Environmental Baseline Report on Cocoa in Ghana

Summary / Overview

The objective of this baseline study is to assess the current status and patterns of cocoa farming in Ghana, particularly in regard to its environmental impacts. The study included a review of existing practices and their environmental implications, as well as of recommended practices to lessen environmental impact and the barriers to their implementation. Existing research and policy was assessed, and gaps identified.

The baseline study showed that Ghana has experienced significant forest loss through the movements of the timber sector and expansion of the cocoa industry by promotion of zero shade cocoa production systems. This has gradually led to the fragmentation of forest landscapes, loss of wildlife corridors and forest connectivity, and degradation of biodiversity and the ecosystem goods and services these ecosystems offer. One of the more prominent consequences of deforestation, which has significantly affected cocoa production, is a significant loss of major soil nutrients. This has been a leading cause of the gradual decline of national cocoa yields.

The expansion of the cocoa industry and resultant forest loss was not only driven by the desire to increase national production, but was also a result of migrant farmers from North Burkina securing land tenure rights. Thus, tenure issues have been an ongoing problem and have facilitated forest loss by removal of forests to establish cocoa farms.

Land tenure policy has also been a significant driver in the lack of on-farm investment generally. This has constrained expansion of more environmentally sound production (i.e. greater shade). Today farmers have very limited incentive to plant or maintain shade trees because of land tenure issues with landowners, and landowners have limited rights to naturally occurring trees on their land. There is also a lack of awareness about tree tenure rights.

Unsustainable production methods have driven cocoa farmers to extend into forested areas but they are now left with little land for further expansion. In fact, many cocoa farms in Ghana today need to be rehabilitated if productivity declines are to be reversed. Work is currently underway to support this, led by the Cocoa Swollen Shoot Virus programme. However, farmers have limited incentives and capital to successfully undertake rehabilitation and to manage farms in a more sustainable manner going forward.

Major environmental threats identified during the baseline were:
Deforestation and habitat conversion. The forests of Ghana, especially in the southwestern part of the country, host a wide range of wildlife including several globally threatened, rare, or endemic plant and animal species. The continued expansion of cocoa farms and the resultant human disturbance of forested ecosystems pose a serious threat to local biodiversity.

Conversion of sustainable cocoa to unsustainable intensified production system. Cocoa cultivation using traditional agroforestry techniques has dwindled following the introduction of sun-tolerant hybrid cocoa. In the past, low-shade or no-shade was recommended for hybrid cocoa, leaving a highly unsustainable production system. The weakness of the zero shade system was masked by the short-term yield increases driven by initially fertile forest soils. However, yields soon declined as forest soils were depleted of major nutrients. The practice of using zero shade production systems needs to be reversed.

Unsustainable land management practices and resource use. The use of slash and burn techniques has led to reduced soil fertility through elevated nutrient release, loss of soil structure and stability, and lack of natural forest mulching that reduces soil and water loss from erosion and from poor water infiltration and retention in the soil. Near abandonment of traditional cocoa agroforestry systems in favor of zero shade cultivation methods has also resulted in widespread land degradation in the cocoa growing areas.

Climate change - Most farmers perceive climate change in terms of changes in rainfall pattern and temperature. Projected rainfall for the semi-deciduous (SDFZ) and high rainforest zones (HRFZ) of Ghana indicates a decline in rainfall by 2%, 11% and 19% in the years 2020, 2050 and 2080 respectively in the SDFZ and 3%, 12% and 20% in the HRFZ. The predicted drop in cocoa yield will be 14% and 28% for 2020 and 2050 respectively. By 2080, moisture is predicted to be inadequate for profitable cocoa production in Ghana if the current trend is maintained.

Overcoming these threats will require a considerable shift in cocoa farming and related practices. At the heart of this is a focus on establishing and maintaining forest tree species to favour species richness, alternative income options, habitat creation, crop microclimates, soil fertility, and reduced plant stress. This will need to be accompanied by other environmentally sound production practices that assist in the rejuvenation of ecosystem goods and services and on-farm biodiversity. Many of them are not fully understood, like the best practices for composting and soil management, water catchment to maintain soil humidity, pesticide usage, and others. These knowledge gaps need to be addressed by research.

An underlying problem that will significantly hinder farmer uptake of environmental best practices is land and tree tenure policy. Tenure issues need to be resolved so that they are not a barrier to forest tree planting. Without suitable change it will remain difficult to encourage active planting and maintenance of trees on farms.

Another barrier relates to markets and the lack of market based approaches to incentivize farmers to adopt environmental best practices. There is currently limited knowledge about payments for environmental services, and markets for additional crops. Initiatives in these areas can greatly assist in ecosystem maintenance and provide additional sources of income to farmers.

This baseline report is accompanied by a strategy document that recommends adopting five broad outcomes as part of an environmental strategy to address the concerns noted above. These outcomes address policy, institutional capacity building, monitoring to address environmental change, the use of market based mechanisms to achieve post-project sustainability, and means to reduce farm risk from the threats posed by climate change.
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ACC  Africa Cocoa Coalition
ADB  African Development Bank
ADM  Archer Daniels Midland
AFOG  Apex Farmers Association of Ghana
AGRA  Alliance for a Green Revolution in Africa
ALIDES  Central American Alliance for Sustainable Development
ASNAPP  Agribusiness in Sustainable African Plant Products
BD  Biodiversity
CA  Conservation Alliance
CABI  Centre for Agriculture and Biosciences International
CATIE  Centro Agronómico Tropical de Investigación y Enseñanza
CBACs  Community Biodiversity Advisory Committees
CBO  Community-Based Organizations
CCE  Certification Capacity Enhancement
CCI  Cocoa Carbon Initiative
CCP  Cadbury Cocoa Partnership
CDM  Clean Development Mechanism
CEPLAC  Comissão Executiva de Planejamento da Lavoura Cacaueira
CERGIS  Centre for Remote Sensing and Geographic Information Systems
CFMP  Country Forest Management
CI  Conservation International
CIRAD  La recherche agronomique pour le développement
CLS  Customary Land Secretariats
CMB  Cocoa Marketing Board
CMO  Cetylmyristoleic acid
CNRA  Centre National De Recherche Agronomique
COCOBOD  Ghana Cocoa Board
CODAPEC  Cocoa Diseases and Pest Control Programme
COSA  Committee on Sustainability Assessment
CREMAs  Community Resource Management Areas
CRIG  Cocoa Research Institute of Ghana
CSIR  Council for Scientific and Industrial Research
CSSV  Cocoa Swollen Shoot Virus Disease
CSSVD  Cocoa Swollen Shoot Virus Disease
CSSVDU  Cocoa Swollen Shoot Virus Disease Unit
DAs  District Assemblies
DFID  Department for International Development
DSW  Department of Social Welfare
ECHOES  Empowering Cocoa Households with Opportunities and Education Solutions
EIA  Environmental Impact Assessment
EP  Ecoagriculture Partners
EPA  Environmental Protection Agency
ET  Eastern Type
EU  European Union
FAO  Food and Agriculture Organization
FASDEP  Food and Agriculture Sector Development Policy
<table>
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<tr>
<th>Acronym</th>
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<tr>
<td>FBOs</td>
<td>Farmer-Based Organizations</td>
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<td>FC</td>
<td>Forestry Commission</td>
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<td>FCPF</td>
<td>Forest Carbon Partnership Facility</td>
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<td>Farmer Field School</td>
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<td>FLO</td>
<td>Fairtrade Labeling Organization International</td>
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<td>FLR</td>
<td>Forest Landscape Restoration</td>
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<td>FOE</td>
<td>Friends of the Earth</td>
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<td>FORIG</td>
<td>Forest Research Institute of Ghana</td>
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<td>GAEC</td>
<td>Ghana Atomic Energy Commission</td>
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<td>GCCI</td>
<td>Ghana Cocoa Carbon Initiative</td>
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<td>GCCSFA</td>
<td>Ghana Cocoa, Coffee and Shea nut Farmers Association</td>
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<tr>
<td>GEF</td>
<td>Global Environmental Facility</td>
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<td>Ghana Environmental Resource Management Project</td>
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<td>GFC</td>
<td>Ghana Forestry Commission</td>
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<td>Geographic Information Systems</td>
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<td>Ghana Meteorological Agency</td>
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<td>GMO</td>
<td>Genetically Modified Organisms</td>
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<td>GNCC</td>
<td>Ghana National Commission of Children</td>
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<td>GPRSR</td>
<td>Growth and Poverty Reduction Strategy</td>
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<td>GSBAS</td>
<td>Globally Significant Biodiversity Areas</td>
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<td>GTZ</td>
<td>Deutsche Gesellschaft Für Technische Zusammenarbeit</td>
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<tr>
<td>HFBCP</td>
<td>High Forest Biodiversity Conservation Project</td>
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<td>HRFZ</td>
<td>High Rainforest Zone</td>
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<td>ICCO</td>
<td>International Cocoa Organization</td>
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<td>ICOUR</td>
<td>Irrigation Company Of Upper Region Ltd</td>
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<td>Integrated Pest Management Unit</td>
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<td>ICRAF</td>
<td>International Centre for Research in Agroforestry</td>
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<td>IDRC</td>
<td>International Development Research Center</td>
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<td>IFoAM</td>
<td><em>International Federation of Organic Agriculture Movements</em></td>
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<td>IIPACCC</td>
<td>Innovate Insurance Products for the Adaptation of Climate Change</td>
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<td>IITA</td>
<td>International Institute for Tropical Agriculture</td>
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<td>IMO</td>
<td>Institute for Marketecology</td>
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<tr>
<td>INIAP</td>
<td>Instituto Nacional Autónomo de Investigaciones Agropecuarias</td>
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<tr>
<td>IPCC</td>
<td>Inter-governmental Panel</td>
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<td>IPGRI</td>
<td>International Plant Genetic Resources Institute</td>
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<td>IPM</td>
<td>Integrated Pest Management</td>
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<td>IRAD</td>
<td>Institut de Recherche Agricole pour le Développement</td>
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<tr>
<td>IRI</td>
<td>International Research Institute for Climate and Society</td>
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<td>ISSER</td>
<td>Institute of Statistical, Social and Economic Research</td>
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<tr>
<td>ITTO</td>
<td>International Tropical Timber Organization</td>
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<tr>
<td>IUCN</td>
<td>International Union for Conservation of Nature</td>
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<tr>
<td>KNUST</td>
<td>Kwame Nkrumah University of Science and Technology</td>
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<td>LAP</td>
<td>Land Administration project</td>
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<td>LBCs</td>
<td>License Buying Companies</td>
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<td>MPCI</td>
<td>Multi-Peril Crop Insurance</td>
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<td>MTS</td>
<td>Modified Taungya System</td>
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<td>NAP</td>
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Part I: Cocoa Farming and Environmental Impacts in Ghana

Cocoa production in Ghana has been carried out in two main regions: the moist semi-deciduous forest (Eastern, Ashanti, Brong-Ahafo, Central Regions) and high rainforest (Western Region) agro-ecological zones. Cultivation has been done under shade regimes that have evolved over the decades.

The relatively dense forest that characterized the initial cultivation of cocoa in Ghana maintained the natural ecosystem suitable for cocoa growth. Under it the stable steep slopes of the forest region developed. It also conserved to some extent many ecosystem functions and the remnant biodiversity of the original forest. Forest ecosystems, such as those in the semi-deciduous and high rainforest agro-ecological zones provide a wide range of services to farmers and to humanity. These include generating and maintaining soils, storing and cycling essential nutrients, water related services such as maintenance by hydrological cycles and prevention of floods, water quality improvement, maintaining biodiversity, carbon sequestration, and regulating climate. In Ghana, those services are constrained by rapid deforestation, at the rate of 2% per year (http://rainforests.mongabay.com/20ghana.htm), with expansion of the area planted and a shift from more to less shaded cocoa farming schemes.

A. Current Farming Practices and Environmental Impacts.

Progressive conversion of forests in Ghana into cocoa fields, particularly in the Western Region, contributes to ongoing deforestation (Ruf 2001; Ruf and Scroth, G. 2004). There is a trend towards less shaded cocoa landscapes that undercuts the environmental sustainability of cocoa production and biodiversity conservation. Several reports suggest that, all other factors being equal, a level of shade that allows 20% to 30% full light to reach the cocoa is needed for optimum growth and productivity (Okali and Owusu, 1975), implying a shade level of 70 to 80%. These figures appear to imply greater shade than what pertains in most cocoa growing regions of Ghana. Gockowski et al. (2004) showed that in Ghana 28% of cocoa is managed under no shade; 42% under low shade; 25% under medium shade; and 5% under dense shade.

Cocoa cultivation that maintains higher proportions of shade trees (cocoa agroforestry) is increasingly being viewed as a sustainable land use practice that is environmentally preferable to other forms of agricultural activities in tropical forest regions because it contributes to biodiversity conservation (Power and Flecker 1998; Greenberg, 1998; Duguma et al. 1998; Rice and Greenberg 2000; Leakey, 2001; Schroth et al. 2004).

The adoption of these improved practices would be influenced by the level of security of land tenure and, more recently, tree tenure, with sharing of ownership and benefit in the candidate trees as well as in the other products of the farm. These issues raise concerns about land tenure and its impact on land use and on natural resource management in Ghana and Africa in general (Waiganjo et al., 2001).

Given continued use of zero-input production techniques and the dependence on fertile soils offered by old forests, both low-shade cocoa cultivation and slash and burn approaches to land clearance have led to soil degradation. Thus, unsustainable production and harvesting practices slowly deplete forest soils of major nutrients, soil carbon, and organic matter. Soil erosion and runoff have also contributed to the decline in soil fertility (Quansah et al. 2000; Quansah 2010). Nutrient loss from uptake followed by harvesting of cocoa removes significant amounts of nitrogen, phosphorus and potassium (N, P and K) from soil (Appiah 1992).
B. Impacts at the Farm Level

The threat to sustainable cocoa production is rooted in the “cocoa cycle” (MASDAR 1998). The cycle begins when the forest is cleared with some trees selectively retained to provide the requisite levels of shade for cocoa production. Cocoa is planted and its growth and development to senescence is supported solely by the fertility built up over the years by the forest (now cleared or degraded) and the litter from the shade and cocoa trees. Continued dependence on the previously built soil fertility without any attempt to replenish nutrients following their uptake and export through crop harvest results in soil fertility depletion. Over time, this leads to a point where a farm can become terminally neglected or abandoned; the farmer migrates to new lands once productivity drops far enough. This cycle underlies the shift of cocoa production to the Western Region and the relative decline of established producing regions such as Volta, Central, Eastern, Brong Ahafo, and Ashanti. The persistence of the situation is due to what Ruf (1995) referred to as “forest rent”, defined as the ability to mine at minimal cost the resources of the forest—in particular, the fertile soils left after its clearance.

The continued production of cocoa on nutrient-depleted forest soils coupled with poor tree maintenance has resulted in decreasing national yield per unit land area. Current average yields are only 400 kg/ha compared to well managed intensified practices that achieve 1000kg/ha to as high as 2500 kg/ha in some places (Ruf et al., 1999). In addition, the depletion and loss of ecosystem services once offered by cocoa landscapes has left many cocoa farms more susceptible to a range of plant health problems. This is exacerbated by the advanced age of most cocoa tree stocks and the continued use of farmer-selected planting material of low yield potential. Improvement through distribution of fast maturing, high yielding and disease tolerant cocoa hybrids is also constrained by planting on impoverished soils, poor microclimatic conditions and risks posed by drought, flooding, and increased pest and disease infection.

A key issue that can arise from the adoption of biodiversity friendly (higher shade) production methods is that of a decline in crop yields (Pain and Pienkowski 1997). These yield reductions typically occur from reducing the application of inputs that encourage yield production and manage problematic pests, not from an increase in shade. In other instances the loss of farmland to create forest habitats can also affect production levels (Green et al., 2005).

However, there are also arguments suggesting that non-intensified production practices will not necessarily lead to reduced yields and can make possible large financial savings (Uphoff 2006). For instance, farmers adopting sustainable crop management practices would benefit from reduced costs by minimizing expensive agrochemical inputs. Farmers would also experience long term benefits from more sustainable yields, less vulnerable to stress, while protecting biodiversity and ecosystem services within their production landscapes.

C. Landscape Level impacts

The unsustainable practices adopted by the cocoa farmers leading to soil degradation of their farms have promoted the migration of farmers, including immigrants and especially the young, to new forested sites and regions to establish cocoa farms. This in turn is responsible for the scale of cocoa production moving from the Eastern Region through Ashanti and Brong-Ahafo and now the Western Region.

The expansion of the area cultivated to cocoa both within and between regions has caused conversion of most of the forests in the cocoa growing regions into initially productive but increasingly degraded farm-
lands with adverse environmental impacts, especially on the meso-climate required for proper growth and replanting of cocoa farms. Human disturbance of forest ecosystems and unshaded production systems impact negatively on the ecosystem services provided, including soil fertility, carbon sequestration, habitat and biodiversity conservation, and regulation of micro climate.

The consequences of unsustainable land use in cocoa landscapes in Ghana have received substantial attention from various authors including MASDAR (1998), UNDP (2004), Gockowski et al. (2004), Ruf et al. (2006), Asare (2006) and Anim-Kwapong and Frimpong (2008). They include the following aspects.

**Low tree cover.** especially in plantations of hybrid cocoa, reduces the longevity of the cocoa trees while temporarily increasing yields. Because of the short-term benefits of producing cocoa in forested land and unshaded conditions, it is difficult to introduce land management practices that can achieve long-term sustainability – more information is needed on the trade-offs. Decline in soil fertility due to the absolute dependence on ‘forest rent’ (defined above), especially under unshaded cocoa, lowers the productivity of cocoa farms. The low fertility and drier meso-climate in a deforested landscape make replanting old cocoa farms more difficult. Yet replanting senescent cocoa stands is a major option to pursue in salvaging the cocoa industry and to build sustainability. The tendency is that farmers exploit new forest lands to expand cocoa production. Customary land tenure systems (‘abunu’ and ‘abusa’) produce substantial benefits to the farmer by favouring the opening of new forest land over investing to improve existing cocoa farms. This encourages deforestation with all its adverse impacts on the environment and biodiversity.

