil remediation, GHG mitigation and crop productivity (2 million RMB)

A baseline project operated at Nanjing University was designed to demonstrate the use of biochar in green agriculture in China. This project is funded by the Ministry of Science and Technology of China. The main targeted provinces are Henan, Hunan, Anhui and Jiangsu. It is planned for upscale by at least a dozen of aggregated household farms. This includes demonstration of the use of biochar in land treatment of polluted soils, biochar use in slow releasing organic/inorganic fertilisers, as well as biochar in GHG mitigation in croplands. Field trials include two trails with biochar compound fertilisers, three sites of land treatment with biochar and four sites with biochar for mitigation of GHG emissions. The overall benefits of using biochar and the sustainable role of biochar in agriculture will be explored in the next years. Also, a socio-economic analysis will be conducted to show the feasibility of using biochar in the targeted rural areas.

Several soils in this project are polluted with heavy metals, which come from various sources, mainly from industrial and domestic waste water used in irrigation, stack emissions from smelters and from the heavy metal content in the fertilisers. Furthermore, a major issue is the burning of crop residues with resultant pollution and loss of carbon and nutrients from the soil. In China, about 505 million tonnes of straw residues are underutilized every year and a significant percentage of these are burned in the field causing large levels of pollution, loss of nutrients and increase of GHG emissions. There is also serious pollution from overuse of fertilizer with degradation of soil and leaching leading to eutrophication. The project includes the design and construction of advanced biochar kilns and the development of new formulations of relatively low application rates of biochar NPK mineral fertilisers with the objectives of increasing the income of farmers through building soil, reducing fertilizer input and of course increasing yields.

Baseline project activities include:

1. field testing of low application rates of biochar NPK fertilisers (2 years);
2. field testing of low application rates of biochar applied every year for agronomic affect and greenhouse gas abatement (3 years);
3. field testing of high single application rates of biochar applied for agronomic affect and greenhouse gas abatement (3 years);
4. reducing bioavailability of heavy metals using biochar in drylands and paddy soils in 6 locations for wheat maize and rice crops (3 years); and
5. field testing of biochar applied at high and low application rates for locking up heavy metals in traditional medicine plantation (4 years).

Indonesia: Improving soil and water management and crop productivity of dryland agriculture systems of Aceh and NSW (ACIAR, total project value AUD1.7m)

Project partners: NSW Department of Primary Industries, Assessment Institute for Agricultural Technology, Aceh (BPTP Aceh), Syiah Kuala University (UNSYIAH), Pusat Penelitian dan Pengembangan Tanaman Pangan (Puslitbangtan), Balai Besar Sumber Daya Lahan Pertanian (BBSDLP). This collaboration includes staff from local and Australian research and extension institutions.

Rural poverty in dryland farming areas is a major challenge to the development of the agricultural sector in Aceh. Topsoil erosion is common in upland dryland areas in Indonesia (Dariah *et al*., 2004) and is one of the main causes of low soil fertility and water holding capacity. Better soil and water management is needed to maximize soil water storage, improve nutrient availability and conserve soil.

The main contributing factors to rural poverty are small holdings, limited livelihood options other than subsistence farming, and low yields of dryland crops. Previous studies have shown that there is potential to improve farmer livelihoods by increasing the yields and profitability of key dryland food crops such as soybean, rice, peanut, maize and vegetables. Soybean is a nationally important food crop for Indonesia, but current production meets only 30% of national consumption. This means that the Indonesian soybean supply and prices largely depend on imports. As a result the Indonesian government plans to reduce this vulnerability by expanding domestic production. It has designated Aceh as a principal soybean producer, with the Bireuen district expanding its production to 36,000 ha. This district will be one of the focus locations for soybean in the Indonesian baseline project. Peanuts, dryland rice and vegetables also contribute significantly to Aceh’s economy, and will also be included in crop rotations.

The current productivity of these crops is limited due to poor soil fertility and water availability. Earlier research (ACIAR project SMCN 2007/040) showed that soybean and peanut crops grown after rice responded positively to the addition of fertilizer. However, fertilizer is either not used or applied at very low rates, leading to continual nutrient mining and soil degradation. Practical strategies are needed to utilize available nutrients and soil water efficiently to increase crop productivity without further degrading the resource base.

These strategies include inclusion of economically important legume crops to improve existing crop rotations, and identification of appropriate soil and water management practices best suited to local conditions. The main aim of the baseline project is to develop and promote strategies to increase the productivity and sustainability of dryland cropping systems. The geographic focus will be on dryland cropping systems in four districts of Aceh: Aceh Besar, Pidie, Aceh Barat and Bireuen. The baseline project will address the following questions:

1. What are the challenges and opportunities for soil and water management to increase cost-effective production of economically important food crops, such as soybean, under dryland conditions in Aceh?
2. What are the possibilities for improving crop rotations best suited to local conditions?
3. What are the appropriate soil and water management practices for the improved rotations?
4. What are the most effective dissemination strategies for promising technologies identified by the project?

The first stage of the baseline project will undertake a survey to synthesize available information on soil and water resources in dryland farming systems in the districts of Aceh Besar, Aceh Barat, Pidie and Bireuen. These districts are representative of dryland farming systems in Aceh, and contribute a significant share of Aceh's dryland rice, soybean, peanut, maize and vegetable production (BPS, 2012).

Results from this survey will identify key constraints and management opportunities in Aceh's dryland cropping systems, and summaries current farmer and extension knowledge and strategies used to cope with the constraints of infertile soils.

The second stage of the baseline project will establish demonstrations of potentially useful strategies for nutrient management and soil and water conservation through modified cropping systems and soil amendments. Previous projects established networks of farmers, extension staff and researchers, who will be involved in selecting sites and treatments, and assessing the responses, thus facilitating a participatory learning process. These networks will be invaluable for the dissemination of promising technologies.

The baseline project will provide a network of women's farming groups, involving 1750 women, and thus an established mechanism for dissemination of promising technologies to rural women, who are largely responsible for food production and generation of household income. The baseline project will conduct training programs for at least 40 district extension staff that will allow efficient dissemination of promising management practices to smallholders. GEF funding will allow inclusion of information about biochar in this training program.

Development of these technologies will require improving local understanding of soil, water and crop constraints and opportunities under dryland conditions; increasing the research and extension capability of BPTP Aceh and Unsyiah under dryland agriculture systems; evaluating potential technologies under field conditions, including those identified in SMCN2007/040; and effectively communicating proven technologies to extension staff and farmers.

The project research and communication strategy capitalizes on the existing network of effective local and national partnerships established during previous ACIAR projects. The integrated research and extension approach, and farmer participatory research/demonstration activities proved very effective in earlier projects in raising farmer interest and productivity and will be used again in this project to ensure effective transfer of knowledge from the project to the local farmers. Increased participation of the local university in the research and extension activities will enhance local agriculture expertise during the project and in the longer term.

Vietnam: Trial of rice husk biochar for soil improvement and reduction in GHG emissions

In Vietnam, agricultural production is commonly conducted on light texture soils, which consist of almost 20 million ha of Acrisols, distributed in provincial Dong Nai, TayNinh, VinhPhuc, PhuTho, Thai Nguyen and BacGiang. Due to high annual rainfall, soil erosion and leaching occur severely, causing soil degradation, especially on the light texture soils on slope areas. Consequently, Acrisols are usually recognized as “problem soils”, containing a number of limitations, such as low soil nutrient contents and fertility. To enhance crop yield, farmers normally apply high rate of inorganic fertilizers and plant-protecting chemicals, such as fungicides and pesticides for pest management. These practices, however, are not sustainable. Biochar is being evaluated as part of integrated nutrient management on sandy soils for balanced plant nutrients and soil organic matter.

Due to dense population, cultivated area per capita in Vietnam is limited and may even decrease in the coming years. Enhancing both crop yield and quality for domestic use and export to develop a sustainable agriculture production is an essential target of the nation. In addition, a clean agriculture environment is another important aim which should be taken into account. These combined targets may be concurrently addressed through biochar additions. However, the acceptance and adoption of biochar for soil amendment in agriculture is still limited in Vietnam. Demonstrating the effect of biochar on crop production and introducing an efficient method of biochar production to farmers is believed to be a promising way to promote production and use of biochar for sustainable land management.

The project, undertaken by Thai Nguyen University, aims at evaluating low rates of biochar application with added chemical and organic materials, compared with conventional fertilizer practice in rice cropping. The biochar is produced at a village level in a simple reactor with three different types of residues, clay and ash. Detailed characterization of the biochar before and after application is carried out to allow process-based understanding of the responses. Life cycle assessment (LCA) and life cycle costing will be conducted to examine the whole system environmental impacts and energy balance of biochar systems compared with alternative uses of the biomass, and conventional soil amendments.

A.1.3. Describe the proposed alternative scenario, with a brief description of expected outcomes and components of the project

The proposed project will bring together a wide range of projects investigating the use of biochar in sustainable land management. Formal biochar research is in its infancy. Yet there is much traditional knowledge about the use of charcoal in various applications to enhance soil productivity. Many scientific studies have been undertaken in recent years using biochar prepared in advanced facilities, and there is increasing understanding of the properties of biochar, and the chemical, physical and biological processes involved when biochar is applied to soil. Much of the research has been undertaken in laboratories and pot trials. Field scale trials and demonstrations have been implemented only in the last 5 years. Research based on novel formulations of nutrient enhanced biochars and low application rates has commenced, but the results have not been assessed and disseminated. This project builds on current activities to evaluate biochar in field trials. Some trials utilize biochar in novel ways to capture nutrients and return them to the soil. Some projects have established networks of landholders and mechanisms for training, but do not have the knowledge of appropriate formulations of biochars. Other projects have strong scientific expertise, but no capacity in rural extension. Therefore this project will collate the best available knowledge generated amongst the project participants, including expertise of world-leaders in biochar science and engineering, to expand the demonstration of biochar in a range of settings (soil types, climates and agricultural systems), and to disseminate the findings broadly amongst landholders and resource managers.

Project components:

Component 1: Evaluation of the role of biochar in SLM: will focus on the demonstration of biochar as a soil amendment to enhance SLM. This will involve the following activities:

- demonstration of biochar in comparison with alternative organic amendments and chemical fertilisers;

- evaluation of alternative formulations of biochar – that is, biochar mixed with manure, compost and mineral matter, and applied at different rates; and
- demonstration of nutrient-enhanced biochar as a strategy to reduce pollution (eutrophication and GHG emissions) and wastage of nutrient resources.

In **Indonesia**, the baseline project will undertake a survey to identify constraints to productivity and establish demonstrations of management practices that improve soil nutrient and water availability in dryland farming systems. GEF funding will allow the expansion of the demonstration to include biochar treatments, and thus allow biochar to be compared with alternative amendments.

In **Vietnam and China**, countries innovative research into appropriate biochar formulations that maintain yield benefits at lower application rates are being conducted by university researchers. There is no current network by which the results of these experiments are conveyed to the local land managers. GEF funding will allow the dissemination of the results of the evaluation of biochar in comparison with the conventional practice, in rice production.

In **Peru**, GEF funding will allow field demonstrations to be undertaken to evaluate the effectiveness of biochar when applied in the upper reaches of the Amazon in coffee orchards where a rust fungus has destroyed over 90% of crops (Vandermeer *et al*., 2014). The intention is to establish large scale field trials to test whether biochar can help to deal with this disease for two reasons: 1) biochar could be used as a strategy to keep the orchards clean, and 2) biochar could improve the mineral nutrition of the plants allowing them to construct the nitrogen based defensive compounds they need to ward of the vectors of the fungus. In Peru, special focus will be on women as they will be the main users of the introduced biochar-making cookstoves. Once the cookstoves have been adopted successfully in the coffee country, the idea is to replicate this work with the Ashaninka tribe, one of the largest remaining tribes in Amazonia. This indigenous group has been identified as potential beneficiaries since they use fuel wood for cooking and biochar-making stove uses less wood than traditional stoves. Wood is becoming scarcer in the area mainly due to deforestation caused by the unsustainable use of resources and cattle ranches moving in.

Specifically, the group at the University Cientifica del Sur (UCSUR) proposes to supervise the manufacture and field testing of 200 units of the ecological cookstove and of 50 simple biochar reactors for use in slash and burn clearings. Their experience in Iquitos has demonstrated that effective and well funding extension is critical for the uptake of this new technology. The group will select twenty villages in the central jungle in the Department of Junin, Peru, a region at the limit of rising agriculture and the rainforest frontier. Each of the twenty villages will be located next to a selected rainforest fragment. In this region the lowland alluvial habitat has been cleared for agriculture and the forest fragments are located on upland slopes. Nevertheless these upland forest fragments are critical for ensuring the continued steady supply of high quality water for human communities and their agriculture in the lowlands, and these forest fragments also supply a range of other important ecosystem services, like crop pollination.

Ten of the twenty selected villages will receive 20 ecological cookstoves and five simple biochar drum reactors for use in slash and burn clearings. The other ten villages will serve as experimental controls (i.e. those villages will not receive cookstoves or the biochar drum reactors). In the then villages that receive the drum reactors and the cookstoves the core team of the project will spend four days living with and building the capacity of the local population to use the new technology. The impact of the cookstoves on the rate of deforestation of the forest fragments adjacent to the twenty villages will be monitored using innovative Geographic Information System (GIS) techniques, focused ground truthing, a simple method of weighing firewood consumed, and interviews of local community members. The UCSUR can make a significant in-kind contribution to this project activity. In 2013, UCSUR invested heavily in developing its GIS teaching lab and will continue to do so in the years ahead. The monitoring of the twenty forest fragments will be incorporated in the under graduate teaching program. Specifically, the group will, as an exercise for the advanced undergraduates, analyses the rates of deforestation in the forest fragments using radar remote sensing (Ladd and Peri, 2013).