**Fewer goods and services are provided by forests** to local communities and the nation as a whole, as the country’s forest cover declines. Benefits from forest ecosystem services are at the verge of collapse. This includes the substantial national income received from timber exports, availability of non-timber forest products like bush meat for local consumption and income generation, and provision of clean water. The country also loses potential future income opportunities, such as those that may come from reducing carbon emissions by preserving standing forest, ecotourism, and bio-prospecting.

Costanza, et al., 1997 have estimated the annual values of tropical forest contributions to ecosystem services are as follows: climate regulation, $223 per hectare; disturbance regulation, $5 per hectare; water regulation, $6; water supply, $8; erosion control, $245; soil formation, $10; nutritional cycling, $922; waste treatment, $87; food production, $32; raw materials, $315; genetic resources, $41; recreation, $112; cultural, $2; for a total value per hectare per year of $2007. Assuming an area of 1.9 billion hectares of forest, this gives a total value for tropical forests of $3.815 trillion dollars per year.

**Steady decline in the productivity of old cocoa plantations** will be one of the ultimate consequences, with decreased incomes for cocoa-producing communities from the low-yielding plantations, reduced availability of a alternative income sources for the local economy, and in some cases scarcity of land to plant food crops. Young people may migrate to the cities or to new forest frontiers (if any still exist) whilst older people remain in the village unable to maintain productivity or replant their ageing cocoa farms. The further productivity levels drop, the fewer resources there will be to rehabilitate or renew the plantings. Opportunities and requirements for sustainable cocoa production should be identified and barriers removed to facilitate the introduction and implementation of best practices in cocoa production.

In fragmented landscapes, cocoa agroforests provide real opportunities, compared to other agricultural systems, to conserve biodiversity (Romlim and Chiarello, 2004). Beyond conservation, such agroforests may have positive environmental affects i.e. improved soil nutrients, water holding capacity etc, on landscapes already degraded by human activities.
Without incentives, farmers may opt for production systems that may provide short term benefits. Currently, there is an increasing preference for moving from shaded to non-shaded cocoa production especially in the Western Region where hybrid cocoa is planted. This is due to the short-term benefits of increased yields. In spite of the environmental benefits of shaded cocoa, the area grown without shade has expanded largely at the expense of the primary forests which hold large stocks of carbon and have significant potential for carbon sequestration schemes (Dixon et al., 1994; Gockowski et al., 2004). However, Ghana is facing a challenge in that the availability of new land for cocoa farming is nearing exhaustion (MASDAR 1998). The option of migrating to new forested areas is no longer a viable option.

**Significance of Biodiversity in the Ghana Cocoa System**

Forested areas in Ghana are classified into reserve (protected) and off-reserve (unprotected) (Prah 1997). Existing legislation has established 282 forest reserves and 15 Wildlife protected areas (MLF 1994). Of the total of 16,340 km$^2$ of protected forest in the high rainforest zone, only 9,000 km$^2$ are in a stable condition; the rest is either degraded or significantly depleted (Hawthorn and Abu Juam 1993). This condition pertains also in the off-reserve forests which are owned and managed by individuals (Owubah et al. 2001).

According to UNDP (2004), the forests of Ghana, especially the high rainforest in the southwestern part of the country, are host to wildlife species typical of the Eastern Upper Guinea forest ecosystem. Several globally threatened, rare or endemic plant and animal species are harboured in them. A recent rapid assessment of four Globally Significant Biodiversity Areas (GSBAS) there recorded over 20 globally rare plant species, 200 butterfly species, 39 amphibians, and 24 small and 25 large mammals.
Box 1. Cocoa and Deforestation

Forests contain most of Ghana’s biodiversity. They also contribute to the livelihoods of many indigenous and other forest-dependent people (World Bank et al., 2005). In their natural state, forest ecosystems carry out a diverse array of processes that provide both goods and services to humanity (Miller 1998). These benefits are lost through deforestation and forest degradation.

Deforestation according to NAP (2003) induces land degradation and desertification, destruction of biodiversity and depletion of the natural sink for carbon dioxide. It impacts adversely on ecosystem services such as watershed protection, provision of habitat for wildlife, storm-flow stabilization, runoff control, prevention of soil erosion, and other types of environmental amelioration. By disturbing the watershed protection function of forests, deforestation causes siltation of streams and rivers and increases flooding. Boreholes also dry up due to lowered water tables. The clearing of forests also affects migratory routes of wildlife, raises isolation and soil temperature, and affects the activities of useful soil microbes. Large scale conversion of forest to other land uses contributes significantly to local climate change.

In 1900, when cocoa was introduced into Ghana, about 34% of Ghana’s land area or 8.2 million ha consisted of natural high rainforest (GFC, 2000). Of this figure 21% was under reserve whilst the remaining 6.5 million ha were deforested at the rate (1981-1985) of 22,000 ha per annum (0.3%).

By 2000, about 5,494,000 ha or 67% [if these figures correct, following ones not] of the original 8.2 million ha of closed forest had been lost leaving a forest cover of 5,517,000 ha [should be 2.7 M ha to sum to 8.2 M] (about 24.2% of total land area of Ghana [should be 11.2% = 2.7 / (8.2/34) ck these figures]) with a deforestation rate (2000 – 2005) of 115,400 ha per annum (2% per annum [ck]). Out of the total forest cover of 5,517,000 ha, 353,000 ha (1.5% of Ghana’s total land area or 6.4% of the total forest cover) consisted of primary forest ([www.rainforests.mongabay.com/20ghana.htm](http://www.rainforests.mongabay.com/20ghana.htm)). According to Hawthorne and Abu Juam (1993), out of the total land area of 1,634,000 ha of protected forest reserves in the high rainforest zone in the Western Region, only 900,000 ha are in a stable condition. The rest is either degraded or significantly depleted. This condition also prevails in the off-reserve forests owned and managed by individuals (Owubah, et al., 2001).

Cocoa cultivation is considered one of the drivers of deforestation (Asare, 2006). The land area of 1,209,807 ha under cocoa, equal to 22% of the total forest cover [ck], consists of different shade regimes from little disturbance of the forest (dense shade) to near complete deforestation (no-shade). The latter covers an area of 338,746 ha using the estimate of 28% no-shade in Ghana (Gockowski et al 2004). These statistics show the magnitude of forest disappearance in Ghana and depict the progressive dwindling and implicit unavailability of new forest land for cocoa expansion.

Since much of the endemic biota of this biodiversity hotspot is dependent on the rainforest, its habitats and prospects for survival decrease rapidly with decline in forest cover through deforestation. The diversity of forest species is also compromised. Research on cocoa agroforestry as a means for biodiversity conservation has been comprehensively reviewed (Asare 2006). Studies on species that inhabit cocoa farms is insufficient in Ghana, but those in other regions indicate that where diverse shaded canopy is in place, cocoa agroforests support higher levels of biological diversity than most other tropical crops (Greenberg et al 2000). This is particularly so in fragmented landscapes, where cocoa agroforests have been found to provide habitat for plant and animal species and to maintain connectivity between forest patches. In areas like southern Cameroon and eastern Brazil, cocoa agroforests are credited with conserving the biological diversity of the humid forest zone (Ruf and Scroth 2004) compared to food crops such as maize and other cereals. In Ghana, Conservation International has had success in using cocoa agroforestry as a buffer zone around protected areas (the Kakum National Park in the Central Region) to reduce forest encroachment. The SAMATEX Timber Company in the Western Region has been able to increase the diversity of forest trees in cocoa farms by working with farmers to plant valuable timber species. Cocoa agroforests thus
provide real opportunities, compared to other agricultural systems, to conserve biodiversity by providing niches for a variety of faunal and floral species (Noble and Dirzo 1997; Romlin and Chiarello 2004) as well as positive environmental impacts in landscapes already impoverished by human disturbances (Reitsma et al 2001).

Farming practices and the treatment of protected areas, including how the surrounding agricultural landscape is designed and managed, are inextricably linked to the fate of the ecosystem and biodiversity at the broader landscape level.

For example, whilst advocating for the rehabilitation of old cocoa farms, Asare (2006) noted that from the perspective of biodiversity conservation, it may be more profitable for farmers to employ more intensive management practices on their cocoa farms for greater productivity than to reclaim abandoned cocoa farms which may be near to forest regeneration in heavily degraded landscapes. In such situations, biodiversity conservation provides a window of opportunity for farmers who engage in practices that promote the protection of abandoned cocoa farms that are located near protected forests and corridors to be rewarded through market based incentive mechanisms i.e. the carbon market.

Part II: Key Factors Influencing Practices

A. Technical Issues

MASDAR (1998) concluded that current cocoa farming practices in Ghana are incompatible with the objective of sustaining the cocoa economy over the long-term because they will eliminate the forest land for new cocoa plantings and result in progressive degradation of plantations already under production. With the disappearance of the last forests outside protected areas, which are increasingly coming under pressure as well, the cocoa economy loses its ability to sustain itself in the old migratory pattern of shifting cultivation. This cocoa economy will decline in the foreseeable future unless production methods change. As the cocoa economy declines in the older production regions, people (especially the young) are forced to emigrate to the forest frontiers or the cities with consequent severe impacts on livelihoods.

The following summary of salient technical issues and practices draws heavily on Appendix 7, which provides greater detail.

Integrated cocoa farming and shade management

Integrated cocoa farming, by combining additional crops with cocoa cultivation, can increase income and food production, reducing pressure to clear forest. Appropriate management of shade and companion crops is needed to optimize productivity. The additional crops may be grown in conjunction with cocoa at different stages and for a variety of purposes, including use of tree crops for shade, planting on parts of the farm not be suitable for cocoa, establishment of barriers against the spread of cocoa diseases and pests, and protection of juvenile cocoa from stress.

Establishment: Young cocoa plants are susceptible to environmental stresses because there is little or no self-shading within the plant (overlapping of leaves) and the root system is not well developed. Plantain is commonly used as a temporary shade worldwide; it provides good early shade but is also a heavy feeder. Additional crops that may be grown with cocoa in West Africa include cocoyam, maize, cassava, yam and various vegetative crops (Appiah and Pereira, 2004). These provide farm income during cocoa establishment.
**Tree Crops as Overhead Shade:** The amount of shade used on cocoa varies greatly among regions and between farms. Shade trees can improve the microenvironment, lowering temperatures, raising humidity, and reducing soil water stress, hence lowering vulnerability to pests and disease. Shade trees can also contribute to soil and water management.

Some attempts have been made to quantify the best planting arrangements of cocoa with fruit trees. The optimal planting combination for a cocoa and coconut intercrop system in Ghana was found to be 3m x 3m square planting for cocoa and 9.8m triangular planting for coconut (Osei-Bonsu et al. 2002). Advice on the density of some other timber and fruit species with cocoa is found in Sonwa and Weise (2008); further research is needed. If complementary species are utilised appropriately, farmers can both increase and diversify their income.

Some cocoa varieties are better than others for growth under shade. Different genotypes vary in their photosynthetic performance at low light levels (Daymond et al., 2010). They also differ in canopy characteristics (Daymond et al., 2002); those with more open canopies do better under shade. Data from field trials on the response of distinct varieties to shade intensity is limited.

Research has shown that both the cocoa and shade may be manipulated to maximise cocoa productivity. Growing the cocoa at an appropriate density and proper pruning will reduce self shading, so that a high proportion of leaves get enough light. Careful timing of shade tree pruning can ensure that the cocoa receives maximal light when its requirements are greatest, as during pod setting (Somarriba, 2007).

**Supplementary Crops:** Farmers may cultivate additional crops on parts of the farm unsuitable for cocoa (e.g. due to topography), to generate income or satisfy food needs. Fruit or timber species may be grown in separate areas if they do not intercrop well with cocoa. Planting of crops as barriers around the edge of the farm can help prevent disease spread and soil erosion.

**Tree management**

Management of long-term productivity and profitability to facilitate replanting old cocoa farms once the cocoa trees are exhausted requires maintenance of soil fertility, pest and disease control, and adequate meso- and micro-climates. Available data show a vast difference between the average yield of cocoa farms in Ghana (400 kg/ha) and that from experimental fields (about 2 t/ha) and Côte d’Ivoire (600 kg/ha) and Indonesia (1000 kg/ha) (Anim-Kwapong and Frimpong, 2008; UNDP, 2004; Quansah, 2010). Such figures reflect the size of the potential for increasing yields, often by using more sustainable practices.

Growing cocoa under shade and keeping a degree of tree cover throughout the cocoa landscape is necessary to create suitable meso- and micro-climates for cocoa. Apart from the shade, trees deliberately left during land clearance or planted by the farmers should provide diverse benefits that improve community livelihoods. Shaded cocoa has lower nutrient demands; it requires fewer fertilizers and is less prone to insect pests. It has overall a longer productive lifespan than unshaded cocoa. Shade trees also add organic matter to the soil and help maintain a favorable soil structure for sustaining long-term soil fertility and productivity (Anim Kwapong, 2006; Asare, 2005; Obiri et al., 2007, Opoku et al. 2002).

Tree densities recommended by the Cocoa Research Institute of Ghana (CRIG) vary from 1111 to 1333 trees/ ha. *Gliricidia sepium*, a leguminous tree, is often recommended as shade for cocoa because it is easy to establish and manage, even on degraded land. *Gliricidia* can be used for forage or for staking (e.g., should black pepper be planted as an intercrop). Timber and fruit trees are often a better option because
they generate additional products and income for farmers and thus reduce their dependence on cocoa as a sole source of revenue. Other promising alternative crops have been discussed in Section 3 of this report.

Whilst promoting shaded cocoa for long-term productivity, the short-term costs to farmers should be recognized to facilitate the development of appropriate strategies to achieve the sustainability goal. Shaded trees start to produce later and maximum yields are lower than unshaded trees. Because of this, farmers typically opt for low-shade, especially if they plant hybrid cocoa. Farmers who attempt to replant their old cocoa farms will be at a disadvantage compared to those who establish their cocoa in new forest because of higher cost and lower initial productivity. Migrants who will eventually return to their home region are not deterred by the later low yields of low-shade. Targeted incentives are therefore needed for farmers to adopt sustainable cocoa production practices.

Management of cocoa farms for long-term productivity may reduce but does not eliminate the pressure of cocoa cultivation on forests. Besides soil fertility, reasons for expansion into forested land include the desire of farmers to enlarge farms or of immigrants to open new ones, the interest of owners of forest land in benefiting economically by converting it into farmland, and to facilitate passing farms on to children, because under the traditional land tenure system, parents can more easily do so with a farm that they have established themselves.

Intercropping

The ability of farmers to intercrop food crops (maize, plantain, cocoyam, cassava) during the first two years helps improve the household food budget and increases food security. However the importance of food crops has led to complete felling of forest trees thus depriving the cocoa plants of shade and the optimal ecological conditions for growth and development. Intercropping is often accompanied by slash and burn land preparation that renders most of the land bare and susceptible to erosion during the establishment phase. This is potentially more serious in growing areas such as Sefwi Wiaso in the Western Region where the land is hilly with steep slopes.

Forest degradation and conversion

The pursuit of the benefits of forest rent by cocoa farmers, immigrants and landholders drives expansion of cocoa into new forest lands both in the older and newer regions, particularly the Western Region where yields are higher and more profitable. The forest rent is realized at the expense of the original forest vegetation and contributes to degradation of forest lands in Ghana. As of 2000, about 67% of the original 8.2 million ha of closed forest had been lost. Of the remaining 5,517,000 ha, 353,000 ha consisted of primary forest. The annual change in forest cover from 2000 to 2005 was 115,400 ha, a deforestation rate of 2% (www.rainforests.mongabay.com/20ghana.htm). It is estimated that 50% to 70% of the total area of protected forest lands of Western Region, where Ghana has its last remaining tropical high forest zone, have been illegally encroached (England 1993) by agricultural expansion, mining, timber extraction, and other activities (ITTO 1993; Ministry of Science and Environment 2002). The westward shift of cocoa production is also accompanied by decreased use of shade trees, to enhance short-term profits. Most Ghanaian farmers keep reducing the number of forest trees in their cocoa farms. In a number of cases, cocoa agro-forests are just disappearing (Ruf et al 2006). In Manso Amenfi in the Western Region, more than 90% of farmers interviewed stated that forest trees are progressively cut down by themselves and their neighbours (Ruf et al 2006). The perception of farmers is that shade was something of the past, related to the old planting material, Amelonado, locally known as ‘Tetteh Quarshie’. The extension information available to a large majority of farmers has made them believe that hybrids do not need shade, and that it is even
harmful to their development and production. These farmers’ perceptions and acquired knowledge pose a grave challenge to the promotion of environmental sustainability in cocoa farming.

**Water Management**

Cocoa is sensitive to water stress, particularly at establishment when root systems are poorly developed and there is little self-shading in the canopy. Water stress reduces photosynthetic assimilation; in mature plants prolonged water stress can lower yields and bean size. In many cocoa-growing regions of West Africa and Central and South America there is a distinct dry season, lasting two to three months. Climate change is predicted to bring about more intense dry periods in some places (Bates et al., 2008).

**Adapting to Water Stress:** Strategies to deal with water stress include reduction of water loss through the use of mulching and shade; use of irrigation; and selection of cocoa varieties that perform well under water stress conditions and of shade species are less competitive for water.