The GIS monitoring of the rate of deforestation in the forest fragments will be complemented with on ground surveys of plant and insect diversity in the forest fragments. The insect surveys will focus on taxa that provide ecosystem services: pollination, pest control, and decomposition (soil formation). Emissions testing will be incorporated to measure GHG emissions from traditional open fire hearths (tushpas) and also from the new ecological cookstoves. The avoided emissions that could be achieved will be then calculated for the new ecological cookstoves using life cycle assessment (LCA) methodology. Biochar produced from the ecological cookstoves and from the 200 l drum reactors will be used in field trials in which the potential for biochar to limit the impact of the rust fungus will be assessed.

In **Kenya and Ethiopia,** GEF funding will allow the establishment of field demonstrations to evaluate the nutrient-enhanced biochar formulations developed through strategies to minimize nutrient loss and water pollution in peri-urban communities.

In **Kenya,** the GEF project will install the world-wide first watershed study on biochar. Building on 7 years of detailed pre-intervention data of water, nutrient and carbon losses by stream water (Recha *et al*., 2012, 2013), yield effects (Kimetu *et al*., 2008 and ongoing), as well as GHG emissions (Kimetu and Lehmann, 2010; Fungo *et al*., 2014), biochar will be added to one set of four watersheds, while a second set of four watersheds will be kept as a control (paired watershed approach). These watersheds are about 10 ha in size, and include a forest and agricultural watersheds that have been converted from the same forest 5, 10 or 15 years before present (Recha *et al*., 2012). The duration of continuous cropping significantly reduced carbon and nutrient stocks (Solomon *et al*., 2007) and as a consequence reduced crop productivity (Ngoze *et al*., 2008). The watersheds are in close proximity of less than 3 km (Figure 1) and formed on the same geological substrate, providing ideal conditions for a chronosequence study of watersheds as has been demonstrated for associated plot studies (Kimetu *et al*., 2008). The watersheds have mixed land use mainly consisting of maize (Figure 2). Participatory trials design workshops will be conducted to ensure farmer-driven processes and inclusion of local innovations in the project (Barrios *et al*., 2012). The initial proposal is to add biochar on maize-growing areas at a rate of 1 t/ha or less. This will allow monitoring of (i) the export of the biochar itself, (ii) changes in stream water export and occurrences of flash floods that were found to be related to soil organic matter contents (Recha *et al*., 2012), and (iii) nutrient and carbon retention as well as soil fertility changes on a watershed scale. It is unknown if a similar experiment exists and it is unlikely that a study that includes duration of cropping and biochar additions in a paired watershed approach with 7 years of detailed pre-intervention stream and soil monitoring will be easily available in any other location. This unique opportunity will provide a basis for critically needed data on a meaningful scale.

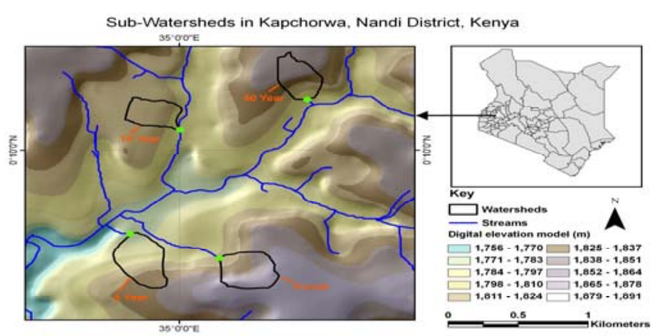

Figure 1: On set of four watersheds with different periods after deforestation in close proximity to each other (Recha *et al*., 2012; a second one has been installed adjacent to each in 2009, see Figure 2).

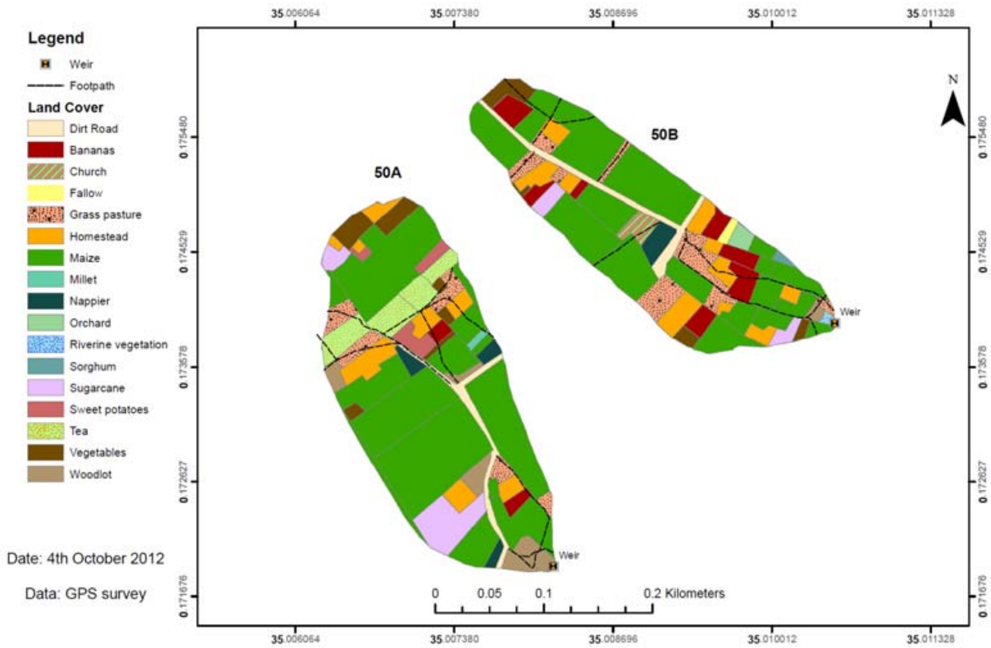

Figure 2: A pair of watersheds in very close proximity with identical landuse history and cropping systems (this example shows two watersheds where the forest has been cleared 50 years ago; Guerena, unpubl. data). One watershed will receive biochar applications and the other will not.

In **Ethiopia**, this project will meet the critical need for longitudinal data that are typically not met by traditional funding sources. The proposal is to complement the ongoing efforts using greenhouse trials and on-farm experiments (that are necessarily short-term, owing to the nature of greenhouse trials and the necessity to change farmer-led trials over the seasons) by long-term field demonstrations operated in agricultural watersheds by Jimma University. In a pilot phase, significant increases when biochar was added together with organic nutrient amendments were observed (Figure 3). The intention is to combine biochar with organic and inorganic fertilisers and amend the highly leached soils in the Jimma region on an annual basis. This provides the opportunity to assess questions about longevity of biochar additions to soil. The longest published results from continuous field experiments with annual biochar additions do not exceed a few years, which is too short to instill confidence in the longevity of soil improvements beyond nutrient and liming effects. Long-term data are also needed to evaluate the business case for biochar in smallholder agriculture.

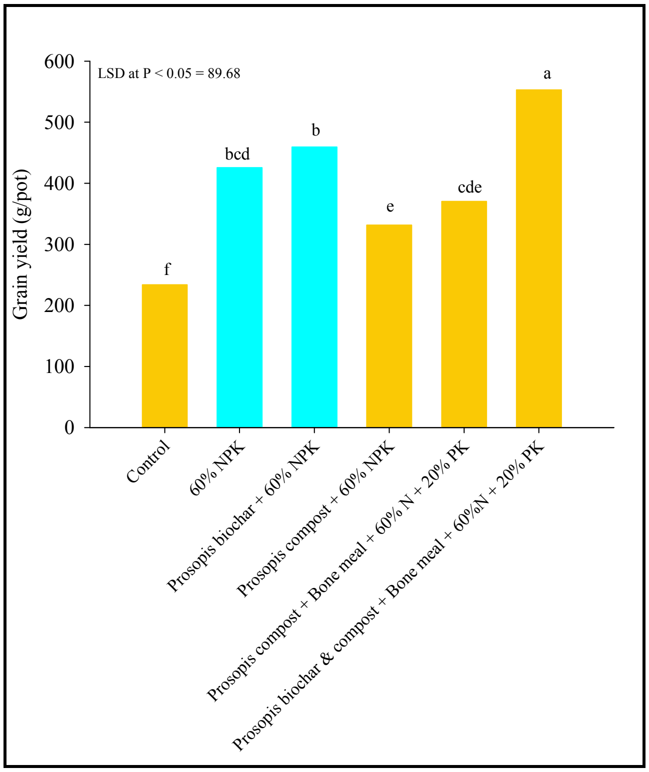

Figure 3: Maize grain yield after additions of biochar from Prosopis or unpyrolysed Prosopis compost in a greenhouse trial on Awassa soils.

Component 2: Knowledge management, capacity building and dissemination

This project will collate and share the knowledge that has been developed in individual biochar research projects being undertaken in these countries. Initially this knowledge will be shared amongst the collaborators to assist the design of GEF-funded activities, ensuring that they build on to previous and current activities rather than duplicate effort. As the results become available, the project manager will collate these, and generate extension materials.

Building on the InPaC-S participatory methodological approach developed by Barrios et al. (2012) through South-South collaboration between Latin America and Africa, the project in Kenya will develop a capacity building manual that blends local and technical knowledge on soil fertility management thus providing the relevance, credibility and legitimacy dimensions required for adoption of improved soil management practices involving biochar. The 'training of trainers' nature of the InPaCs-S methodology could provide opportunities to follow a similar participatory process across different country projects.

Outcomes

- Biochar used effectively to improve the capture and efficient use of nutrients;
- Increased awareness of the potential of biochar, the most effective applications (cropping systems, soil type), and most effective application rates and formulations (e.g. mix with other organic and mineral amendments);
- Build capacity through training on biochar and its uses as a soil amendment;
- Enhanced productivity, reduced rate of land degradation, increased resilience;
- Develop strategies and capacity in the production of sustainable energy from biomass that is accessible to the poor (cookstoves); and
- Creation of a larger experienced network of producers and users of biochar across the globe.

Outputs

- Demonstrated innovative interventions for closing the nutrient loop;
- Guidelines on the use of biochar in sustainable land management developed for land users, land managers, natural resource planners, and agricultural extension staff; and
- Guidelines will include guidance on environmentally-sound biochar production methods, effective biochar formulations based on different biomass feedstocks, for different soil types and environments
- Guidelines for extension strategies for the clean cookstoves; and
- The plan is to distribute the guidelines in English and Spanish through a web site.

A.1.4. Describe the incremental cost reasoning and expected contributions from the baseline. The GEFTF and co-financing

There has been increasing interest in biochar for different objectives. These include enhanced crop production, waterways protection, soil remediation, carbon sequestration, improved nutrient and water retention, GHG mitigation, use of co-products in renewable energy generation, waste and resource recovery, and sustainable land management (SLM). Therefore, the interest in biochar comes from a diverse group of farmers, universities, public institutions, private companies and civil society groups – among others. However, the scale and impact of biochar projects for SLM remain small. In addition, the recent interest in adopting biochar for SLM has not been matched by an equivalent framework of systematic evaluation and research, sharing and management of knowledge among different communities of practice, and strategic planning and definition of priorities for future programs and investments. Moreover, the lack of cross-sectoral collaboration and efforts to disseminate lessons learned and build capacity for SLM approaches for traditional sectoral players (such as government ministries, universities, NGOs and private sector) has also hindered the mainstreaming of the use of biochar for SLM activities, many of which remain at the laboratory or pilot scale.

Under the baseline, without incremental GEF financing, the production and application of biochar into soils will continue to be evaluated under various conditions in the target countries in Asia, Africa and Latin America. However, in the absence of this project, each of the baseline activities would occur independently. The sharing of the experience and management of the knowledge arising from the undertaking of the different biochar demonstration activities among these six countries would be scarce (if any) throughout the proposed three year period. Therefore, GEF funding will enable knowledge generated through the individual activities to be shared amongst the partners, thus allowing them to utilize latest findings in devising appropriate organic treatments involving biochar to address soil constraints, particularly on marginal lands. Specifically, greater knowledge of biochar properties and responses will enhance capacity of researchers and agricultural extension staff to advise landholders on effective strategies employing biochar for soil improvement.

The baseline activities create a sound foundation for the expansion of understanding of biochar and its role in SLM. Each of the projects delivers specific outputs, including evaluation of biochar in specific applications – managing nutrient export, heavy metal contamination, plant disease; others evaluate a range of biochar-based amendments to identify effective treatments for enhancing benefits of biochar at low rates; and others provide insights into effective approaches for dissemination of knowledge through participatory learning. With GEF financing the learning from these individual components will be brought together and shared amongst the project partners, and ultimately made available to a broad audience through online publication of guidelines for biochar use in SLM.

Thus, GEF finance will assist in catalyzing informed evaluations of biochar, building on learning from other projects. It will allow knowledge generated in the biochar research and demonstrations to be directed to devising biochar-based amendments for enhancing the productivity of marginal lands, and validating these approaches in a range of environments. This will deliver the added benefit of reducing pressure on other productive land, thus facilitating future productivity of this land also. The application of specific biochar formulations into soils will be assessed as a cost effective method for addressing land degradation and rehabilitation. Hence, GEF funding will enable generation of a strong evidence base to inform future decisions on utilization of biochar-based amendments in addressing specific land degradation issues.

. GEF funding will allow strengthening of the evidence base to be specifically built into the baseline projects, which will support much closer linkages between research, demonstration and implementation of biochar for SLM.

A.1.5. Describe the Global Environmental benefits

Soils are dynamic ecosystems that cycle life-sustaining nutrients between the biosphere, lithosphere and hydrosphere; and serve as foundation of the food production system and healthy crops that, if properly managed, can reduce nutrition-related health problems. Organic matter provides the following functions in soil: increased rainfall infiltration and water holding capacity, improved aeration, cycling of essential plant nutrients and reduced erosion, which combine to increase soil fertility and crop productivity, and it is a sink for atmospheric carbon. Therefore, healthy soils rich in organic matter provide several ecosystem functions such as storing and regulating supply of water and nutrients; climate change mitigation, and enhancement of soil biodiversity.