Organic mulches can reduce evaporative water loss from the soil in regions with a distinct dry season or intermittent rainfall. It appears that uptake of the practice is limited in West Africa, in part by the cost and labor involved in transporting large volumes of mulch. A trial in Afosu, Ghana showed that use of organic mulches (cocoa bean shells and coffee bean husks) reduced seedling mortality and increased early yields (Amoah et al 2005). In the same region, trials using plantain pseudostems showed 31.7% greater survivorship of young cocoa than in the control (Frimpong et al 1994).

The use of shade trees may be either beneficial or detrimental to water conservation. Shade reduces water loss from the soil by lowering temperatures and raising humidity; but the shade trees extract and transpire water and may compete with the cocoa for it. The balance depends on a number of factors, including the type and age of the shade trees, their density, and the intensity of the drought.

Irrigation systems are not widely used for cocoa, though drainage ditches are sometimes used to store water (Lass, 1985). In India research at the Central Plantations Research Institute in Kerala has identified irrigation thresholds and optimum levels. Stress symptoms in cocoa were observed at drip irrigation levels of 10 litres/day/plant, while optimal responses and yields were achieved at 20 litres/day/plant (Balasimha and Apshara 2007). Such studies could be done elsewhere to determine regionally specific optimal irrigation schedules.

There is variation in the capacity of different cocoa varieties to conserve water by rapid closure of stomas in response to soil water deficits (Balasimha and Daniel, 1988; Balasimha et al 1988, 1999; de Almeida 2003). Furthermore, it has been shown that cocoa varieties vary in water use efficiency (Daymond et al 2010), measured as the rate of photosynthetic carbon assimilation per unit of water transpired. Little is known about variation in the capacity of different varieties to extract water through their root systems. Breeding programmes in India are including drought tolerant accessions as parents (Balasimha and Apshara, 2007). With increasing concern about water stress as a result of global climate change and localised deforestation, it is likely that tolerance to water stress will be incorporated into breeding programmes.

**Soil Management**

Key issues related to soils on and around cocoa farms are 1) erosion; 2) degradation; and 3) nutrient run-off.
**Soil Erosion:** erosion may be a problem for cocoa farms that are in particularly exposed locations. The planting of trees as windbreaks is often recommended. Erosion is greater during the establishment stage; the use of organic mulches and live mulching can help protect soil (Oppong et al, 1998). The magnitude of soil and fertility loss by erosion may be significant. On a 6% bare slope in the semi-deciduous zone, Adama (2003) recorded an average soil loss of 65 t ha\(^{-1}\) in the major rainy season and 16 t ha\(^{-1}\) in the minor season. The respective runoff was 110 mm and 40 mm constituting 16% and 11% of rainfall received. The cumulative soil loss (143 t ha\(^{-1}\)) over three rainy seasons in 2000–2001 resulted in a soil depth loss of 10.8 mm. Cumulative nutrient losses in the three rainy seasons were 131, 2 and 5.4 kg NPK per hectare. The respective enrichment ratios were 2.2, 1.3, and 1.0. Organic matter loss was 2.3 t ha\(^{-1}\) with an enrichment ratio of 1.6. These enrichment ratios (>1.0) indicate that the eroded organic matter is richer in nutrients than the soil from which the sediments originated. Such losses in the early establishment stage of cocoa can lead to reduced soil water holding capacity, soil productivity loss, poor plant growth, and low yield. Poor agronomic practices, weed control, the inability of farmers to effectively control pests and diseases and poorly managed trees exacerbate the problem of low crop yields. Without appropriate soil conservation measures such as mulching, sediments and any fertilizer applied (particularly by broadcasting) may be transported by runoff to pollute streams and rivers in the cocoa landscape.

**Maintenance of Soil Quality:** degradation is a serious issue affecting the sustainability of cocoa production in much of West Africa. Impacts are felt on two scales: locally, as degraded soils can no longer sustain satisfactory cocoa productivity, and regionally, since farmers often move on from a particular area once the soil has become depleted. In Ghana, the large shift in cocoa cultivation from the Eastern to the Western region has been largely due to soil degradation. This shifting agricultural pattern increases pressure on remaining forests. Thus while excessive or inappropriate application of fertiliser has well documented environmental side effects (e.g., leaching, water pollution), neglect of soil maintenance also has serious environmental consequences. Strategies to maintain soil quality on cocoa farms are integral to sustainability.

There is an interaction between the nutrient requirements of cocoa and shade levels. The use of shade can help maintain soil organic matter, though tree species that compete heavily for water and nutrients should be avoided (Petithuguenin et al 2004). Long term field trials at the Cocoa Research Institute of Ghana (CRIG) revealed that under no-shade conditions yields were higher but could only be maintained with fertiliser input. In contrast, shaded plots were lower yielding but maintained their yields over longer periods (Ahenkorah et al, 1987). There was depletion of soil phosphorus in all shade regimes over time, however, suggesting that shade alone is not a complete substitute for fertiliser applications. The importance of soil type in determining the shade requirement for cocoa is highlighted by Petithuguenin et al. (2004) using Cameroon as an example. Where soils are low in chemical nutrients and organic matter, cocoa is grown under the shade of residual forest canopy. Where soils are volcanic and rich in minerals, with a high porosity, cocoa is usually grown with little or no shade.

Studies on fertiliser inputs on cocoa farms generally show that nitrogen inputs make little or no difference to yields, whereas phosphorus and potassium inputs can result in a marked improvement. The process of harvesting and removing pods from a cocoa farm represents a gradual removal of nutrients. Farmers will sometimes scatter the pod husks within the cocoa farm to act as decomposable mulch, thereby returning some of the nutrients to the soil, particularly potassium. Alternatively, husks could be machine shredded, such as has been done in a recent project in Nigeria (WCF, 2010). Often, however, pod husks are simply piled up in a corner of the farm. In areas where *Phytophthora* is prevalent, there is a danger that the pod husks can act as a source of inoculum. A solution is to ash the pod husks before application to the soil (Ahenkorah et al., 1981), thus killing any *Phytophthora* spores. Such ash contains around 38% potassium and 1.5% phosphorus. Currently, the alternative products division of CRIG produces cocoa pod ash ferti-
liser on a small scale only. Ashing kilns could be set up on a village-wide basis, reducing the cost of this option.

The role of decomposing cocoa leaves in the phosphorus dynamics of cocoa soils in Ghana was investigated by Ofori-Frimpong and Rowell (1999). The authors point out that phosphorus in the decomposing litter may become immobilised at least for part of the year by soil microbial biomass. Their experiments demonstrated that addition of inorganic phosphorus to the leaf litter stimulated mineralization and therefore ground fertilization in the field might increase the rate of phosphorus released by the litter.

Any applications of fertiliser to cocoa farms should ideally be preceded by a soil analysis. This allows the fertiliser regimes to be targeted to the needs of individual farms or to local landscapes. This increases the benefit to cost ratio and limits excessive nutrient application and consequent problems of run-off. In practice, most cocoa farmers currently have no access to reliable and affordable soil analyses.

Organic composts have the advantage of improving soil organic matter as well as generally releasing nutrients more slowly (although, as with inorganic fertilizers, care needs to be taken not to over-fertilise in order to minimize run-off). Reports on the use of organic manures in cocoa are relatively sparse. A study by Afrifra et al. (2002) in Ghana showed a modest increase in yield in response to additions of chicken manure along with the aforementioned cocoa husk potash. Rock phosphate is used to enrich organic fertilisers on a large, high yielding farm in Costa Rica (Hermelink, 2005). The value of this should be studied in West Africa.

**Fallow Land Restoration**

Since cocoa farming has the potential to encroach further on primary and secondary forests, employment of strategies are needed to restore fallow land that has previously been used for other crops. Examples of successful conversions of crops usage include conversion of coffee plantations to cocoa in Côte d’Ivoire (Freud et al., 2000) and conversion of clove plantations in Indonesia (Petithuguenin et al., 2004). A project to re-plant cocoa on fallow lands using agroforestry techniques was conducted in Côte d’Ivoire between 1993 and 1999 in the Oumé region within the “Fallow Project”. The project involved the testing of leguminous shade species on fallow land in order to re-created a forest micro-climate and improve soil fertility. Among the species tested, the most promising species were *Aracia auriculiformis*, *A. mangium*, *Albizia lebbeck*, *A. guachapele* and *Gliricidia sepium*. In Costa Rica, Beer et al. (1990) in converting an area of sugarcane to cocoa agroforestry found an increase in soil organic matter of 21% over ten years under pruned *Erythrina poeppigiana* and 9% under unpruned *Cordia alliodora*.

**Climate Change and Cocoa**

Climate change, from sources both global and local, will impact on cocoa productivity across the tropics. The main environmental parameters include the following:-

**Carbon dioxide concentration:** It is well documented that increases in CO₂ concentration have a fertilising effect on plants, bringing about increases in photosynthetic rates, growth and yields. However, realistic, large-scale research has shown that the well-known fertilising effect of elevated CO₂ is far less than had previously been thought (Long et al., 2006) and is highly dependent on the addition of nutrients and irrigation. Published reports on the effects of increased CO₂ concentration on cocoa are very limited.

**Water availability:** Global climate change is likely to bring more erratic rainfall patterns to some cocoa-growing regions, particularly in West Africa where more intense dry periods are predicted. Local defor-
estation can impact on rainfall patterns and relative humidity levels. To some extent the effects of water stress and on photosynthetic assimilation and growth will be offset by higher atmospheric CO$_2$ concentrations resulting in greater water use efficiency (i.e. the ratio of photosynthetic rate to water lost through photosynthesis). However, this may not compensate for reduced assimilation during prolonged dry seasons when partial or complete stomatal closure is likely to occur. Cocoa seedlings will become more vulnerable to mortality if dry periods are prolonged. Hence strategies to conserve water are likely to become more important with changing climate; particularly in regions that already have a marked dry season.

With more intense dry periods, it is likely that cloud cover will be reduced, exposing cocoa plants to higher light intensities. The use of shade may then be of greater importance in some regions.

**Temperature**: Since the optimum growing temperature for cocoa is between 30 and 32°C, increases in temperature can be expected to have most impact where temperatures are already challenging (e.g. Kerala, India). High temperatures are associated with dryer air, bringing about reduced assimilation that may impact yields. Higher temperatures also raise rates of soil evaporation. There is evidence that an increase in temperature can result in reduced bean size; some varieties are more sensitive (Daymond and Hadley 2008).

**Climate Change and Ghana**: The effects of climate change in Ghana have been examined via models by Anim-Kwapong and Frimpong (2005). They conclude that cocoa yields are likely to decline due to reduced rainfall which would be exacerbated by longer dry spells, higher temperatures, and dryer air unless adaptive measures are applied. Potential adaptive strategies to climate change include 1) avoiding use of marginal areas for cocoa, 2) managing the crop to ameliorate stressful conditions (e.g., using irrigation and shade to maintain soil moisture, lower temperatures, and raise humidity), and 3) growing cocoa varieties that are more tolerant of environmental stresses.

**Pest management**

**Weed control**: development of previously cropped land for cocoa production, be it secondary forest or bush, is more difficult due to more weedy ground flora (e.g. Chromolaena adorata, locally known as “Acheampong”, which is difficult to remove and re-sprouts rapidly), relatively low soil fertility, and presence of iron-rich hardpan (Petroplinthite). These conditions prevail mostly in the older cocoa production area where crop yields are low.

**Pests and Diseases**: Losses from pests and diseases of cocoa are considerable. Flood et al (2004) estimate that over 40% of global cocoa production is lost each year to just five diseases. The principle diseases and pests of cocoa, along with their distribution are summarised in Appendix 7, Table 7. Environmentally sensitive strategies for dealing with pest and disease problems of cocoa include

- **Targeted pesticide use**: for example, optimising the timing of pesticide applications and using spraying technologies to maximise impact thus limiting pesticide usage.
- **Cultural techniques**, such as frequent harvesting or the planting of barrier crops.
- **Biological control**—e.g., use of natural enemies to attack pest or disease species, or mass trapping of pests using pheromone traps--can also help.
- **Selection and breeding of improved material**: cocoa varieties that have a degree of resistance to pests or diseases will not require as much (if any) pesticide application. Furthermore, if cocoa varieties are selected for high yield, the farmer may be able to live with losing a proportion of the crop to a pest or disease.

**Control of Pest and Diseases in West Africa**
**Cocoa Swollen Shoot Virus:** Cocoa swollen shoot virus (CSSV) is a major cause of crop loss in Ghana, Côte d'Ivoire and Nigeria. It causes loss of yield and, over time, the most virulent strains of the CSSV will ultimately kill the tree. Plants that are infected cannot be treated but instead may be cut out by the farmer. Thus the environmental impact of CSSV is not usually through the use of pesticides. Instead, the reduced yields caused by this disease means that a greater area of land is needed for the production of cocoa than would otherwise be the case.

Breeding for resistance to cocoa swollen shoot virus has been an integral part of the breeding programme at the Cocoa Research Institute of Ghana (CRIG) (Thresh and Owusa, 1986; Thresh et al., 1988). The potential for the use of barrier crops has been investigated at CRIG. As a result of these studies various tree crops, like oil palm and citrus, are recommended as barriers to the various species of mealybug that are vectors for CSSV (Ollenu et al., 2005).

A number of trees act as alternative hosts for CSSV and should be removed from farms. These include: *Cola chlamydantha*, *Sterculia tragacantha*, *Adansonia digitata* and *Ceiba pentandra* (Dzahini-Obiatey, 2010).

**Phytophthora Pod Rot:** Phytophthora pod rot or black pod is widespread in West Africa. Environmentally sensitive methods of control include more targeted fungicide applications, botanical pesticides, various cultural practices and breeding for disease resistance. More effective fungicide applications are achieved with low volume sprayer nozzles that improve pesticide coverage and reduce the quantity required (Bateman et al 2004). Some success has also been achieved with injecting systemic pesticides into the trunk. In Ghana under experimental conditions, a trunk injection with potassium phosphonate provided a moderate level of protection, comparable to spraying with mixtures of cuprous oxide and metalaxyl, a systemic fungicide (Opuku et al., 2004). The use of botanic pesticides has been studied at IRAD, Cameroon. Trials suggest that treatment of pods with hemp extracts can reduce infection rates (Nyassé et al, 2002).

Various cultural practices may be used to restrict the movement of fungal spores from the soil to the cocoa canopy. These include using appropriate pruning and spacing of both cocoa and shade to increase air movement and thus reducing surface wetness (and hence sporulation). Other husbandry measures include frequent and complete harvesting, sanitary pruning and appropriate disposal of infected pods/ pod husks (Flood et al., 2004). In Ghana, cultural control alone can be effective in areas where only *P. palmivora* is present but not in areas where *P. megakarya* is the dominant pathogen (Opuku et al., 2000). In Papua New Guiana, Konam and Guest (2002) showed that leaf litter mulch can reduce the survival of *P. palmivora*. The use of mulches may reduce disease levels when used as part of an integrated disease management programme. Similar studies are needed in West Africa particularly in areas where *P. megakarya* is present.

Research in Côte d’Ivoire has identified species and isolates of the fungus *Trichoderma* that are antagonistic to *Phytophthora palmivora* under *in vitro* laboratory conditions. These isolates are now being investigated as potential biological control agents under field conditions (Mpika et al., 2009).

Selection and breeding activities for resistance to *Phytophthora* pod rot are being conducted in the major cocoa research institutes in West Africa and offer the most sustainable means of disease control in the long run. Genotypic variation has been found in susceptibility to *Phytophthora* species under both experimental and on-farm conditions (e.g. Pokou et al, 2008).

**Mirids:** these sap-sucking insects cause damage to cocoa worldwide, attacking both canopy and pods. In West Africa, the most common species are *Distantiella theobroma* and *Sahlbergella singularis*; the spe-
cies *Helopeltis lalendei* (cocoa mosquito) and *Bryocoropis laticollis* feed on the pods only. Environmental best practice in cocoa includes appropriate shade management (mirid infestations tend to be greater under no-shade conditions; Babin et al 2010) and effective use of pesticides (for example, mist-blower applicators are often used in Ghana to give better crop coverage). A number of genotypes in Ghana, Cameroon and Côte d’Ivoire have been found to be resistant to mirid attacks.

**Integrated Pest Management Strategies:** Research at CRIG, Ghana, is moving towards integrated pest management for mirids that would combine targeted sprayed with cultural best practice and more resistant varieties. Critical to this has been the development of pheromones at the Natural Resources Institute, UK. When these are used in trapping devices (e.g. sticky traps), the population of mirids may be monitored across the year, enabling pesticide applications to be timed for maximal impact. Mass trapping may be able to disrupt the mating cycle, thus reducing further the need for pesticides (Sarfo, 2008). This work is still at the experimental stage but has the potential to be applied in the field in the future. Another potential IPM strategy is to use models to predict peaks of flushing and fruiting, thus determining when the cocoa trees will be more susceptible to insect or disease attack and when pesticide applications would be most effective.

**Post Harvest Practice**

**Drying:** After fermentation, cocoa beans must be dried for safe storage and shipment. The drying process will affect bean quality (McDonald *et al.*, 1981; Wood, 1985b). In regions where the main harvest is in the dry season (such as West Africa) the beans are usually sun dried, commonly on mats raised above the ground. Artificial drying is sometimes done in particular regions or at times of the year when sun drying is difficult. Farmers may also opt for artificial drying in order to reduce the labour associated with the drying process. There are various methods of artificial drying (Wood 1985b). Cocoa dryers are typically wood-burning, thus having an environment impact if the wood comes from an unsustainable source. Use of such dryers increases the carbon footprint associated with cocoa production. Artificial dryers can also impact on the bean quality, in some cases bringing about “off-type” flavours (Wood, 1985c).