Many of the rural poor, especially those without a secure food supply depend on functions delivered by healthy soils. However, fertile soils and other environmental resources that are critical to supporting rural development including water resources, agro-ecosystems, natural forests and biodiversity are negatively impacted and in some cases rapidly degrading due to population growth and unsustainable land use practices. Land degradation and soil fertility decline have posed tremendous challenges to increasing agricultural productivity and economic growth, for example in Ethiopia (Amare *et al*., 2005; Hengsdijk *et al*., 2005). Sanchez (2002) indicated that soil fertility depletion alone is the fundamental biophysical cause of stagnant per capita food production in the region. Nandwa (2003) classified Ethiopia as having a high nutrient depletion rate of more than 60 kg N, P, and K ha^{-1} yr^{-1}. Hurni (1993) reported that the average annual rate of erosion of fertile topsoil from low-input croplands in Ethiopia is estimated to be 42 tonnes per hectare per year, with an estimated annual erosion-induced crop productivity decline of 2.2%, exceeding by far the soil formation rate of 3 to 7 tons per hectare per year (Gebremedhin and Swinton, 2003; Dahlberg *et al*., 2008). The resulting crop productivity decline limits Ethiopia's opportunities in striving for food security, development and self-reliance. Similar challenges are faced in many other countries, including Kenya and Peru.

Critical to addressing these challenges are climate smart agricultural systems approaches that increase soil organic matter content, rainfall infiltration and water holding capacity, to moderate soil reaction and improve soil health, reduce nutrient runoff and leaching, and increase the efficiency of inorganic and traditional organic fertilisers, while sequestering carbon in the soil. Biochar has been proposed as a valuable constituent of climate smart agricultural systems. The resulting synthesis of knowledge on the effects of biochar on productivity and resilience is expected to be used to enhance food security and living conditions of local people.

The potential is to achieve these goals through effective recycling and more efficient use of agricultural and agro-industrial biomass in an environmentally and socially sustainable manner. The key feature to the potential solution is, therefore, the unique ability of climate smart agriculture to integrate sustainable soil biochar systems and other conservation agriculture practices as well as development of biochar-based bio-fertilizer. Biochar will leverage locally available agricultural and agro-industrial wastes such as coffee husks, rice residues, wheat straw, nutrient rich discarded bones (poultry and fish), etc., which otherwise are a public health hazard, polluting waterways and other areas. Many biochars also offer a unique value of liming, supply of critical plant nutrients such as potassium, phosphorus, calcium, etc., thus enhancing soil fertility and crop productivity. Furthermore, the proven capacity of biochar to sequester carbon in soil for long periods, in a verifiable manner, and to reduce non-CO_2 GHG emissions from soil in some situations, provide added benefits through contributing to climate change mitigation.

The project will thus prepare the groundwork to provide Global Environmental Benefits (GEBs) by supporting participant organizations to mainstream the use of biochar in SLM as a viable strategy for integrating sustainable agriculture, ecosystem conservation, climate change mitigation and adaptation, as well as enhancing human wellbeing. Effective use of biochar formulations have the potential to arrest decline in soil fertility, which will potentially improve land condition and enhance productivity and resilience of the land resources. Biochar thus could play a major role in addressing the global food security challenge for the future.

A.1.6. Describe the innovativeness, sustainability and potential for scaling up

The intentional production of biochar, in environmentally-sound engineered facilities, for use as a soil amendment, is a novel concept that has been investigated only in the last decade. While research is producing evidence that biochar can be effective in enhancing productivity, the use of biochar has not been widely adopted, due to limited awareness of its effects. Furthermore, the biochar application rates often suggested in the literature for observing significant soil-related benefits are relatively high (≥10 t/ha) and therefore the large scale application of biochar is perceived as prohibitively expensive. The uniqueness of this project is based on the development of innovative formulations based on low application rates of biochar. This project will evaluate the potential effectiveness of biochar, in comparison with other soil amendments for enhancing fertility, in a range of situations. There is potential for scaling up nationally and globally to other regions affected by similar conditions.

The optimization of a participatory approach for knowledge management in natural resource management that integrates local and scientific knowledge and that is conducted simultaneously with a South-South capacity building effort is innovative. Similarly, the focus and principle-based learning that increases the capacity of key decision makers influencing land use and management for learning and adaptation through innovation in ways that balance production with sustainability objectives is also innovative.

The ‘training of trainer’s nature of the capacity building workshops and methodological guide provides the great potential for multiplicative impacts through capacity building provided by teams of best performing trainees. The recognition of the value of local experience and practice during the development of a more robust knowledge base that informs decision makers is a key scalable principle that can be used in any component and level of the agricultural sector. The ability of our participatory methodological approach to foster the integration of local and technical knowledge into ‘hybrid’ knowledge that is relevant, credible and legitimate, would be an asset during scaling up processes.

A.2. Stakeholders. Identify key stakeholders (including civil society organizations, indigenous people, gender groups, and others as relevant) and describe how they will be engaged in project and/or its preparation:

Key stakeholders are identified as smallholders, including women’s farming groups, agricultural extension staff, resource managers, policy-makers, students and researchers. In each country, farmer participatory demonstration sites will be used to demonstrate promising technologies identified through the initial collation of expert knowledge on the use of biochar. The effectiveness of this participatory research approach in encouraging adoption of improved management practices has been demonstrated in Indonesia, through ACIAR project SMCN 2007/040.

In Indonesia, small demonstration and training sites led by field extension staff will be established in the four districts to replicate promising technologies across a range of conditions. BPTP Aceh will build on their established networks and existing farmer field schools to facilitate collaboration with field extension staff, farmer groups and sub-district extension offices. Project sites will be used as a resource for local farmer field schools, farmer exchanges and training activities. Promising technologies will be disseminated using training packages, publications and presentations aimed at extension services and smallholders. Results will be disseminated to Aceh's scientific community through annual conferences and forums held at Unsyiah.

In the project countries, there is a great need for improved skills amongst the research staff employed by agriculture and environment agencies. Staff lacks the necessary skills in design and establishment of field trials to assess the effectiveness of sustainable land management and climate smart agriculture practices. This project will provide training in these skills to key staff in these countries, specifically targeting women research staff.

The GEF itself is a key stakeholder in this project, which focuses on knowledge management. The GEF has recognized the need for concerted effort to collate and disseminate knowledge generated at the local level, and in individual projects, to capitalize on efforts of individual research teams and landholders, to expand understanding of the management of global environmental issues. The learning from this project will be utilized in GEF 6 to provide guidance in understanding soil-based constraints to productivity, and a broader range of effective SLM interventions. The use of biochar as an innovative organic-based soil amendment may enhance fertility and water-holding capacity of marginal lands, particularly in the drylands, thus enhancing productivity and assisting to address food security issues. The knowledge generated will therefore support the GEF 6 integrated approach on "Sustainability and Resilience for Food Security in Sub-Saharan Africa".