Solar drying technologies are being applied to cocoa in various forms, particularly in the Caribbean and parts of South America, but are not widespread in West Africa. They offer environmentally sensitive alternatives where direct sun drying is difficult. Simple technologies include erection of greenhouse or polytunnel type structures over the cocoa drying area. Ventilation is achieved by having open ends and sometimes also open sides. A variety of other dryer designs exist worldwide (Sukha 2009, Hii *et al* 2006; Bonaparte et al. 1998; Fagunwa et al. 2009). A study by Bonaparte et al. (1998) in St Lucia showed little difference in bean quality between sun-dried beans and those dried with a solar dryer, though a marginal improvement in quality was found in indirect dryers compared to direct dryers.

**Storage:** during storage there is danger of dried beans becoming infested with pests such as the tropical warehouse moth (*Ephestia cautella*), the tobacco beetle (*Lasioderma serricorne*), and the coffee weevil (*Araeus fasciculatus*) (Wood, 1985b). Such infestations are usually treated with pesticides. Store construction to minimise the risk of outbreaks should be used. The store should have cement floors and bricks or concrete walls (not wood, which can harbour larvae). Stacking sacks away from walls, inspecting them regularly and rotating the stock also help to minimise infestations.

**Biodiversity Habitat Management**

**Biodiversity on Cocoa Farms:** shaded cocoa often supports higher levels of biodiversity than other tropical crops (Rice and Greenburg 2000). However, species diversity will vary greatly with management
practices and location. A study of biodiversity associated with different agroforestry regimes in Sulawesi showed that conversion of rainforest to extensive cocoa farms with dense shade reduced the species richness of forest-dwelling species by 60%. As shade was reduced further to 40-50%, the additional reduction in biodiversity was relatively small (Steffan-Dwenter et al 2007).

In Cameroon, Sonwa et al., (2007) studied plant diversity in cocoa agroforests along a gradient of market access, population intensity and resource use intensity. A sample of 60 agroforests found 206 tree species (averaging 21 per agroforest); some of them provided supplementary farm income. With increasing market access, farmers were replacing native tree species with exotic tree crops. The authors conclude that farmers need better financial rewards for their conservation efforts such as access to markets for native tree species.

Shade Species of Conservation value: a few publications have specified shade species of value to fauna and flora. In Cameroon, Laird et al. (2007) highlight shade trees with particular conservation value in the Mount Cameroon region. These include Cola lepidota, Cordia aurantiaca, Mansonia altissima and Mili-cia excels.

Management Practices and Government Interventions to Enhance Biodiversity: In Côte d’Ivoire the PRODUCAO (Production Durable et Amélioration de la Qualité de Cocoa) project is introducing agroforestry techniques for sustainable cocoa production which will take the pressure off forest areas around the Taï National Park. A part of this project involves rehabilitation of moribund cocoa farms as an alternative to expansion into virgin forested areas (Gilmour, 2004).

Excessive and/or inappropriate pesticide usage will impact on the biological diversity associated with a cocoa farm and the surrounding environment. Thus the use of integrated pest management strategies that have minimal environmental impact are an important part of biodiversity conservation practices.

Carbon Management and Payment for Ecosystem Services

Payments for ecological services (PES): the practice of offering farmers financial incentives to manage their land for some kind of ecological service has potential application to cocoa agroforestry systems. For example, Sonwa et al. (2006) identify the Yaoundé fringe (Cameroon) as a cocoa-growing area that provides good opportunities for PES. The authors suggest that the environmental services provided by such agroforestry systems could include 1) biodiversity conservation and landscape restoration, 2) carbon sequestration, 3) ecotourism, and 4) watershed maintenance. PES for cocoa cultivation operates for organic certified cocoa, where farmers are usually paid a premium of US$ 100 to US$ 300 per tonne (ICCO 2010b). Currently this market represents only a small proportion of the total (about 0.5%).

Reducing Emissions from Deforestation and forest Degradation (REDD) is a specific type of PES, where payments are made for preserving carbon stocks (e.g. large forest trees) or for carbon sequestration activities (re-forestation). Cocoa itself sequesters little carbon, having a relatively low growth rate, but cocoa agroforestry systems with native forest or timber species provide opportunities for REDD initiatives. For example, Isaac et al. (2005) calculated carbon sequestration rates in 25-year old multi-strata cocoa farms in the Western Region of Ghana to be three tonnes/ha/year. Carbon storage estimates for un-shaded cocoa in Cameroon are 60 tonnes/ha, compared with 243 tonnes/ha for shaded cocoa agroforests (Sonwa and Weiss, 2008). In Ghana, forests in the Eastern region were found to store 155 tonnes/ha of carbon, compared with 131 tonnes/ha for traditional shaded cocoa and 39 tonnes/ha for intensive cocoa (Wade et al., 2010).
Whilst REDD payments are not currently widely employed for cocoa agroforestry systems, the potential exists for them to be adopted, particularly as the UNFCC clean development mechanism (CDM) can be applied to agroforestry, forestation or reforestation. A study by Seeburg-Elverfeldt (2009) on potential carbon finance options for cocoa agroforestry in Indonesia indicated that the deforestation activities of the majority of households could be stopped with current carbon prices. The author concluded that for carbon payments to be effective, such payments should not be paid in a general manner to all agroforestry systems within a region but should be biased towards those that provide greater ecosystem services. Furthermore, the study illustrated that poorer households would benefit proportionally more from such payments.

Currently the clean development mechanisms cannot be used with plantation systems e.g. when two crops are intercropped. However, in studying carbon sequestration in areca-cocoa mixed crop systems, Balasimha and Kumar (2009) found that CO₂ sequestration ranged from 1.38 – 2.66 t/ha for cocoa and 5.14 – 10.94 t/ha for areca. They argue that based on these data CDM should also be considered for plantation systems.

B. Policy and Administrative Measures and Issues

1. Policy Framework for Cocoa

The Growth and Poverty Reduction Strategy II (GPRS II) is the national policy that drives the economy of Ghana. It sets out the general framework for the various sectors which then develop sector-specific strategies and action plans for implementation to achieve the national goal. Attention is focused on the relevant sections of the national, sector and cocoa policies that have direct or potential impacts on the promotion of best practices for environmentally sustainable cocoa production in Ghana.

In most cases, the issues and strategies to address them are well articulated in the relevant section of the GPRS II. What is not so obvious is how effectively these policies have been implemented and more specifically their explicit impact on environmental sustainability.

This offers an opportunity to use the stated policy strategies as an advocacy entry point to collaborate with and support the relevant sector Ministries to develop action plans for implementation involving all concerned stakeholders. The development of improved mechanisms for implementing action plans is critical for achieving policy goals and objectives. Developing and implementing environmentally sustainable development policies, especially in the cocoa sector is a multi-faceted issue requiring inter-ministerial and multi-stakeholder collaboration. These include the Ministry of Food and Agriculture (MoFA), Ministry of Lands, Forestry and Mines (MLFM), Ghana Cocoa Board (COCOBOD), Research Institutes, District Assemblies, Chiefs/Skins, Farmer-Based Organizations, and Non-Governmental Organizations, among others.

A comprehensive analysis of national and sector policies impacting directly or indirectly on Environmental Sustainability can be found in Appendix 2. It reflects the Government of Ghana’s commitment to promoting environmental sustainability in the management of land and natural resources. The relevant sections of GPRS I and II together with FASDEP II and the Land Policy, the Forest and Wildlife Policy, and policies that directly affect the cocoa industry, attest to this. All these policies articulate, empowering the rural populations to take the lead in improving their livelihoods. This accords with the overall vision of CCP of supporting cocoa communities in Ghana to become “thriving rural communities that support a sustainable cocoa supply chain” with its governing objective of empowering cocoa growing communities to “take leadership in meeting their long-term goals and delivering sustainable cocoa production.
Direct policies in the cocoa sector that relate to environmental sustainability

**Internal and external marketing of cocoa** is being restructured. Internal marketing of cocoa, which was a monopoly by Ghana Cocoa Board (COCOBOD), has been liberalized to allow License Buying Companies (LBCs) to operate alongside COCOBOD. External marketing is to be exclusively conducted by Cocoa Marketing Company (Ghana) Limited, a subsidiary of COCOBOD.

**Disease and pest control** on farms has direct Government involvement. Since the 2001/02 cocoa season the Government, through COCOBOD, has been organizing a nation-wide Cocoa Diseases and Pests Control Programme free of charge for the farmers (CODAPEC, popularly known as “mass spraying”). This programme has positively impacted on national cocoa production.

**Introduction of the Farmer Pass Book** streamlined the registration of product sales by farmers to the Licensed Buying Agencies, payment of bonuses/dividends, short-term loans and advance repayments, and purchase and payment of agro-inputs (see further information on the farmer passbook below).

**Supply of subsidized improved planting material** (seeds and seedlings) and application of fertilizer to boost productivity – dubbed “Cocoa High-tech” was introduced in the 2002/03 crop year after a series of on farm trials by CRIG. Cocoa farmers are encouraged to plant improved seeds and seedlings as well as to apply fertilizers to cocoa to help improve farm performance. The fertilizers under this programme are supplied on credit to beneficiary cocoa farmers; payments are made by instalment during the ensuing harvesting season.

**Price supports.** The cocoa rehabilitation project of 1988-1996, addressed the issue of low producer price with a policy to increase it annually to 65% of the world market price. The policy was again reviewed in 1999, and the producer price was projected to be raised gradually to reach 70% of the f.o.b. price by the 2004/05 cocoa season. The annual increases of the producer price have resulted in the retrieval and rehabilitation of abandoned farms, expansion of old farms and the establishment of new ones.

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2. **Land and tree tenure**

Ghana’s land tenure system is characterized as one of legal pluralism in which customary and statutory laws co-exist in a complex mix, with a range of institutions and regulations having authority over land rights and multiple bodies through which disputes are resolved (Lavingne-Delville, 1998). Customary and statutory land tenure are distinguished (Bentsi-Enchil, 1964, Woodman, 1996; Agbosu, et al, ISSER 2007: 30). The former is characterized by its largely unwritten nature, based on local practices and norms that are said to be flexible, negotiable and location-specific (Agbosu, et al, ISSER: 30). Customary land tenure is usually managed by a traditional ruler, earth priest, council of elders, family or lineage heads. Its principles stem from rights established through first clearance of land, conquest or settlement (Agbosu et al, ISSER 2007: 30). The state tenurial land system, on the other hand, is usually codified, written statutes and regulations, based on laws having their roots in the colonial power, which outline what is acceptable and provide consequences for non-compliance. Management of such codified systems is usually in the hands of government administrators and bodies having delegated authority. The principles guiding this system are derived from citizenship, nation building, and constitutional rights. Land rights are allocated and confirmed through the issuance of titles or other forms of registration of ownership (Agbosu, et al, ISSER 2007: 30). It is instructive to note that despite the fundamental differences underlying the principles and systems for managing land under the customary and statutory forms, in practice this neat distinction is not obvious (Agbosu, et al, ISSER 2007:30), perhaps due to commonalities and overlaps in both
systems. These two systems, which form the foundation of Ghana’s land tenure system, have undergone several years and stages of interaction and have impacted both positively and negatively on agricultural development as well as on the environment.

**Land tenure** provides the legal and normative framework within which agricultural and other economic activities are conducted (Ondiege, 1996). According to FAO (1989) tenure is a set or “bundle” of rights which a person or entity holds in land, trees, or some other resource, and which is recognized by law and custom in particular societies or communities. It is critical to the management and conservation of the environment for sustainable productivity. Tenure insecurity undermines the effectiveness of best environmental practices in the cocoa industry in Ghana. The land tenure system has defied many attempts by several governments to improve the administration of land in the country. When tenure rights are certain, whether customary or statutory, the land tenure system can provide incentives to use the land in a sustainable manner or invest in resource conservation whether for individual or community purposes (Ogolla and Mugabe, 1996). The promotion of best environmental practices and their adoption in the cocoa growing areas of Ghana would require the correction of land and tree tenure systems, removing constraints on the attainment of environmentally sustainable cocoa production in the country. This will facilitate the development of strategic solutions to deal with the problems of unsustainable cocoa farming in Ghana. An elaboration of land tenure issues appears in Appendix 3.

**Tree tenure**—ownership and benefit sharing in planted and naturally growing trees on farms—has become one of the thorny issue areas facing the both landowners and cocoa tenants. The term refers to a system or bundle of rights over trees and their produce which may be held by different people at different times (FAO 1989). These rights include the right to own or inherit trees, plant trees, use trees and tree products, dispose of trees and exclude others from the use of trees or tree products. Security of tenure is needed to ensure that farmers benefit from planting and tending trees, and from investing in improvements that enhance the value or sustainability of the trees. This is relevant to the success of the country’s ongoing development of REDD carbon sequestration projects and the identification of suitable contributors to the carbon stocks, who deserve to benefit from the proceeds from the carbon market. Tree tenure issues are covered in Appendix 4.

A tree tenure regime may distinguish between planted trees and wild trees. The rights to trees depend on their species, nature, and use, and on the nature of the person or group with interest in them. Rights in a tree may be distributed among several individuals, often according to provision of labour and other productive resources. In the off-reserve areas in Ghana, the provision of the 1962 Concessions Act which “vests all timber resources in the office of the President” gives the government the management rights over all naturally growing trees, and landowners and users cannot cut trees for commercial reasons. The environmental implication is the tendency of farmers to remove trees from off-reserve land, particularly given the usually uncompensated damage that logging causes to cocoa and other crops during harvesting of timber. This may constrain efforts in promoting tree planting in the cocoa growing areas. The key issue in tree planting on-farm, off-reserve, degraded forest reserve areas and cocoa landscapes is the extent to which the farmer has the security of tenure needed to invest in trees. Trees are slow maturing and therefore constitute a long-term investment. Security of tenure is required to ensure that farmers reap the benefits.

In off-reserve areas, farmers are the *de facto* managers of the tree and forest resources, and thus strongly influence the density and diversity of tree species found in the landscape. This is because the forest-farm mosaic is one in which farmers actively manage natural processes of forest succession by selecting and nurturing tree seedlings, coppice sprouts, and mature trees to provide shade and other products on their farms (Asare and Asare 2008; Amanor 1996). Despite their clear role in influencing the off-reserve landscape, farmers are not entitled to any of the stumpage fees from trees that they nurture. Because land
owners and land users have no economic rights to naturally regenerated trees, farmers have few reasons to retain or maintain high value economic species that are likely to be felled for timber. Most farmers intentionally eliminate timber species so as to avoid future damage to their tree crops and conflicts with timber companies. Under the current system, trees on farms represent a risk to farmers, as opposed to an asset or a secure investment. The perverse incentives surrounding timber trees on cocoa farms was documented by Richards and Asare (1999).

As Ghana embarks on its Readiness Preparation Proposal (R-PP) which outlines the process by which the Government will develop its national strategy for participating in and implementing an international mechanism for reducing emissions from deforestation and forest degradation, conserving stocks and sustainably managing its forests (REDD +), attention should be directed at enacting laws and legislation that will streamline securing land ownership and tree tenure in general, and in the cocoa growing areas in particular. This will promote sustainable investments in tree planting and position the cocoa farming communities to benefit from the proceeds from the carbon markets that would be developed.

3. Sustainable forest management

Sustainable forest management uses a landscape approach to improved farming and forestry practices. Forest landscape restoration (FLR) should be adopted by the Forestry Commission as the core approach in the sustainable forest management of the country. The principle can be applied to the rehabilitation of the old cocoa farms currently going on in the country. The FLR approach would also provide direct source of livelihood for the cocoa farmers living off the forest reserves.

Forest Landscape Restoration is a process that brings people together to identify, negotiate and put in place practices that restore an optimal balance of environmental, social and economic benefits from forests and trees within broader land use patterns. The term ‘forest landscape restoration’ (FLR) is defined as a process to regain ecological integrity and enhance human well-being in deforested or degraded forest landscapes. Since then the concept has been further developed under the umbrella of the Global Partnership on Forest Landscape Restoration (GPFLR). (See www.ideatransformlandscapes.org).

Forest Landscape Restoration differs from conventional restoration approaches in several ways:

- It takes a landscape-level view: this does not mean that every FLR initiative must be large-scale or extensive but rather that site-level restoration decisions need to accommodate landscape-level objectives and take into account likely landscape-level impacts;
- It operates on the ‘double filter’ condition: that is, restoration efforts need to result in both improved ecological integrity and enhanced human well-being at the landscape level;
- It is a collaborative process involving a wide range of stakeholder groups collectively deciding on the most technically appropriate and socio-economically acceptable options for restoration;
- It does not necessarily aim to return forest landscapes to their original state, but rather is a forward-looking approach that aims to strengthen the resilience of forest landscapes and keep future options open for optimizing the delivery of forest-related goods and services at the landscape level; and
- It is applied not only to primary forests but also to secondary ones, forests and even agricultural land.

4. Potential for additional income generation


**a. From alternative crops**

A review of the traditional cultural practices for establishing cocoa farms in Ghana, shows a system in which cocoa is planted on forest land, selectively cleared and planted to various types of food crops for one or two seasons. When land is cleared, indigenous fruit, medicinal and timber tree-species are deliberately retained both for their economic value and to provide shade for the cocoa plant (Asare, 2006; Masdar, 1998). Cocoa farmers also actively nurture and manage the regeneration of forest species in their farms for their ecological, economic, or cultural value (Amanor 1996). As farmers harvest the seasonal and annual crops, the cocoa is left to develop. Depending on the density of the retained species and the mortality rate of the cocoa seedlings, the system is enriched by planting additional tree crops, particularly edible fruits which farmers prefer, such as mango, orange, and avocado (Osei Bonsu et al., 2003; Asare, 2005; IUCN, 2006a).

As the cocoa and other components mature, mainly by utilizing the residual fertility that had been built up by the forest in the newly cleared area (forest rent), the system evolves to a closed canopy multi-strata system resembling natural forest. Environmental benefits include habitat conservation, climate change mitigation, hydrological cycling, watershed protection, and enhanced nutrient cycling (Gockowski et al. 2004).

Agroforestry systems store more carbon than other cropping systems (Albrecht and Kandji 2003; Montagnini and Nair 2004). Conversion of agricultural lands to cocoa agroforests could be a management strategy for storing large quantities of carbon as well as maintaining biological diversity (Siebert 2002; Parrish et al 1998). This presents an opportunity for environmentally sustainable cocoa production with income and livelihood enhancement through payment for ecosystem services (PES) and carbon trading.

According to IUCN (2006a), the preference for trees to be associated with cocoa has shifted gradually from any tree that provides shade to timber and more recently non-timber forest products (NTFP). This presents an opportunity to introduce high value NTFPs into cocoa farms for employment and income generation, enhancing livelihoods for cocoa communities in Ghana. This will contribute to the realization of CCP’s long-term vision of helping to develop “thriving rural communities that support a sustainable cocoa supply chain”.

NTFPs include a wide range of high value products that present viable income-generating options, especially in the face of dwindling timber-based forestry products and fluctuating markets for leading cash crop exports (Acquaye, 2009). NTFPs have good potential as a tool for diversification and to mitigate over-reliance on traditional income sources. They offer development options and can contribute to economic growth.

Candidate NTFPs have been worked on and are being promoted in the country through various initiatives by IUCN, ASNAPP, and Samartex, among others. They include: *Allanblackia purvisiflora*, *Voacanga africana*, *Griffonia simplicifolia*, *Aframomum maleguetta* and *Thaumatococcus danielli*, *Piper nigrum*, *Pyxanthurus angolensis* and *Syncepalum dulcificum*. These plants are described in Appendix 5.

**b. From carbon trade**

In recent years, the growing concern about climate change has stimulated interest in the role of forests as carbon sinks. This trend has given rise to a global market in “carbon credits” by which payment can be made for the enhancement and/or conservation of carbon stocks. Payment of Ecosystem Services (PES) is an innovative, market-based approach to conservation financing. In essence the it seeks to link those who benefit from environmental services (“the buyers”) with those who contribute to generating them.
("sellers"). It creates a mechanism whereby those who derive benefits pay for the environmental services, while those who help generate the services receive compensation for providing them.

Carbon trading markets are platforms that bring buyers and sellers of carbon credits together with standardized rules of trade. A potential buyer of carbon credit is any entity, typically a business, that emits carbon dioxide to the atmosphere and has interest or may be required by law to balance its emissions through mechanisms of carbon sequestration. The businesses may include power generating facilities or many kinds of manufacturers. Potential sellers of carbon credits, on the other hand, are entities that manage forest or agricultural land who might sell carbon credits based on accumulation of carbon in their forest trees or agricultural soils. Similarly, business entities that reduce their carbon emissions may be able to sell their reductions to other emitters that were not able to meet their emission reduction goals directly. The promotion of environmental best practices in the cocoa growing areas offer communities an opportunity to benefit from carbon trading as they practise shaded cocoa production.

**Carbon sequestration in cocoa agroforestry:** Shade trees sequester more carbon than cocoa; studies by Kirkby and Potion (2007) and Morris (2009) suggest that traditional shaded cocoa stores over twice as much carbon as shade-free farms and that farming cocoa sustainably will result in approximately 40% more carbon stored in that landscape. Similarly, Wade et al. (2010) confirmed that traditional cocoa farms have higher carbon storage and species richness than intensive cocoa, but productivity is lower than intensive cocoa.

Mason (pers. comm. 2010) estimates that 200+ million metric tonnes of carbon credits are lost to Ghanaian cocoa farmers over 20 years. At the market price of US$5/t for CO_2 credits (Pearson and Brown 2006), the predicted total potential revenue could be about US$1 billion dollars over the 20 years. It is speculated that given the current interest of international firms the carbon financing for cocoa agroforests may be an attractive market in future. Farmers could also generate carbon credits through maintenance of carbon stocks and/or carbon sequestration by integrating more shade trees into their farms under favourable tree tenure and ownership arrangements. Gockowski et al. (2004) showed that using cocoa agroforests as a tool to reforest degraded fallow lands could sequester up to 95 t/ha of atmospheric carbon. Soma-rribab (2010) calculated the carbon stocks in a cocoa agroforests in Ghana to be 65 t/ha and 16 t/ha in the shade canopy and cocoa trees respectively. The total carbon stock was 81±13 t/ha. The author further showed that carbon fixation rate in cocoa plantations in Ghana and Costa Rica vary from 1.1 to 2.8 t/ha-yr.

Options available to cocoa farmers include bringing additional carbon revenue streams into the cocoa landscape through the development of carbon finance for cocoa to create monetary incentives that minimize carbon dioxide in farms and surrounding lands. This carbon funding should be seen as an opportunity primarily to increase farmers’ income. To a considerable extent it also presents new challenges for the government of Ghana through COCOBOD in accurately measuring and reporting carbon stocks. Morris (2009) found that, including soil carbon and the cocoa trees, shaded cocoa (crown canopy in excess of 30%) stored about 159 tonnes/ha or 70% of the carbon found in intact high forest (224 t/ha) and over double that stored in unshaded cocoa (< 10% canopy cover) cocoa (72 t/ha). Excluding soil carbon, shaded cocoa stored 107 t/ha or about two-thirds the non-soil carbon in high forest (156 t/ha) and almost three times more than unshaded cocoa (38 t/ha).

Current major carbon activities in Ghana: The baseline survey has revealed that some important projects and activities on carbon stock are currently going on in the country. These projects and activities have been mainly carried out by the West Africa Katoomba Ecosystem Services Incubator. Five areas are being targeted:

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Building a carbon map of Ghana: Ghana does not yet have a map of its ecosystem carbon resources (Aitkin et al., 2010). Developing credible carbon maps can provide a range of benefits to government ministries, project developers and research organizations. At the national level, carbon maps can improve reporting of carbon emissions and help identify areas where carbon stocks need to be conserved. At the project level, carbon maps can provide a carbon stock baseline. This can help organizations develop carbon offset projects and get carbon finance flowing to forest and farming communities. For research purposes, carbon maps can help determine what factors drive change in carbon stocks and which systems are more effective at conserving them. The Moore Foundation has provided financial support to produce a robust carbon map of Ghana, showing total biomass and soil carbon stocks based on 2009 land cover, with 100 m resolution by the end of 2010. The mapping is being done by the Katoomba group and the Nature Conservation Research Centre (NCRC).

Preliminary review of constraints and feasibility of ‘cocoa carbon’ in Ghana: The Incubator aims to develop two cocoa carbon projects in 2010-2011. These will be taken from four potential cocoa carbon options in two main cocoa production areas or ‘types’: the Western Region Type (WRT) and the Eastern Type (ET), composed mainly of the Ashanti, Eastern and Brong-Ahafo Regions. The WRT is characterized by unshaded shorter cycle cocoa, and the ET by more traditional shaded cocoa farms. Projects will be developed in close partnership with farmer organizations, research institutions and other groups to maximize learning and shared expertise.

Preliminary feasibility analysis of the potential of ‘carbon cocoa’ in Ghana: The specific objective of the project is to develop economic models to help assess the attractiveness of cocoa carbon for farmers and investors. This is a preliminary study based mainly on secondary data. This pre-feasibility analysis of cocoa carbon is under way. Preliminary results suggest that carbon finance alone at current prices will not likely be the sole or even the primary means for persuading farmers to adopt higher shade cocoa systems. It could however be an enabling factor to encourage improved farming practices and productivity. The models imply that tree tenure reform, combined with policy, fiscal and institutional reforms in the cocoa sector, will be important drivers of ‘improved’ cocoa farming practices, including increased shade.

REDD opportunities scoping exercise: legal and institutional constraints: An early activity of the West Africa Incubator was a “REDD Opportunities Scoping Exercise” workshop of key informants in July 2009. Distinguishing cocoa carbon as one of the high potential project types, the workshop identified tree tenure as the main constraint for REDD cocoa carbon since it acts as a strong disincentive to farmers to keep trees, especially timber trees. The workshop concluded that REDD cocoa carbon will only work if farmers obtain increased rights or incentives over trees, and that a promising way forward would be by establishing Community Resource Management Areas (CREMAs) or ‘Designated Forests’ in off-reserve areas. CREMAs confer increased local control and participation in natural resource management, increase the scope for farmer rights over trees, and provide a facilitating platform to sort out land tenure issues. It was also observed that improved institutional coordination, particularly for cocoa grown in forest reserves, and increased involvement of traditional authorities (chieftancies) and District Assemblies are needed for REDD initiatives to work.

REDD and REDD+
REDD is an afforestation programme under the Climate Change Adaptation mechanism that enables countries to trade forest carbon stock on the International market for cash. Plantations (and potentially agroforests) are used to stock carbon dioxide, one of the leading causes of global warming and climate...
change, thus preventing its emission into the atmosphere. “REDD” stands for Reducing Emissions from Deforestation and Degradation. The Bali Action Plan decided at the United Nations Framework for Climate Convention (UNFCCC) ‘Conference of the Parties’ at its thirteenth session states that a comprehensive approach to mitigate climate change should include:

“Policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries.”

The ‘+’ in REDD+ is taken to denote the inclusion of conservation, sustainable management of forests and enhancement of forest carbon stocks. This makes it more likely that countries with high levels of natural forest remaining and historically low levels of deforestation will be compensated under REDD for maintaining those forests. That will have positive impacts on the delivery of environmental co-benefits from those forests. REDD could simultaneously address climate change and rural poverty, while conserving biodiversity and sustaining vital ecosystem services. Ghana has adopted REDD as one of the main adaptation mechanisms for climate change.

The Clean Development Mechanism (CDM)

The CDM is an instrument under the Kyoto Protocol allowing industrialized countries with a GHG reduction commitment to invest in projects that reduce emissions in developing countries as an alternative to more expensive emission reductions in their own countries. More precisely, the CDM allows projects in developing countries to earn certified emission reduction credits. These CERs can be traded and used by industrialized countries to meet a part of their emission reduction targets. Currently only afforestation and reforestation (A/R) projects are allowed in the forestry sector and forestry projects constitute less than 1% of the CDM pipeline (Ebeling and Fehse, 2009).

Cocoa carbon initiative (CCI) site selection report: The Cocoa Carbon Initiative by the Katoomba group and the Nature Conservation Research Centre (NCRC) is an effort to alter the economics of deforestation and forest degradation from cocoa expansion by providing cocoa farmers and communities the opportunity to benefit from carbon finance. To do this, CCI aims to establish two cocoa carbon pilot projects that will test the feasibility and sustainability under different scenarios of REDD+ within Ghana’s cocoa sector. To lay a strong foundation for the development of these sites, a stakeholder consultation process was adopted to identify project areas. This process involved two participatory workshops and two site assessment trips, culminating in selection of three areas: 1) Juabeso District, 2) Asunafo North/Asutifi District, and 3) Assin North District. Detailed feasibility assessments will be undertaken at least two of the sites.

The carbon conundrum

Currently the government of Ghana, through the COCOBOD, does not have a policy on carbon credits. This may be attributed to the fact that the international community has not defined how carbon credits will be evaluated and then packaged for the world market.

Cocoa carbon will only work if farmers obtain increased rights over trees or other incentives. A promising way forward would be to establish Community Resource Management Areas (CREMAs) or ‘Designated Forests’ in off-reserve areas. CREMAs confer increased local control and participation in natural resource (especially wildlife) management, increase the scope for farmer rights over trees, and provide a facilitating platform to sort out land tenure issues. While CREMAs have so far been mainly oriented to wildlife, biodiversity, and ecotourism, there is scope to modify the new Wildlife Bill (at a final drafting stage) so that it can accommodate REDD objectives.
More generally, the complex dynamic of cocoa carbon in Ghana calls for landscape-level approaches that integrate strategies for REDD, and agriculture in order to enhance agricultural productivity, community commitments to forest conservation, carbon storage and other ecosystem services. The key to unlocking such a landscape approach is to give farmers and communities rights and therefore incentives for natural resource management; a possible tool for this in Ghana is through the establishment CREMAs and/or ‘dedicated’ community forests in off-reserve areas.

Carbon benefits are likely to be modest due to the relatively low price of carbon and may not fully compensate project costs. However, when considered in conjunction with the adoption of improved farming practices that enable farmers to significantly increase their yields, plus other initiatives that provide benefits like certification or shade tree diversification, the policy could substantially increase the number of trees in the cocoa landscape and help to conserve the country’s remaining forests. The smallholder basis of cocoa raises challenges to cost-effective carbon monitoring and verification. Simplified methodologies and monitoring protocols such as the use of Farmer Passbook will be needed so that thousands of small farmers, each with small carbon volumes, can benefit. Well organised producer cooperatives like Kuapa Kokoo and Cocoa Abrabopa provide an excellent basis for the needed ‘aggregation’ mechanisms.

In view of the strong evidence of the potential of carbon stock becoming the next foreign exchange earner, COCOBOD should develop a strategy and create an office to identify, develop and market carbon stocks. But realizing the full potential of “cocoa carbon” will require concurrent progress in policy and legal reforms, as well as building practical experience on the ground. Demonstration activities, working closely with rural communities, farmer organizations and industry, will shed light on practical issues of how to promote improved farming practices, where carbon finance could play a catalytic role, and what impact specific policy reforms could potentially have.

Initially, afforestation/reforestation (A/R) projects under CDM supported by the voluntary carbon market may be a more viable strategy than the REDD option because the farmer can register the trees with the Forestry Commission and the trees and (presumably) the carbon rights would belong to the tree farmer; A/R can either be from increasing shade cover in new or replanted cocoa plantations, or in the form of tree planting (most likely for timber) as a separate land use.

c. From certification schemes: eco-labels

Communities or farmers that agree to practice environmentally sustainable, biodiversity friendly cocoa production may be able to access a price premium paid by the market. However, they must meet standards for of production, many of which include environmental best practices, and achieve certification of compliance to those standards. Working in groups reduces transaction costs to acquire the certificate and facilitates sustainability of product supply. Criteria differ with the type of certificate sought, reflecting the distinct concerns of buyers. These include sustainable farming methods (e.g. integrated pest management; good soil conservation practices; protection of wildlife and waterways; minimisation of agrochemical use; social issues like equitable pay, workplace conditions, child labour, etc.)

All certificates also require that the group of farmers has a record keeping system on the performance of members (internal control system). The records make it feasible for an independent assessor to verify that all members are meeting the criteria before a certificate is awarded to the group.

More information on the environmental specific criteria considered by the different certification schemes is found in Appendix 7, Section 3.1. Some existing certification systems in Ghana include:
**UTZ Certified** - The UTZ Certified vision is to support cocoa farmers to become professionals implementing good practices which lead to better businesses, whilst also addressing social and environmental issues. UTZ certification focuses on rewarding cocoa farmer groups that practise sustainable farming methods. Premiums received for UTZ Certified cocoa are spent in ways that clearly benefit all certified producers, in cash and/or in kind.

**Rainforest Alliance** uses standards set by the Sustainable Agriculture Network, SAN. It encourages cocoa farming practices that are sustainable, maintain a healthy environment, ensure decent working conditions, and support communities by transforming land use practices, business methods, and consumer behavior. Participating producers meet standards that conserve biodiversity and ensure sustainable livelihoods. Farms meeting SAN standards earn the Rainforest Alliance Certified seal.

**Fair Trade** is an organized social movement and market-based approach to help producers in developing countries and promote sustainability. The movement advocates the payment of a higher price to producers as well as promoting social standards in areas related to the production of a wide variety of goods. Fair Trade certified cocoa must be grown and harvested in accordance with the international Fairtrade standards set by FLO International. The supply chain must also have been monitored by FLO-CERT, to ensure the integrity of labelled products. The minimum price paid for Fair Trade certified cocoa is guaranteed, so if prices for conventional cocoa drop below this level, farmers receive a better price for their cocoa. The Fair Trade premium is used by farmer groups for social and economic investments within their communities. Pre-harvest lines of credit can be requested by the farmer groups, of up to 60% of the sale price. However, FLO standards currently lack the environmental criteria promoted by many of the other certification organizations such as the Rainforest Alliance. It would be advantageous if FLO set standards to improve environmental performance of farmers as part of the premium offered to Fair Trade certified member farmers.

**Organic certification** addresses a growing worldwide demand for organic food. The criteria vary for each organic certificate and generally involve a set of production standards for growing, processing, packaging, and shipping that include avoidance of most synthetic chemical inputs (e.g. fertilizer, pesticides, antibiotics, food additives, etc), genetically modified organisms, and the use of sewage sludge; use of farmland that has been free from chemicals for a number of years (often three or more); and maintaining strict physical separation of organic products from non-certified products.

In this scheme, communities may receive an annual direct payment in return for complying with agreed standards and practices, such as payment for each hectare of off-reserve area conserved instead of converting it to cocoa, or reverting an old cocoa farm to forest. The payment may comprise the income forfeited/ha of land converted to forest. Such a scheme may be promoted temporarily by external funding; however, because there are no direct economic returns on investment, it will not be cost effective and may not gain the support of many donors.

d. **Other potential incentive mechanisms**

**Price premium**: another form of PES is price premiums paid by a client in return for the adoption of environmental standards. Agreement to comply with set standards or practices may earn a community or producer group a higher price for cocoa where the price difference will constitute the PES. For example, a price premium may be paid for organically produced products where agrochemicals are not used and yields may be lower. A constraint may arise if the part of the premium passed to consumers is large enough to restrict consumer patronage, creating a niche market for a small group. This can limit demand and adversely affect production. The feasibility of the scheme will depend, among others, on the willing-
ness of the intermediary to absorb a share of the premium. Because price premiums are mostly tagged to specific commodities (e.g. cocoa), economic diversification such as integrating other trees or high value non-timber forest products may not be feasible.

**Preferential sourcing**: A company can also provide an incentive for the adoption of biodiversity standards by sourcing cocoa only from communities that adhere to them (or from district where all communities have adopted the standards). Commitment on the part of the big companies is required to provide the incentive to implement them at whole district or regional level. This requires traceability.