A.3. Describe the socioeconomic benefits to be delivered by the Project at the national and local levels, including consideration of gender dimensions, and how these will support the achievement of global environment benefits (GEF Trust Fund/NPIF) or adaptation benefits (LDCF/SCCF):

A wealth of evidence suggests that economically-disadvantaged people rely more heavily on healthy, functioning ecosystems that provide ecosystem services than do richer people (Lasley *et al*., 2013). By providing information that can be used to improve natural resource management the project aims to ensure the maintenance of the natural capital on which the poor people depend heavily for their livelihoods. More specifically the development of biochar-based soil amendments that can limit plant uptake of heavy metals is intended to ensure the long term viability of a labor intensive industry that is critically important to poor farming families. Likewise the development of a biochar-based soil amendment specifically designed for promoting crop growth, plant water use efficiency, and reduced impact of plant disease is intended to facilitate efforts to improve conditions for extremely disadvantaged people. The successful diffusion and adoption of biochar-making cookstoves will help to alleviate respiratory and eye diseases by reducing indoor air pollution. The less use of fuel wood for cooking will also contribute to reducing deforestation and land degradation.

A.4 Indicate risks, including climate change, potential social and environmental risks that might prevent the project objectives from being achieved, and if possible, propose measures that address these risks:

Nature of risk	Level	Mitigation measures
1. Establishment of demonstration sites delayed due to unfavorable weather conditions.	L-M	The project includes a wide range of sites across many locations, in different continents. This geographic distribution minimizes the risk that a significant number of sites will be affected.
2. Biochar is not found to be effective, and the project is criticized for using inappropriate formulations.	L	The project is advised by the world's leading biochar researchers, and thus has access to latest knowledge of effective use of biochar. Whether biochar is found to be effective or not, is useful information. Project builds on well-established baseline activities… strong leverage…
3. Miscommunication leads to activities not being implemented correctly.	L	In-country project coordinators will have to follow up on activities implemented locally, keep in constant communication with the project director who will provide guidance when required.
Inappropriate communication of challenges and uncertainties posed by the application of biochar over large areas leads to refusal of permission by local authorities in Kenya.	L-M	Participatory capacity building processes will need to be put in place at the beginning of the project to ensure the full understanding of challenges and uncertainties faced by the application of biochar over large areas. In-country project coordinators will facilitate the direct communication of project leaders with local leaders and government officials. Official permissions will be obtained if considered necessary.
Raw materials and/or technologies for biochar production are not available.	L	Biochar will be produced from locally-available biomass feedstocks in each location. Furthermore, biochar production technologies are available in most locations through baseline activities and cover a range of scales from cookstove to large pyrolysis plants, including low-cost options. Therefore, availability and cost of technology will not limit the project.
Transaction costs for coordinating activities in six countries may mount up, especially if exchange rates fluctuate significantly, and limit the funding available for planned activities.	L-M	Transaction costs have been budgeted realistically. In-kind contributions from project collaborators will assist to cover transaction costs. Note that project management costs have been raised to 10% in recognition that transaction costs will be a relatively high proportion of the total project costs.

A.5. Explain how cost-effectiveness is reflected in the project design:

The project seeks to promote the diffusion and adoption of biochar techniques for sustainable land management (SLM) in the proposed participant countries. The project aims at collating the existing knowledge that is generated through the implementation of the targeted biochar demonstration projects. Awareness and improved understanding amongst smallholders, including women's groups, and resource managers about the most effective biochar application rates and formulations to improve soil functions and reduce land degradation, will be created and shared among stakeholders. This integrated global approach to advance the knowledge on the use of biochar for SLM is expected to be an effective and empowering way of conveying other messages to farming communities mainly interested in soil improvement. This information extends from other environmental effects of biochar, such as climate-change mitigation and reduced potential for eutrophication, to improvement of health (e.g. decreased household air pollution by replacing traditional stoves with biochar-making cookstoves) and living conditions (e.g. poverty alleviation). The cost effectiveness of the knowledge management approach proposed is not only related to the quantity of smallholders targeted but also to the amount of interested parties that could be reached through the website and guidelines created. Moreover, the value of the knowledge management approach also depends on its quality. The project will deliver guidelines for the use of biochar in SLM (in English and Spanish). Hence, by reaching a wider audience through different channels, the GEF will develop a more comprehensive network.

A.6. Outline the coordination with other relevant GEF financed initiatives [not mentioned in A.1]:

This project specifically addresses the priorities of the land degradation focal area, and will deliver information that will support land degradation and food security objectives in GEF 6. However, it will simultaneously deliver benefits that align with the goals of other focal areas. For example, it seeks to demonstrate the effects of biochar in managing nutrient loss in runoff and subsurface lateral flow, which is critical to managing eutrophication of inland waters. In addition, it contributes to meeting the objectives of the climate change mitigation and adaptation strategies, which increasingly recognize the importance of engaging the land sector.

The project will coordinate with the UNEP GEFID 5272 "Scaling up sustainable land management and agro-biodiversity conservation to reduce environmental degradation in small scale agriculture in Western Kenya" FSP that is mainstreaming sustainable land management (SLM) practices across the productive landscapes around the Kakamega Forest ecosystem through reducing land degradation and improving soil productivity. In China, the project will coordinate with the FAO GEFID 4922 "Decision support for mainstreaming and scaling up of sustainable land management" FSP. It will also link up the ADB GEF ID 5142 "Sustainable and climate resilient land management in western PRC" FSP that is engaged with restoration of degraded lands through sustainable and climate resilient land management.

A.7 Describe the institutional arrangement for project implementation:

UNEP Division of Environmental Policy Implementation (UNEP DEPI) is the Implementing Agency (IA) for this project. As such, UNEP DEPI will be responsible for coordinating activities, monitoring the implementation of UNEP's standard M&E procedures, and transmitting financial and progress reports to the GEF.

Starfish Initiatives is the Executing Agency, whose purpose is supporting and creating regional sustainability through a growing range of innovative governance, strategy, collaboration, community enterprise, communication and learning systems and practices ~ each of which is designed and developed specifically for sustainability in a rural, regional or remote setting.

While Starfish is a relatively young organization ~ having commenced operations in early 2010 ~ the personnel and partners involved are highly experienced professionals.

The ultimate governance for the Project rests with Starfish's Board of Directors, whose members bring chartered accounting, public planning, agribusiness, legal and community development expertise.

Day to day Project Coordination will be devolved to a Committee which is accountable to Starfish's Board. The committee will comprise individuals with expertise in biochar production and application, sustainable development, land degradation, SLM, project management.

Project partners, country coordinators and in-field personnel will report to the Committee, through the project director, as well as participate in coordination meetings from time-to-time to ensure the integrity and quality of the project.

The Project director directly coordinates the project through the country coordinators. This key role includes knowledge management and the integration of "baseline" projects across all the countries involved. This role will also work directly with the in-country project coordinators through planning, implementation, monitoring and evaluation.

New knowledge, know-how and key messages will be identified through a facilitated process led by the project director and involving project partners, personnel plus monitoring data and analysis. This interactive exchange of knowledge and know-how will be woven throughout the project, as well as include communication strategies for disseminated more widely.

Monitoring and reporting ~ for UNEP, the project Committee and Starfish board of directors ~ will also be meetings ~ including one in-country meeting during the project duration ~ and form part of the knowledge coordinated by the project director. This function will include annual in-country visits, project for dissemination as described above.