**Access to credit and technical assistance**: Access to affordable credit for a community or group of farmers that meets certain standards, can provide a significant incentive for small farmers to adopt environmentally sustainable production methods. This requires monitoring of compliance with agreed standards in the community. Such a package should include technical assistance to enable farmers to pay back the loans.

5. **Passbook and tracking systems**

**Farmer passbook**

The Farmer Passbook was a tool to introduce checks and balances into the purchase of cocoa in the country and to prevent cheating of the farmers by the Purchasing Clerks. It was issued to all cocoa farmers to monitor cocoa sales by the farmer to the Purchasing Clerk of the Produce Buying Company (PBC), the acreage of the cocoa farm, and the performance of the farmer from year to year. The PBC also issued to its clerks a Ledger which contained the personal accounts of the farmers, to enable the Cocoa Marketing Board (CMB) to monitor and cross-check both the data recorded in the Farmer Passbook with the personal accounts kept by the Purchasing Clerk.

The Ledger contained the names of all the farmers, cocoa sales made by each farmer and the performance of the farmer over the years. This mechanism enabled CMB to detect any financial malpractice in the purchase of the cocoa and to forecast the total cocoa production each year for the country.

The acquisition of the Passbook involves a simple procedure. The farmer must be a known cocoa farmer in the district and must produce cocoa. He must also belong to a Society in a Cocoa District. As soon as the farmer sells his produce to the Marketing Clerk of the society he/she is registered and issued a Passbook and a Personal Account opened in the Society’s Ledger Book. The Passbook contains basic information such as the name, gender and date of birth of the farmer, his/her membership number and Society name. He/she authenticates the information in the Passbook by signature or thumbprint. The Passbook contains the following information on the sales record for both Major and Minor seasons: Date, Quantity, Unit Price, Total Sales, and Name of Purchasing Clerk (LBC).

In the past the Farmer Passbook had been used for i) payment of yearly bonus to the farmers based on the volume of cocoa sold; ii) purchase of cloth by the farmer from the Society at a discount; iii) application of scholarship from CMB for the farmer’s ward or children to Secondary School; and iv) facilitating a legacy to cocoa farmers’ children upon death. In the mid nineties the Passbook was used when the akuafu cheque system was introduced to pay cocoa farmers through Ghana Commercial Bank.

Now, with influx of LBCs into the system and the introduction of technologies into cocoa production, the Passbook is serving additional purposes such as a) a licence to buy agricultural inputs like fertilizers and pesticides, b) monitoring and evaluation of cocoa with respect to smuggling, and c) a monitoring tool to check any abuses and cheating of farmers by the various Purchasing Clerks of the LBCs.
In 1993, the government acceded to World Bank recommendations as part of the Cocoa Sector Reform to grant autonomy to PBC. The Board further introduced the participation of other private companies into the internal marketing of cocoa to compete with the PBC. A total of 29 Buying Companies were eventually licensed to purchase cocoa from farmers on behalf of the PBC. The Ledger and the Passbook concept were introduced to the LBCs but soon it was observed that the Passbook was abused by both the farmers and the LBCs. Some of the LBCs issued their own Passbooks to the farmers making cheating of the latter possible and PBC monitoring of cocoa sales extremely difficult. Other challenges were that some farmers operated more than one Passbook because of the location of their farms and the use of discounted fertilizers and insecticides for non-cocoa commodities.

**Alternative Use of the Farmer Passbook**

In view of the above challenges the PBC for the last three years had introduced new Passbooks with different colours for the different cocoa producing regions. The new Passbooks also have columns for all the recognised LBCs, to make it easier to monitor the LBCs and the smuggling of cocoa to neighbouring countries. It is suggested that the passbook could be reissued to collect other relevant sector information.

**Future use of the Passbook**

Continued passbook use appears to be assured. Currently the IUCN is proposing introduction of a Tree Passport to register all timber trees with the Forestry Commission so that those registered trees on farmers’ farms are outside the Commission’s authority. The Farmer Passbook can be adopted as a useful tool to monitor tree cultivation, carbon credit and other PES. Its replacement with an Identification Card may serve a limited use and may not eliminate the current challenges to passbook use. It is important that the farmers own systems in their communities be used to monitor the misuse of the Passbook for non cocoa activities.

6. **Risk Management: an emerging challenge**

Cocoa is the most significant crop harvested in Ghana. In 2006 it earned over US$ 900 million in exports, 28% of the country’s total export sales. Yet cocoa production is subject to significant risks. According to FAO data, the harvested area of cocoa peaked at 2.0 million ha in 2004. The area subsequently declined to 1.45 million ha in 2007 due to various factors including price swings, disease, and pests, before rising to 1.75 million ha in 2008. Ghana is also subject to other factors that could hinder development in cocoa. For instance, it is considered very vulnerable to climate change; mean daily temperatures are expected to rise by 1.1°C to 6.4 °C by the end of the 21st century (IPCC 2007), with increasing seasonal and spatial variation, resulting in a higher frequency and intensity of droughts and floods, some of which may have major consequences for cocoa producers.

The factors contributing to the recent decline in cocoa production noted above are not unusual circumstances and may be expected to re-occur over time. These difficulties are likely to be compounded by the gradual effects of climate change. The need to formulate risk management plans at the farmer, business and government levels is evident if the impact of such events is to be mitigated. Many of the risks or problems in cocoa production can best be addressed at the farmer level, assuming that appropriate training in up-to-date farm management practices is made available to improve skills. For instance, yield per hectare can be improved by selecting the most appropriate seedlings and applying best husbandry practices. Many common pests and diseases can also be controlled at the farm level. However, without adequate training, many small-holders would be unaware of how to handle the various tasks involved.

On the other hand, major outbreaks of diseases such as cocoa swollen shoot virus disease (CSSVD) and outbreaks of pests such as capsids may be beyond the ability of many smallholders to cope with. Other
disasters, such as fire, flood and drought also fall into this latter category. These major issues will require a higher level of resources and risk management policies if their impact on local economies is to be minimized. Risk management is therefore not just the responsibility of the farmers but of all concerned stakeholders including businesses reliant on cocoa production (that suffer if crop quality or quantity is diminished) and government agencies that are affected, such as COCOBOD (responsible among other things for providing farmers with compensation in the event of major outbreaks of CSSVD).

Many of the risks, such as spread of pests and some types of disease, can be minimized by effective strategic planning and timely preventative intervention. Other risks such as drought, excessive rains, and fire are unpredictable and may require alternate approaches to risk management planning.

The IIPACC project is currently investigating the feasibility of introducing crop insurance in Ghana; farmers attending discussion group meetings have expressed a strong demand for it. According to IIPACC, the main demand is for cover against climatic risks—drought, excess rain, floods—while some farmers also indicated a need for protection against losses as a result of bush fire and crop pests and diseases. COCOBOD has also expressed interest in learning whether it is possible to purchase an aggregate excess of loss insurance programme to protect against catastrophic CSSVD losses which exceed the CSSVD compensation budget.

Part III: Constraints to the Development of Sustainable Cocoa

A. Barriers to the establishment of an environmentally sustainable cocoa sector

Barrier 1: Policy, regulatory and institutional frameworks support environmentally unsustainable cocoa production.

Ghana’s policy, regulatory and institutional environment presents several unfavourable conditions for environmental sustainability and biodiversity conservation in cocoa landscapes. These include

⇒ Economic pressures that reward growers who produce early and intensify production using hybrid cocoa in low- or no-shade conditions, and discourage taking a more sustainable approach.

⇒ Insecurity of land and tree tenure and inheritance discourages investment in soil maintenance, shade trees, and other long-term improvements that foster sustainability.
    o Unfavourable (inefficient, non-transparent, multiple) land and tree tenure systems serve as a disincentive to long-term investments in shade cocoa and other sustainable best practices.
    o Lack of harmonization of co-existing statutory and customary land tenure laws affects compliance, transaction costs, and long-term investments in sustainable land management.

⇒ Weak integration of land degradation and sustainable land management elements into key development and sector policies, strategies and action plans. Implementation of land management policies is weak due to the absence of action plans, implementation mechanisms and funding.

⇒ Lax environmental law enforcement and compliance, due in part to weak capacity and inadequate resources, permits illegal logging, brushfires, mining, and others to undermine sustainability.
**Root causes:** This barrier is based on underlying “business as usual” economic pressures that drive intensification of cocoa cultivation, with concomitant externalization of costs like soil fertility maintenance and environmental degradation (e.g., erosion of biodiversity and soils, water pollution). As the cocoa sector is forced to internalize these costs, sustainable ecosystem management will become a more viable option.

Root causes also include the uncertainty of land and tree tenure resulting from the gaps between a patchwork of customary and statutory tenure systems and the rapidly evolving social milieu. This favours a short-term horizon in land management decisions such as preference for the short-run benefits of no-shade cocoa production.

**Barrier 2: Lack of knowledge, information, and capacity building at local and farm levels.**

The current prevalence of unsustainable farming practices in the cocoa growing areas amply demonstrate a shift from the sustainable practice of shaded cocoa which characterized the early cocoa production in Ghana. Though farmers are often endowed with indigenous knowledge of resource conservation, they face challenges associated with resource restrictions from land-use change, population growth and migration, and a lack of incentives to adapt and adequately apply the knowledge.

- Traditional economic dependence by farmers on forest rent (soil fertility from natural forests), now without enough land or time to allow fertility to re-build naturally during fallows, leads in effect to mining the natural forest environment. But to do otherwise would be economically non-competitive.
  - Pressure on land (e.g., from change to non-agricultural uses, population growth, and immigration) limits use of intact forests to start new cocoa farms and let old ones cycle back into forest.
  - Low mean productivity of cocoa in Ghana (400 kg/ha) requires more forest than otherwise.

- Lack of technical assistance, training, credit, and incentive programmes sufficient to overcome inertia, catalyze change.

- In the field, mainstreaming sustainable cocoa production is characterized by unsustained integration, ad-hoc piloting, and weak support for up-scaling.
  - Weak institutional structure and manpower expertise to deal with environmental best practices in cocoa landscapes especially at the district and community levels.
  - Externalyzed environmental costs absorbed by farmers, public sector; not passed to industry.

- Weak research programmes and little integration of proven results into sector activities.
  - Integrated cocoa farm management not effectively supported
  - Carbon sequestration PES schemes not effectively pursued

**Root causes:** No effective policies have been established to help farmers deal with impacts of forest resource depletion, population growth, and immigration on cocoa sector. Many farmers lack knowledge of sustainable cocoa farming and of the benefits potentially available from carbon sequestration and by adopting environmental best practices. They are unaware of the impact and costs of land degradation and
its link to poverty and climate change. They lack adequate baseline information and systematic benchmarks for assessing the rate, extent and impact of deforestation in the cocoa growing areas as well as to monitor the progress and efficacy of interventions to address the problem. Technical assistance and training programmes are scarce; there is limited access to information on the technical, social and economic requirements of environmentally sustainable practices. The scant research done concentrates on technical issues at the expense of socio-economic factors that influence the adoption of environmental best practices. Institutions and programmes to apply research findings and scale up sustainable land management are weak.

Farmers are mostly unaware of available incentive mechanisms such as those related to use of alternative income-generating crops, payment for ecosystem services (PES), and others. Extension service in the area of sustainable cocoa production has been weak in capacity, content, and accessibility to farmers. There is a lack of training of “champion farmers” for extension activities and farmer to farmer extension. It should be mentioned that currently Cocoa Extension services have picked up and efforts are being made to improve information flow and farmers’ education. Inadequate access to credit constrains farmers from providing and/or sustaining the upfront costs associated with the adoption of best practices. This involves high interest rates, no collateral to secure loans, poor repayment and high risk to the bank, lack of innovative banking products to address farm credit needs, and the capacity of farmers to manage loans for intended uses. Targeted incentives to support environmental best practices in cocoa production are also lacking.

**Barrier 3: Inadequate access to markets for tree products**

Farmers have limited access to markets for tree products and therefore have little incentive or interest in integrating and maintaining non-cocoa and non-timber forest products (NTFP) on their farms. VSO which is one of the CCP partners is currently working with some cocoa farmers to improve market access for supported products and enterprises. This entails working with small scale cocoa farmers through partner/intermediary organizations at the production level by building their technical and managerial competencies to meet market needs. A number of NTFP will be supported to realize the full potential of income generation for the farmers.

**Root causes:** Poor access to markets for both forest and NTFP goods is a disincentive for farmers to engage in tree planting. Farmers also generally lack capital to invest in planting and tending trees. Pre-financing of those activities and guaranteed markets for the final product by companies (such as practiced by SAMATEX) motivates farmers to plant and maintain timber and other trees.

Farmers also lack current knowledge in the propagation and agronomy of most trees and NTFPs, as well as access to improved planting stock. The economics of integrating non-cocoa and NTFPs in cocoa agro-forestry have not been well studied. Traditional research has concentrated more on the cocoa plant without due consideration for the non-cocoa intercrops. The Cocoa Research Institute of Ghana (CRIG) has currently directed its research attention to this area using various fruit trees and other NTFP intercrops in cocoa.

**Barrier 4: Limited creation of incentives in international markets for adopting environmentally friendly cocoa practices nationwide.**

Since adoption of environmentally sustainable production practices by cocoa farmers will involve changes in land use practices, and in some cases additional costs, appropriate incentives will be necessary for
this to happen on a large scale. International cocoa trading, processing and manufacturing companies could provide market-driven incentives for this via preferential market access or other benefits linked to the adoption of certification schemes that promote social and environmental production standards by communities. Current certification programs are far too small in scale to achieve nationwide change in Ghana.

**Root causes:**

International trade in cocoa has historically been dominated by a small number of companies that have, until recently, endeavoured to minimize production costs regardless of the impact on primary producers or the environment. This scenario is changing as companies heed an ever increasing consumer demand for fair trading and environmentally sustainable practices. While some companies have made significant changes in corporate policies to actively foster environmentally friendly productions, others have shown little interest in insisting on an environmentally friendly cocoa supply. This lack of interest is partially driven by a current lack of strong consumer demand for sustainably produced goods. Many companies in the cocoa industry also appear to remain unaware of the environmental and long term business risks imposed by continuing the use of unsustainable practices. Cocoa producing countries therefore need to work closely with companies in the cocoa industry to work towards a common goal – reduced environmental impact costs and a fully sustainable cocoa industry.

**B. Internal Threats**

**Internal Threat 1: Deforestation and habitat conversion**

The forests of Ghana, especially in the southwestern part of the country, are a host to a wide range of wildlife species (MEST, 1999). Several globally threatened, rare and endemic plant and animal species are harboured in these forests. These species are dependent on the forest and therefore their habitat and prospects for survival decrease rapidly as the forest cover declines through deforestation. The natural forest cover also creates the micro- and meso-climate favourable for the survival of the diverse floral and faunal species. Human disturbances on forested ecosystems therefore pose a serious threat to local biodiversity, which in turn affects economic potential from tourism and loss of NTFS and forces the country to assume the long-term costs associated with the loss of watersheds, soil nutrients and controlling disease outbreaks within cocoa landscapes.

Deforestation and forest degradation also reduce availability of fertile soils, natural shade, and other conditions for the continued sustainable exploitation of cocoa itself.

**Root causes** - In Ghana deforestation has been attributed to human activities such as agriculture expansion, mining and timber extraction. The deforestation rate in the country is about 2% per annum and it is projected that the expansion of agriculture will proceed at a rate of 2.5% annually for the production of tree and food crops like cocoa and maize (MoFA, 1991). Because agricultural activities diminish biodiversity by displacing or replacing natural environments, there is a great need to balance the economically driven agricultural expansion with strategies for conserving natural resources and maintaining ecosystem integrity and species viability.

Ghana’s cocoa growing areas are undergoing major deforestation through progressive conversion of forest into cocoa fields. The desire to expand cocoa farms for more outputs and economic benefits both for the farmer and the country’s cocoa supply all result in deforestation. However, cocoa cultivation that maintains higher proportions of shade trees in a diverse structure maintains some of the biodiversity-conserving attributes of the closed forest. The problem is that current cocoa production is progressively
shifting to no-shade practices (Gockowski et al. 2004) that tend to impact adversely on the habitats of diverse species.

**Internal Threat 2: Conversion of sustainable cocoa to unsustainable intensified production systems**

Cocoa cultivation that maintains greater shade regimes (cocoa agroforestry), as was the case in the pioneer growing areas in the Eastern Region, is increasingly being considered as an environmentally sustainable land use practice that complements the conservation of biodiversity (Duguma et al. 1998; Rice and Greenberg 2000). But the introduction of hybrid cocoa with its need for high inputs of fertilizers, pesticides and fungicides, and its low-to-no-shade cultivation methods has left an unsustainable cocoa production system in its wake. This system is masked by the short-term yield-increasing benefit of the fertilizers or by the inherent fertility built up under the forest, at the expense of the greater longevity of cocoa trees and steady long-term, respectable yields under shaded cocoa.

**Root cause** – In a policy context where costs of environmental degradation and unsustainable production systems can be easily externalized, the introduction of the high yielding cocoa hybrids and low-to-no-shade recommendation for optimum growth and yield has encouraged expansion of the area under no-shade (28%) and low shade (42%) (Gockowski et al., 2004). This has led to deforestation with adverse impacts on soil health, micro- and meso-climate for sustained cocoa production and biodiversity. Even without fertilizers, most farmers perceive low shade cocoa as more profitable. This is due to the near absolute dependence of the growth of the crop on the soil fertility built under the forest (forest rent) which though depletive in the long-term sustains crop yield in the short-term.

**Internal Threat 3: Unsustainable land management practices and resource use**

The retention and decomposition of most of the biomass on the soil during thinning of the forest to plant cocoa contributes to enhanced soil fertility through nutrient release, soil structure stability from organic matter additions, provision of mulch to reduce losses of soil and water through erosion particularly during the establishment phase and improved water infiltration and retention in the soil.

This sustainable land management system, locally referred to as “Proka” (a land management practice whereby the vegetation cleared in the course of land preparation for farming is left in place without burning and allowed to decompose in-situ to add organic matter and nutrients to the soil for the benefit of the crops) (Quansah and Oduro, 2004), characterized the pioneer cultivation of cocoa in Ghana. The current use of fire to burn the cleared biomass deprives farmers of the above benefits. The near abandonment of the “Proka” system accounts, in part, for the widespread land degradation in the cocoa growing areas.

**Root cause** - The use of fire is more convenient for farmers in dealing with the heavy biomass produced after forest clearance for cocoa production. The intercropping of the no-shade compatible food crops (maize) in cocoa farms has led to near total clearance of the forest and clean land preparation for easy planting and weed control. The perception and preference for no-shade cocoa production complements this form of land preparation.

**C. External Threat**

**External Threat 1: Climate change**
Most farmers perceive climate change in terms of changes in rainfall pattern and temperature. Projected rainfall for the semi-deciduous (SDFZ) and high rainforest zones (HRFZ) of Ghana indicates a decline in rainfall by -2, -10.9 and 18.6% in the year 2020, 2050 and 2080 respectively in the SDFZ and -3.1, -12.1 and -20.2% in the HRFZ (Anim-Kwapong and Frimpong, 2008). The predicted drop in the yield of dry cocoa beans is 14% and 28% for 2020 and 2050 respectively. In 2080, moisture is predicted to be inadequate for profitable cocoa production in Ghana if the current trend is maintained. Mean annual temperature in the SDFZ will rise by 0.8, 2.5 and 5.4°C by 2020, 2050 and 2080 respectively and by 0.6, 2.0 and 3.9°C in the HRFZ.

**Root causes** - Land cover changes especially deforestation, is among the root causes of regional climate change. At the local scale, the massive deforestation of the forest to establish cocoa farms as well as other agricultural land uses adversely affect the moist micro- and meso-climate characteristically associated with the natural dense forest.

These barriers need to be addressed to facilitate the promotion and implementation of best practices for environmentally sustainable and biodiversity friendly cocoa production. To achieve this goal, constraining barriers should be identified and the requisite strategies developed to deal with them.

**Part IV. Guide to environmentally sound production practices**

Appendix 1 provides an elaboration of environmentally sound practices for cocoa that can be included within the national best practices training curriculum. It is critical that specific best practices be strengthened to address the underlying environmental benefits for each of the areas. It must be stressed that the environment best practices described are not intended to be a standalone curriculum; rather this information should be used to support and strengthen the relevant sections of the existing cocoa manual. They are intended to be used as a reference to assist with the adoption of environmental best practice.

When working towards improved environmental performance, it is important to gain an understanding of the distinct environmental issues in each region. For instance, cocoa producers in the western region of Ghana are concerned about forest encroachment as a major threat to conservation in that region. However, in the central and eastern regions issues are more aligned with farm rehabilitation and reducing the conversion rate to other crops that have little to no biodiversity benefits and can lead to more extensive environmental damage. An Environmental Curriculum Stakeholder meeting analyzed these and related issues, as summarized in Appendix 6; past and current technical assistance projects in the cocoa sector are listed in Appendix 8; and a listing of stakeholders relevant to the promotion of environmentally sound cocoa production is found in Appendix 9.
## Appendix Section

**Appendix 1: Environmentally Sound Practices for Cocoa Farming**

### Environmentally Sound Approaches to Cocoa Production

<table>
<thead>
<tr>
<th>Environmental practice</th>
<th>Direct and Indirect Environmental and Farmer Benefits</th>
<th>Considerations and Research Options</th>
</tr>
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<tbody>
<tr>
<td>Implement a landscape approach</td>
<td><strong>Environmental objective</strong>&lt;br&gt;Determine a continuum in the roles of naturally regenerating forests and planted forests to have protection as well as productive functions. The landscape should provide economic, environmental, social and cultural services within a landscape or watershed, both spatially and temporally;</td>
<td><strong>CONSIDERATIONS</strong>&lt;br&gt;<strong>Stability</strong> – Ability to retain key defining features while adapting to changing environmental, social and economic conditions&lt;br&gt;<strong>Functional flexibility</strong> – Ability to respond to varying livelihood needs, demands and changing priorities and values&lt;br&gt;<strong>Ecosystem integrity</strong> – Ability to protect biodiversity and nature&lt;br&gt;- Educating local communities and the public through outreach programmes, so they better understand the interrelationships in the management of planted forests, naturally regenerating forests, lands destined for conservation, grasslands, croplands and other land uses;&lt;br&gt;- Locating roads and stream crossings and selecting maintenance programmes appropriate to the landscape (social, cultural, environmental and economic);</td>
</tr>
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<td></td>
<td><strong>Environmental Benefit</strong>&lt;br&gt;- Targets overall ecosystem function;&lt;br&gt;- Encourages connectivity of Agroforestry /forest patches (3) Reduces negative effects on soil- and water-conservation and visual impacts of harvesting and other forest operations;&lt;br&gt;- Designating and managing landscapes have a significant scientific and cultural value, within which planted forest management will be restricted</td>
<td><strong>RESEARCH OPTIONS</strong>&lt;br&gt;Ensure the adaptive management of the landscape by;&lt;br&gt;- Develop a participatory vision for the rational use of resources on the broad landscape;&lt;br&gt;- Develop tools, processes and institutions for the realisation of the vision and strategy.</td>
</tr>
<tr>
<td></td>
<td><strong>Farmer benefits</strong>&lt;br&gt;- Improved economic and market valuation to better recognize the full range of goods</td>
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| Avoid deforestation | **Environmental objective**  
To halt further deforestation of critical ecosystems and habitats to maintain and conserve biodiversity and the ecosystem goods and services provided.  
**Environmental Benefit**  
- Are critical for the protection of biodiversity  
**Farmers benefit**  
- Provide and maintain the overall biodiversity to maintain ecosystem goods and services;  
- Provision of watershed that allow a steady rate of water flow from river, creeks and streams;  
- Positive effects on assisting the atmospheric requirements for the creation of precipitation for crop development;  
- Harbors pollinators/vectors  
- harbors beneficial insects for crop protection;  
- Firewood collection needs;  
- Medicinal plant uses and the collection of other NTFP. | **Are the Policies, Legislations and institutional settings in place to promote a landscape approach? Need to consider:**  
- Provide stable and transparent investment, land-use and land management policies, laws, procedures;  
**The value of the forest landscape is restored**  
- Determine the functional ecological processes of the landscape;  
- Factors that will assist the restoration of the genetic variation of the landscape. |

**CONSIDERATIONS**  
- Policy to protect forest from excessive unsustainable harvests;  
- Encroachment onto forest reserves;  
- Enforcement of policy to protect forest;  
- Land tenure issues  
- Awareness and education on environmental services forest offer;  
- Species requirements i.e. some species need intact forest and other can live within fragmented and disturbed landscapes (opportunistic species);  
- Size of protected area and the need for corridors that connect landscapes.  

**RESEARCH OPTIONS**  
- Promote the use of REDD as a tool for conserving forest stands using a community resource environmental management action plan – i.e. cocoa specific sourcing/purchase policy does not address other drivers of deforestation, thus community approaches work best for deforestation concerns;  
- Establishment of well defined and maintained buffer zones around protected areas;  
- The promotion of production systems that satisfy household income requirements – agroforestry with mixed cropping, and peren-
| Establishment biological corridors | Environmental objective | CONSIDERATIONS  
Environmental objective  
Establish forested corridors to provide transportation functions for fauna and seed dispersal for flora. Corridors are used to connect naturally regenerating forest areas with high environmental conservation value and fragmented forest patches.  
Environmental benefit  
Helps to maintain species mobility and promote???
Farmer benefit | -Landscape connectivity;  
-Species mobility;  
-Important for restoring natural habitats that have been fragmented by natural and human induced pressure;  
RESEARCH OPTIONS  
-Land use planning tools are needed to map out current corridors and where further corridors are needed; |
| Establish buffer zones | Environmental objective | CONSIDERATIONS  
Environmental objective  
To improve natural filtration, protecting waterways from excessive sedimentation, polluted surface runoff, erosion and supply shelter and food for wildlife.  
Environmental benefit  
-Reduces water runoff and improves infiltration of water into the soil and assists with water conservation;  
-Reduces nutrient loss in runoff;  
-Assists in soil stabilization via plant root systems;  
-Reduces sheet and gully erosion and maintenance of watersheds;  
-Cocoa Agroforestry system near forest typically host high biodiversity through epiphytic plants, mosses, lichen, insects etc;  
-Assists in the protection of natural gene banks and gene | Zoning strategy: Organic cultivation  
-It would be environmentally and economically beneficial for farmers in potential buffer zone locations to undertake organic methods of production. The government zoning or support in the creation of buffer areas for environmentally friendly production practices would significantly assist in the protection of forest reserves reducing the impact of agro-chemicals on biodiversity i.e. runoff, drift etc. In addition to this, sediment load of runoff into waterways would be minimized.  
RESEARCH OPTIONS  
-Determine the most appropriate financial incentives for establishing and maintaining buffer zones i.e. REDD, different production schemes (organic);  
-Tree species composition of buffer zones |
<table>
<thead>
<tr>
<th>Establish barrier crops</th>
<th>Environmental objective</th>
<th>CONSIDERATIONS</th>
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<tbody>
<tr>
<td></td>
<td>To establish clearly defined strips at the edge of the field, between the crop and the farmer’s boundary. The barrier crop can provide habitats for wildlife and farmers environmental objectives.</td>
<td>- Farm size may be prohibitive to establish barrier crop/trees since;</td>
</tr>
<tr>
<td></td>
<td>Environmental benefits</td>
<td>- Shading effects on adjacent farms may lead to disputes.</td>
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<td></td>
<td>☑️ Reduce agrochemicals from reaching waterways; ☑️ Reduce erosion; ☑️ Provides additional habitats for bird species and predatory beneficial insects; - Can assist in habitat connectivity and species resilience to climate change i.e. linking fragmented forest patches - Improves carbon retention</td>
<td>- Determine the most appropriate species for the creation of barrier crops/farm boundaries i.e. for crop protection and biodiversity gains enhancement on farms;</td>
</tr>
<tr>
<td></td>
<td>Farmer benefits</td>
<td>- Develop financial support/incentives to offset any costs/losses incurred from establishing and maintenance barrier crops i.e. Insurance premiums would be reduced if farmers actively plant barrier crops to protect against CSSV transmission.</td>
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<td></td>
<td>- Protects cocoa farms from the transmission of cocoa swollen shoot virus i.e. movement of mealy bugs from farm to farm; - Can act as a barrier for chemical spray drift – dependent on width of barrier crop; - Can reduce the spread and infestation of weeds from adjacent areas.</td>
<td></td>
</tr>
<tr>
<td>Intensive cultivation</td>
<td>Environmental objective</td>
<td>CONSIDERATIONS</td>
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</tr>
<tr>
<td></td>
<td>To reduce the amount of land required to achieve national and farmer yield targets so land can be set aside for forest regeneration</td>
<td>- Farm needs a strict business approach to be successful;</td>
</tr>
<tr>
<td></td>
<td>Environmental Benefit</td>
<td>- Many environmental risks while practicing intensive cultivation including - Soil erosion, agrochemical runoff, loss of soil carbon and organic matter, Soil acidification on already acidic soils &gt;4.5 pH, high pest and disease infestation;</td>
</tr>
<tr>
<td></td>
<td>- By using fertiliser poor quality soils can support cocoa;</td>
<td>- Intensification production systems can be used to promote land sparing; however land sparing is not always practised and is dependent on commodity price triggers;</td>
</tr>
<tr>
<td></td>
<td>- Better yield per unit land area reducing the need for extra land – land sparing;</td>
<td>- Intensive systems have high usage of fertilisers, pesticides and herbicides;</td>
</tr>
<tr>
<td></td>
<td>- Land sparing can conserve more species richness.</td>
<td>- It is difficult to replenish depleted soils following long term intensive crop production;</td>
</tr>
<tr>
<td></td>
<td>Farmer benefit</td>
<td>- Deteriorates soil structure;</td>
</tr>
<tr>
<td></td>
<td>- Improved yields and potential revenues from cocoa as a monoculture;</td>
<td>- Is usually susceptible to high pest pressure – mealy bug, capsid, and stem borer because of plant stress.</td>
</tr>
<tr>
<td></td>
<td>- Maximizes land area</td>
<td><strong>RESEARCH OPTIONS</strong></td>
</tr>
</tbody>
</table>

- The cost of inputs and the ability of farmers to receive the appropriate amount of credit to effectively carryout this approach; 
- Need to determine the cost benefit analysis compared to low input extensive Agroforestry systems i.e. can a sustainability premium be paid to extensive and not intensive farms if using land set asides? 
- Needs appropriate support by sourcing/production policies at both the government and private sector level; 
- Needs adequate land use planning tools to promote landscape connectivity.
<table>
<thead>
<tr>
<th>Extensive cultivation</th>
<th>Environmental objective</th>
<th>CONSIDERATIONS</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Promote the reforestation of cocoa landscapes in Ghana by encouraging the adoption of Agroforestry system that improves and enhances ecosystem goods and services and reduces farmer’s revenue dependency on cocoa cultivation through crop diversification.</td>
<td>- More land area required for equivalent yields in intensified settings; dependent on fertilisers; - Competitive markets drive fertiliser sales – interest on the sales of inputs and intensified settings rather than agroforestry systems with the exception of organic fertilisers; - More affordable fertilisers can significantly assist with cocoa rehabilitation during the initial years – it is important for farmers that have planted new seedlings or grafted material to encourage vegetative growth in the form of leaf area to reduce time to fruit maturity; - Intensified systems can experience high pod loss from pest and diseases.</td>
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<tr>
<td></td>
<td>Environmental benefit</td>
<td>RESEARCH OPTIONS</td>
</tr>
<tr>
<td></td>
<td>- Composition and density of Agroforestry systems are critical elements of maintaining high conservation value; - Better nutrient recycling; Agroforestry systems contain higher species richness.</td>
<td>- Need to better understand tree species and tree combinations that promote on-farm species richness; - The start up costs of differing extensive systems i.e. using various alternative complimentary crops; - How to best use Payments for Environmental Services (PES) to encourage the adoption of Agroforestry systems – what are the most appropriate tools?</td>
</tr>
<tr>
<td></td>
<td>Farmer benefit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Can sustain ecosystem goods and services; - Less capital required; - Protects against commodity price shocks while using diverse Agroforestry crops; - Requires less labor management than intensive systems</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Alternative crops for diversified agroforestry systems for improved rural income</th>
<th>Environmental objective</th>
<th>CONSIDERATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Most extensive systems with limited crop inputs and management are not economically viable due to low producer prices; it is not until cocoa sales are complemented by the revenues from alternative crops that farmers start to earn profits. There are many types of alternative crops used across West Africa including fruit tree species such as orange, African plum, mango, avocado, guava, coconut, oil palm etc, medicinal species,</td>
<td>- Tenure issues; - Road network;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Reduce market vulnerability from low prices of one specific crop, crop loss from pest and disease infestation; - Distant from market a determinant of species chosen;</td>
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<tr>
<td></td>
<td></td>
<td>- Farmer need to be aware of basic plant requirements and the difficulty of maintaining appropriate levels, the cost of replenishing nutrients (fertilisers) and how well managed agroforestry systems can</td>
</tr>
<tr>
<td>Encourage Agroforestry in dry transition zone</td>
<td>Environmental objective</td>
<td>CONSIDERATIONS</td>
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</tr>
<tr>
<td>To reduce a further decline in precipitation through Ghanaian cocoa landscapes and the expansion of the dry transition zone in the northern edges of Western, BF and Ashanti cocoa growth regions.</td>
<td>Environmental benefit</td>
<td>Zoning strategy: Agroforestry in dry transition zone</td>
</tr>
<tr>
<td>Cocoa farmers in the dry transition zone need to be encouraged to undertake Agroforestry practices to minimize drought related impacts and the progression of the dry zone; The decline in precipitation with elevation is unusual in the presence of offshore winds but given Ghana’s relatively low topogra-</td>
<td></td>
<td>- The decline in precipitation with elevation is unusual in the presence of offshore winds but given Ghana’s relatively low topogra-</td>
</tr>
</tbody>
</table>
-May improve the extent of rainfall; -Reduces and further enhances the creation of forest habitats; Improve available habitats for wildlife;

**Farmer benefit**
-Improve unit area yield; -Reduce the loss of family land to long term drought


<table>
<thead>
<tr>
<th>Avoid land conversion to crops with little conservation value</th>
<th>Environmental objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce the transformation of cocoa farms to crops that do not particularly cater for environmentally friendly cropping practices i.e. heavy use of agrochemicals, and do not present a case for the creation of additional wildlife habitats i.e. not grown under the shade of forest trees.</td>
<td></td>
</tr>
<tr>
<td>Considering cocoa is the dominant crop within the landscape there is good opportunity to bridge forested landscapes while increasing the production of other desired crops.</td>
<td></td>
</tr>
<tr>
<td>Farmer benefit</td>
<td></td>
</tr>
</tbody>
</table>

**CONSIDERATIONS**
-Needs to align with existing government initiatives and production goals for various commodities – for instance Palm Oil production has been driven by the President’s Special Initiative.