Starfish can access additional expertise through its Associates Network, particularly:

1. Bronwyn Pearson | Personnel Strategy & Development
2. Legal Minds | Legal, compliance, contractual and intellectual property
3. Forsyth's | Financial, compliance and accounting
4. Peter Arkins | Creative design & communications

Each country coordinator will be responsible for the implementation of the baseline activities and the management of the day to day activities for each in-country biochar initiative. Key messages will be disseminated to a broad audience though development of guidelines for use of biochar in SLM.

B. DESCRIPTION OF THE CONSISTENCY OF THE PROJECT WITH:

B.1 National strategies and plans or reports and assessments under relevant conventions, if applicable, i.e. NAPAs, NAPs, NBSAPs, national communications, TNAs, NCSA, NIPs, PRSPs, NPFE, etc.

China

The project is consistent with China's national and regional priorities and plans. China ratified the Convention on Biological Diversity (CBD) in 1993 and updated the National Biodiversity Conservation Strategy and Action Plan (2011-2030) in which strategic goals, strategic tasks, priority areas and actions were identified for biodiversity conservation for the next two decades. Furthermore, since ratifying the United Nations Convention to Combat Desertification (UNCCD) in 1997, China has progressively increased its conservation efforts, and recognised the need to combat land degradation as a national development priority. The government expanded its programs to combat land degradation under the 11th Five Year Plan (FYP) (2006-2010) addressing reforestation, protection of natural forests, grassland improvement, soil and water conservation, biodiversity protection and renewable energy generation. These programs have been widely effective with observable environmental improvements in numerous areas. The 11th FYP contains significant further environmental commitments and related reforms towards building a new countryside. The New Countryside program (2006-2010) is considered the foremost task facing the country by China's highest authorities. Farmers and countryside development are at the top of the development agenda, showing the government's determination to solve problems in rural areas. The New Countryside program will strengthen the FYP to boost sustainable and modern agriculture, land management measures, develop new relationships between industry and agriculture, cities and countryside, and increase rural affluence. All these measures aim to effectively use government and private investments as efficiently and effectively as possible in the interest of reversing long-term trends of land degradation.

Ethiopia

Ethiopia ratified the CBD and the UNCCD in 1994 and 1997 respectively. To coordinate the implementation of the Convention, the government designated the Environmental Protection Authority (EPA) as the focal point. To carry out this mandate, the EPA established a national steering committee for the development of a National Action Programme (NAP), which recognizes land degradation, soil erosion, deforestation, loss of biodiversity, desertification and recurrent drought as priority issues for the country.

Indonesia

Indonesia has ratified the CBD and the UNCCD in 1994 and 1998 respectively. The project's objectives are consistent with the UNCCD-NAP for Indonesia. The project links with the Indonesian National Agriculture Strategy 2010-2014: 1) sustainable self-sufficiency for food crops (rice, maize, soybean) and livestock, improvement in horticulture production, and adaptation to rainfall variability and climate change; 2) increased diversification and value adding of food crops; and 3) improving farmers' welfare.

Kenya

Kenya ratified the CBD and the UNCCD in 1994 and 1997 respectively. The country is committed to implement the National Biodiversity Strategies and Action Plan (NBSAP) and the National Action Programme (NAP). This project is consistent with the country's NBSAP and NAP, directly supporting the objective of reducing further degradation of affected areas.

Peru

Peru ratified the CBD and the UNCCD in 1993 and 1995 respectively, and published its National Action Programme (NAP) in 1996. The role of the national Focal Point for the UNCCD has been assumed by the General Directorate for Climate Change and Desertification within the Ministry of the Environment. In 2007, a national commission to combat desertification and drought was created to represent the national and local interests of the government and civil society groups. Peru has also been appointed coordinator of the UNCCD Regional Thematic Network on Traditional Knowledge. Recently, there has been an increasing interest in investing in sustainable land management (SLM) practices, but SLM investments have been low. This proposal is in full conformity with the priorities identified in the government's strategies.

Vietnam

Vietnam ratified the CBD and the UNCCD in 1994 and 1998 respectively. The National Barren Land Programme (1992-1998), also known as Programme 327), was designed to prevent soil erosion, land degradation and to reclaim degraded land for agricultural and forestry activities. In addition, there have been many small local projects combining afforestation with other objectives such as rural infrastructure development, poverty alleviation, watershed protection, soil erosion control and irrigation. This proposal is in line with Vietnam's national strategies and plans under relevant conventions.

B.2. GEF focal area and/or fund(s) strategies, eligibility criteria and priorities

The proposed project is consistent with the objectives of the GEF-5 Focal Area in Land Degradation to contribute to arresting and reversing current global trends in land degradation, specifically desertification and deforestation. The project activities are designed to contribute to the Land Degradation objectives 1, 3 and 4 in the following overarching outcomes: Outcome 1.2 Improved agricultural management; Outcome 1.3 Sustained flow of services in agro-ecosystems; Outcome 3.2 Integrated landscape management practices adopted by local communities; and Outcome 4.2 Improved GEF portfolio monitoring using new and adapted tools and methodologies.

B.3 The GEF Agency’s program (reflected in documents such as UNDAF, CAS, etc.) and Agencies comparative advantage for implementing this project:

UNEP’s comparative advantage derives from its mandate to coordinate UN activities with regard to the environment, including its convening power, its ability to engage with different stakeholders to develop innovative solutions and its capacity to transform these into policy- and implementation-relevant tools. UNEP’s comparative advantages in the GEF are also aligned with its mandate, functions and Medium Term Strategy and its biennial Programme of Work (2015- 2016). The proposed project is consistent with the Ecosystem management thematic priorities. Specifically, it will contribute to the achievement of Expected Accomplishment EA (a): Use of the ecosystem approach in countries to maintain ecosystem services and sustainable productivity of terrestrial and aquatic systems is increased by (2): Tools, technical support and partnerships to improve food security and sustainable productivity in agricultural landscapes through the integration of the ecosystem approach.

UNEP’s science and technical focus will bring comparative advantages as summarized in the following table:

Areas of UNEP comparative advantage in the GEF (all Focal Areas)		**UNEP Thematic Priority Areas (subprograms)**					
		Climate change	Disasters & conflicts	Ecosystems management	Environmental governance	Harmful substances & hazardous wastes	Resource efficiency
1. Sound science for national, regional and global decision-makers	Early warning and emerging issues			xx			
	Science to Policy linkages			xx			
	Environmental monitoring and assessment			xxx			
	Norms, standards, and guidelines			xxx			
	Enabling Activities for MEAs and synergies						
2. Cooperation, coordination and partnerships (regional or international)	Trans-boundary cooperation			xx			
	Regional, or South-South cooperation						
	Global transformative actions			xx			

3. Technical assistance and capacity building at country level (contribution to Bali Strategic Plan)	Technology assessment, demonstration, and innovation			xx			
	Capacity building			xxx			
	Lifting barriers to market transformation						
4. Knowledge management, awareness raising and advocacy				xxx			

In addition, the project is a priority in all the UNDFs of the countries in enhancing land productivity to contribute to increasing agricultural production and food security in all the countries engaged in this project.

C. DESCRIBE THE BUDGETED M &E PLAN:

The project will follow United Nations Environment Programme (UNEP) and Global Environment Facility (GEF) minimum requirements for project monitoring, reporting and evaluation processes and procedures. Substantive and financial project reporting requirements are an integral part of the UNEP legal instrument that will be signed by the executing agency and UNEP. The Monitoring and Evaluation (M&E) process will include an end of project assessment undertaken by independent review teams. The final reports will be submitted to the GEF M&E Unit as well as other stakeholders and or donors involved in the implementation of this project. A report on the status of implementation of the project will be submitted to the regular meetings of the Project Steering Committee (PSC). The project will be evaluated on the basis of: execution performance, output delivery, and project impact. Evaluation of the project's success in achieving its outcomes will be monitored continuously throughout the project through the bi-annual progress reports, annual summary progress reports and the final evaluation. Details of M&E activities are provided in the Table below.

Type of M&E activity	Responsible Parties	Budget from GEF	Budget co-finance	Time Frame
Inception Meeting	Starfish Initiatives & UNEP DEPI Task Manager	2,000	5,000	Within 2 months of project start-up
Inception Report	Starfish Initiatives & UNEP DEPI Task Manager	0	500	1 month after project inception meeting
Semi-annual Progress/ Operational Reports to UNEP	Starfish Initiatives & UNEP DEPI Task Manager	0	500	Within 1 month of the end of reporting period i.e. on or before 31 January and 31 July
Project Steering Committee meetings and National Steering Committee meetings	Starfish Initiatives & UNEP DEPI Task Manager	3,000	5,000	Once a year minimum
Reports of PSC meetings	Starfish Initiatives & UNEP DEPI Task Manager	500	500	Annually

Type of M&E activity	Responsible Parties	Budget from GEF	Budget co-finance	Time Frame
PIR	Starfish Initiatives & UNEP DEPI Task Manager	0	500	Annually, part of reporting routine
Monitoring visits to field sites	Starfish Initiatives & UNEP DEPI Task Manager	5,000		As appropriate
Terminal Evaluation	UNEP EOU/UNEP DEPI Task Manager	35,000	20,000	Within 6 months of end of project implementation
Audit	Starfish Initiatives	4,400	6,000	Annually
Project Final Report	Starfish Initiatives with final clearance and processing by UNEP DEPI Task Manager	500	500	Within 2 months of the project completion date
Co-financing report	Starfish Initiatives	0	500	Within 1 month of the PIR reporting period, i.e. on or before 31 July
Publication of Lessons Learnt and other project documents	Starfish Initiatives; project partners and UNEP DEPI Task Manager	10,000	5,000	Annually, part of Semi-annual reports & Project Final Report
Total M&E Plan Budget		**60,400**	**44,000**	

PART III: APPROVAL/ENDORSEMENT BY GEF OPERATIONAL FOCAL POINT(S) AND GEF AGENCY(IES)

A. RECORD OF ENDORSEMENT OF GEF OPERATIONAL FOCAL POINT (S) ON BEHALF OF THE GOVERNMENT(S): (Please attach the Operational Focal Point endorsement letter(s) with this template. For SGP, use this OFP endorsement letter). **N/A**

NAME	POSITION	MINISTRY	DATE *(MM/dd/yyyy)*

B. GEF AGENCY(IES) CERTIFICATION

This request has been prepared in accordance with GEF/LDCF/SCCF/NPIF policies and procedures and meets the GEF/LDCF/SCCF/NPIF criteria for project identification and preparation.					
Agency Coordinator, Agency name	**Signature**	**DATE** *(MM/dd/yyyy)*	**Project Contact Person**	**Telephone**	**Email Address**
Brennan Van Dyke Director,		16 May 2014	Mohamed Sessay Portfolio	+254 20 762 4294	Mohamed.sessay@unep.org

GEF Coordination Office, UNEP			Manager, UNEP GEF		

ANNEX A: PROJECT RESULTS FRAMEWORK

Objectives, outcomes and outputs	Mid-project target	End-project target	Objectively verifiable indicators	Means of verification	Important assumptions
Project objectives: To demonstrate and promote the adoption of SLM practices involving the use of innovative organic amendments, based on biochar, that improve the capture and efficient use of nutrients, and enhance productivity, improve climate resilience, support rural livelihoods, and contribute to watershed management.					
Component 1: Evaluation of the role of biochar in sustainable land management (SLM).					
Outcome 1: Increased understanding of the potential of biochar in improving productivity and addressing issues of declining soil fertility and mismanagement of nutrient resources.	≥60	≥120	Number of farmers that will experience the effects of biochar in soil and are generating useful information for land managers and value chain actors	Assessment surveys carried out by project personnel in each country at mid-project and end-project levels.	Surveys will be specifically developed for each country to address local conditions.
Output 1.a: Collation of demonstration results comparing biochar with alternative management practices.	≥ 3	≥ 6	Number of demonstration programs developed and implemented	Establishment of these programs documented by in-country project coordinators	Establishment of demonstration sites will occur when suitable sites are identified, required materials are assembled, and seasonal conditions are favorable.
Output 1.b: Evaluation of a range of formulations and application rates of nutrient-enhanced biochar.	≥12	≥24	Number of biochar formulations/rates/soil type/crop type combinations evaluated in all the six participating countries	Inventory of field test results and internal reports	The reporting of biochar formulations that are found to have negative effects is as valid as for biochar formulations that have negative effects.
Output 1.c: Collation of recommended practices for the use of biochar in SLM.	N/A	Completed report	Report documenting recommended practices	Report submitted for peer review	Recommendations will be developed jointly between project participants and steering committee
Component 2: Knowledge management, dissemination and capacity building.					
Outcome 2: Knowledge generated and disseminated on the appropriate use of biochar to improve the capture and efficient use of nutrients, while	≥60	≥120	Number of landholders visiting demonstration sites	Assessment surveys carried out by project personnel in each country at mid-project and end-project levels.	Surveys will be specifically developed for each country to address local conditions.

reducing air and water pollution; Increased awareness and improved understanding amongst smallholders, including women's farming groups, and resource managers of the use of biochar to address soil constraints, and most effective application rates and formulations (e.g. mix with other organic and mineral amendments) to achieve agronomic benefits.					
Output 2.a: Guidelines for the use of biochar in SLM.	0	2	Number of guidelines produced (in English and Spanish)	Guidelines published online	Demonstrations produce unequivocal results indicating the most effective formulations
Output 2.b: Networks of demonstration sites and farming groups.	6	6	Number of local networks created due to the implementation of this project	Farm visits and documentation of location details, and photographs showing activities.	Demonstration sites are accessible to other farmers. At least one local network is created in each country.
Output 2.c: At least 36 smallholders and resource managers trained in the use of biochar as soil amendment.	≥ 18	≥ 36	Number of smallholders and resource managers trained in the use of biochar as soil amendment	Training records, sign-in sheets and photographs.	At least, two people trained in each country every year.

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