**RESEARCH OPTIONS**
-Assess the economic drivers for crop conversion;
-Determine the most appropriate tools to use that will minimize the rate of crop conversion;

| Shade establishment | Environmental objective  
To encourage farmers to plant a diverse array of shade tree species within their farms to provide both temporary and long term shade and later environmental benefits that are provided by Agroforestry systems.  
Environmental benefit  
-Nitrogen fixing leguminous trees can assist in fixing nitrogen in the soil but not to a large extent, trees with high leaf fall rather add significantly to total organic biomass in soils from decomposition.  
Farmer benefit  
-Protects young cocoa plants from excessive solar radiation;  
-Suppresses the growth of weeds – reducing the need for herbicides;  
-lower nutrient demand of seedlings – particularly nitrogen.  
CONSIDERATIONS  
-Shade tree selection influenced by farmer preference, and information obtained from researchers/extension offers/radio education;  
-It is recommended to use fruit crops as temporary shade – however farmers must note that plantains which are commonly used for temporary shade are heavy feeders of potassium and this could deplete soils of this critical nutrient especially if potassium is already limiting.  
RESEARCH OPTIONS  
-Architecture of crown, self pruning branches (damage cocoa) needs to be investigated prior to recommendations  
-Situational analysis of the status of shade, tree species, relationships and impacts in cocoa agro-forests. |  
Maintaining shade trees | Environmental objective  
To maintain a diverse selection of indigenous and fruit forest tree species  
Environmental benefits  
-Biodiversity conservation and improvement in species richness;  
-Can support high species richness;  
-Multi-strata cocoa Agroforestry best for conserving  
CONSIDERATIONS  
-Manage canopy cover;  
-Shade amount, shade type, shade characteristic during different seasons differ -Shade strata’s;  
-Management needs of shade trees - pruning and labor needs;  
-Dense shade encourage fungal pathogens;  
-Tree types for biodiversity consideration;  
-Shade tree competitiveness on cocoa – nutrients and water;  
-Regional allelopathic conditions for different tree species and se- |
biodiversity
- Provide habitat linkages (corridors and connectivity between remnant patches through Agroforestry systems);
- Increases soil organic matter;
- Improved soil porosity, drainage, nutrient release and overall soil fertility by encouraging microorganisms activity;
- Improved soil pH, cation exchange and nutrient recycling;
- Improves water holding capacity minimizes flooding events;
- Reduces the likelihood of fire damage;
- Reduced erosion;
- Improved carbon storage by soil and tree sequestration i.e. PES;
- Can lead to improved rainfall – economies of scale (landscape);

Farmer benefits
- The overall maintenance of ecosystem goods and services vital for the continued sustainability of cocoa farming landscapes through the provision of soil nutrient, water resources and climatic parameters that support growth and production;
- Additional income from natural resources offered by overhead shade in the form of timber, fruit, medicinal and non timber forest products;
- Selected annuals i.e. cassava;
- Lower production compared to full sun;
- Tree tenure issue;
- Do not recommend the removal of any tree species, as different species offer difference environmental benefits and cultural significance;
- Felling of shade trees should be timed with the rehabilitation/replacement of cocoa plants if possible.

RESEARCH OPTIONS
- Leaf Area Index of different species, and species composition – coverage of crown and density of leaves;
- Quality of forest ecosystems reduced when converted to Agroforestry situation – indicators are reduced biomass – tree height, girth, etc;
- Need to determine what is best combination of timber trees, fruit trees, cocoa and herbaceous understory species to adequately maintain ecosystem goods and services;
- Need to understand species composition;
- Patch size dynamics;
- Conduct rapid biological surveys of species that live on shade trees for biodiversity benefit value;
- Understanding of cost benefit sharing agreement for felled timber.

---

2 Leaf Area Index (LAI) is the ratio of total upper leaf surface of vegetation divided by the surface area of the land on which the vegetation grows
<table>
<thead>
<tr>
<th>Create watersheds and micro water catchments</th>
<th>Environmental objective</th>
<th>CONSIDERATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Promotes the adoption of agroforestry configurations that can provide opportunities to combine environmental services with productive and profitable crops. These options may reduce the risks and survival of smaller-scale farms with a greater diversity of production, markets and expansion of agricultural areas.</td>
<td>- Dependent on the number of farmers practicing agroforestry systems to influence the overall hydrological benefit; - Many people along the supply chain benefit from watersheds, not only producers but end users of water further downstream; - Encourage organic certification around critical watersheds i.e. large buffer zones; - Provide policy makers with comprehensive information to drive factual decisions making processes.</td>
</tr>
<tr>
<td></td>
<td>Environmental benefit</td>
<td>RESEARCH OPTIONS</td>
</tr>
<tr>
<td></td>
<td>- Climate stabilization; - Habitat for biodiversity conservation; - Supplies water requirements for agricultural, industrial, etc;</td>
<td>- Analyzing water system innovations; - Determine all on-farm water management practices and tech-</td>
</tr>
<tr>
<td>Soil management techniques</td>
<td>Environmental objective</td>
<td>Environmental benefit</td>
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<td></td>
<td>To rejuvenate soils that are able to drain well, have good drainage and infiltration properties, is able to resist erosion and nutrient loss, supports good populations of soil microorganisms and does not need high inputs of synthetic fertilisers for good crop yields.</td>
<td>- Intercropped species on farms assist with rebuilding soil fertility; - Organic cultivation has positive biodiversity benefits over extensive agriculture; - Organic fertiliser assists in the re-construction of organic layers and carbon storage;</td>
</tr>
</tbody>
</table>

**CONSIDERATIONS**
- Need to achieve optimal soil pH to allow uninterrupted nutrient uptake by cocoa and alternative crops;
- It is critical soil organic matter is managed to improve microorganisms. This is achieved by working to maintain favorable factors for soil development including adequate moisture, temperature, nutrients and aeration.
- Assess the use of nitrogen fixing creeping groundcover species – access to seeds for this cover crop may be limiting.
- Are the materials for creating compost bins readily available and cost effective

**RESEARCH OPTIONS**
- Research and provide advice to farmers on different types of composting methods that are dependent on farm location and access to organic materials i.e. how to construct composts with different organic layers, weeks required to produce a compost, amount required for a one hectare farm etc;
- Research needed on different ingredients used for creating com-
<table>
<thead>
<tr>
<th>Mulching</th>
<th>CONSIDERATIONS</th>
</tr>
</thead>
</table>
| Environmental objective  
Reduces the use of herbicides, helps moderate the soil temperature to encourage micro-organism activity protects soil from erosion, assists with breaking up clay and allowing better water and air movement through the soil.  
Environmental Benefit  
- Builds organic matter in the soil  
- Can provide plant nutrients  
- Improves soil structure stability  
Farmer benefit  
- Improves soil moisture and seedling survival at times of drought;  
- Promotes saprophytes that reduce pathogen concentrations;  
- Reduces weeds around seedling and labor required for weeding | - Need to investigate the use of termite inspection bins to avoid unnecessary spraying of pesticides;  
- Mulches must not be green so to avoid soil de-nitrification.                                                                                   |
| Cocoa rehabilitation                                                                                                                                  | CONSIDERATIONS                                                                                                                                  |
| Environmental objective  
To cost effectively bring old unproductive cocoa farms back into production to reduce the need for agricultural expansion into new forest areas.  | - Farm credit a major issue for rehabilitation;  
- Method of rehabilitation must firstly recognize soil type i.e. rocky degraded soils would not particularly cater to the complete removal |
<table>
<thead>
<tr>
<th>Environmental benefit</th>
<th>Farmer benefit</th>
</tr>
</thead>
</table>
| Successful rehabilitation of abandoned or old cocoa farmers will reduce pressure on remaining forests for clearing to establish new productive farms. | -New techniques allow farms to be transformed from unproductive to productive in 2 years;  
-Farmers have many models on how to rejuvenate farms of old cocoa and replanting green field;  
-Most appropriate way for rehabilitation while reducing inputs costs and period of limited income generation is to partly thin old cocoa canopies to encourage light penetration and use old trees as rootstock (if farm is not diseased) by budding and grafting improved material onto trunks. In light gaps shade trees should be planted (timber or fruit trees);  
-Abandoned farms can act as hosts for fungal spores and pest insects. |

**Cocoa Hybrid Variety**

<table>
<thead>
<tr>
<th>Environmental objective</th>
<th>Environmental benefit</th>
<th>Farmer benefit</th>
</tr>
</thead>
</table>
| Farmers that are able to access new high yielding fast maturing cocoa hybrid seeds/seedlings will require less land area to achieve equivalent yields compared to farmer selected material. This will reduce the requirement of land needs for production requirements. | -Can support the theory of land sparing – land set asides for forest  
-Ability to tolerate poorer quality soils;  
-Since hybrids are tolerant to some pest and diseases this reduces some of the requirement for chemical control; | -Higher yields – improved yield per unit area on small holder farms; |

**Considerations**

-Planting density – dependent on variety and planting material (cutting, seed, grafting, plagiotropic or orthotropic material);  
-On farm selections of planting material through the use of pod seeds is not a good way of selection because of high variability in seeds.

**Research Options**

-Establish a simple yield monitoring tool for typical farmers;  
-Determine the best planting densities for hybrid cocoa under different combinations of agroforestry settings.
| **Removal/replenishment of unproductive cocoa trees** | **Environmental objective**  
To improve revenue generation from cocoa and reduce the chances of crop conversion to other less environmentally friendly crops and the requirement for more land area to achieve greater yields.  
**Environmental benefit**  
- Encourages the maximum usage of landholding and theoretically reduces the need for farmers to expand production into forested areas, or areas that have been set-aside as forest remnants.  
**Farmer benefit**  
- Improves yield per unit land area by slowly improving yield per tree through using unproductive trees as rootstock and applying side graft techniques using known high yielding cuttings from trees on farm that are taken from plants that are 4-5 years old (if possible);  
- Side grafting technique of approximately 5% of cocoa trees per year when times are optimal i.e. during good physiological growth periods | **CONSIDERATIONS**  
- Need to ensure farmers have some understanding of plant breeding i.e. F1 and F2 hybrids;  
- Many farmers are illiterate and this needs to be taken into consideration prior to developing a monitoring system;  
- Grafting techniques need to be perfected prior to upgrading unproductive trees;  
- Access to basic grafting supplies i.e. tape etc;  
- Ensure farmers know the best approaches for encouraging chupon emergence that will be used for grafting material;  
- Farmers need to understand the difference between selecting grafting material above and below the jorcette.  
**RESEARCH OPTIONS**  
- A section in the national curriculum needs to be reserved to expand on the breed/training element. This is to ensure farmers are aware of the benefits of introducing new genetic material and the various methods for achieving this;  
- Develop a training module that allows farmers to develop their own on-farm plant performance monitoring system. This will typically record yield data (pods that develop through to maturity) using a simple assessment means while harvesting. Data will then be used by the farmer to select grafting material and replenish unproductive material. |
| **Pests and disease control through Integrated pest management (IPM)** | **Environmental objective**  
To improve the effectiveness and efficiency of using agrochemicals and encouraging the adoption of more | **CONSIDERATIONS**  
- Use approved and recommended agrochemicals  
- Strict observance of dosage, time of application and mode of appli- |
<table>
<thead>
<tr>
<th><strong>biodiversity and environmentally friendly pest and disease control within cocoa landscapes.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environmental benefits</strong></td>
</tr>
<tr>
<td>-Cultural control methods such as the burial of black pod infested husks reduces the need for fungicide applications;</td>
</tr>
<tr>
<td>-Using pheromone trapping instead of chemical to control various pest reduces the dependence on harsh environmentally unfriendly chemicals;</td>
</tr>
<tr>
<td>-Reduce the use of non-targeted chemicals (i.e. synthetic pyrethroids) that kill beneficial organisms.</td>
</tr>
<tr>
<td><strong>Farmer benefit</strong></td>
</tr>
<tr>
<td>Cost effective while use in conjunction with cultural methods – depending on family system and labor access.</td>
</tr>
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<table>
<thead>
<tr>
<th><strong>Farm safety</strong></th>
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<tbody>
<tr>
<td><strong>Environmental objective</strong></td>
</tr>
<tr>
<td>Observe best farm safety practice to provide a healthy environment for effective farm work and prevention of human health hazard and pollution</td>
</tr>
<tr>
<td><strong>Environmental benefit</strong></td>
</tr>
<tr>
<td>-Prevention of environmental pollution</td>
</tr>
<tr>
<td>-Reduced potential sites for mosquito breeding</td>
</tr>
<tr>
<td>-Clean air and water</td>
</tr>
<tr>
<td><strong>Farmer benefit</strong></td>
</tr>
<tr>
<td>-Sustained human health</td>
</tr>
<tr>
<td>-Clean air and water for human survival</td>
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<tr>
<td>-Facilitate certification and access to incentives such as</td>
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<table>
<thead>
<tr>
<th><strong>RESEARCH OPTIONS</strong></th>
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<tbody>
<tr>
<td>-Pheromone trapping of insect pests;</td>
</tr>
<tr>
<td>-Coordinated mass spraying programme through collaborative effort between crop research groups;</td>
</tr>
<tr>
<td>-Monitoring considerations by farmers to determine critical pest and disease levels.</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th><strong>CONSIDERATIONS</strong></th>
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<tbody>
<tr>
<td>-The items under the IPM section are applicable in addition to prevention of child labor.</td>
</tr>
<tr>
<td>-Prevent surface water pollution by providing buffer vegetation along on-farm streams and rivers and avoiding washing of spraying machines in on-farm streams and rivers.</td>
</tr>
<tr>
<td>Enterprise</td>
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<tr>
<td>------------</td>
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<tr>
<td>Appropriate application of synthetic fertilisers</td>
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<td>Weed control</td>
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<tr>
<td>Effective Pruning</td>
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<tr>
<td>Monitoring against introduced pests and disease</td>
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<tr>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>To monitor and stop the potential spread of foreign pest and diseases at a landscape level. In introduction of certain cocoa pests and diseases to West Africa would have a massive indirect affect</td>
</tr>
<tr>
<td>Environmental benefit</td>
</tr>
<tr>
<td>-Halting the spread of an introduced pest or disease would reduce the chances of incurring significant losses</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Effective pruning opens up the canopy reduces plant height and thereby allowing for more effective spraying of pesticides and fungicides to reduce over spraying and resultant chemical runoff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental benefit</td>
</tr>
<tr>
<td>-Reduces the amount of chemicals needed to control pest and disease outbreaks</td>
</tr>
<tr>
<td>-Improves annuals yields and reduces the chance of farm expansion</td>
</tr>
<tr>
<td>-Foliage from regular pruning events can be used in composts</td>
</tr>
<tr>
<td>Farmer benefit</td>
</tr>
<tr>
<td>-Improves aeration around canopy and therefore reduces the promotion of fungal and pest infections – reducing the need for possible chemical sprays;</td>
</tr>
<tr>
<td>-Improves photosynthetic active radiation (PAR) to lower and inner canopy leaves;</td>
</tr>
<tr>
<td>-Reduces unnecessary woody growth that respires resulting in losses of fixed carbon;</td>
</tr>
<tr>
<td>-Reduces plant height for ease of farm operations.</td>
</tr>
</tbody>
</table>

| Time of pruning – it is best to prune at the end of the main harvest period; |
| -Need to be careful not to removal excessive vegetative growth that is used to store fixed carbohydrates that will support the reproductive component i.e. pods; |

<table>
<thead>
<tr>
<th>CONSIDERATIONS</th>
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</thead>
<tbody>
<tr>
<td>Farmers will be trained to identify certain problematic pest and diseases to serve as an early warming response mechanisms for authorities to act. It is important any foreign introduction be quickly eradicated to stop the spread of foreign cocoa pest and diseases.</td>
</tr>
</tbody>
</table>

| RESEARCH OPTIONS |
to cocoa producing areas from cocoa tree death or pod loss. Farmers would need to turn to other sources of income i.e. forest resources, or convert cocoa farms to crops that are less environmentally friendly.

**Farmer benefit**
- Stop to potential spread of pest and diseases that would otherwise cause significant crop loss and loss of revenue.

<table>
<thead>
<tr>
<th>Indigenous Technologies and Knowledge</th>
<th>Environmental objective</th>
<th>CONSIDERATIONS</th>
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</thead>
<tbody>
<tr>
<td><strong>Indigenous Technologies and Knowledge</strong></td>
<td>Indigenous knowledge created within the community and knowledge gained from outside is a resource that needs to be harnessed. Local knowledge is operational and measurable and has specific environmental benefits.</td>
<td>It should reflect the capability and competence of the local community and put them on an equal footing with outsiders, and it is a resource needing little investment for realization.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Environmental benefits</strong></th>
<th>Tried and proven soil and water conservation methods from traditional cocoa farmers; Good understanding of season approaches to cultivation with environmental consideration i.e. when to plant seedlings etc.</th>
<th>RESEARCH OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Farmer benefits</strong></td>
<td>Knowledge may different from region to region and share indigenous knowledge may provide farmers with little capital and credit opportunities to improve production while adopting environmental principles</td>
<td>-Complete rapid rural assessment of traditional technologies;</td>
</tr>
</tbody>
</table>
## National and Sector Policies Impacting Directly or Indirectly on Environmental Sustainability

<table>
<thead>
<tr>
<th>Key area of focus</th>
<th>Issues</th>
<th>Policy</th>
<th>Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPONENTS OF NATIONAL POLICY – GPRS II</td>
<td><strong>I. Agriculture led-growth</strong>&lt;br&gt;(a) Modernized Agriculture&lt;br&gt;-Low soil fertility; -High incidence of pests and diseases; -Low agricultural productivity; -Over reliance on traditional -Agricultural commodities; -Unsustainable agriculture management practices.</td>
<td><strong>1. Ensure sustainable increase in agricultural productivity and output to support industry and provide stable income for farmers</strong>&lt;br&gt;-Develop and multiply new and improved seeds and planting materials of selected crops; -Promote soil fertility management systems; -Promote an integrated pest and disease management system; -Update existing technological packages and promote environmentally sustainable cropping practices in agroforestry, land and water management in farming communities.</td>
<td><strong>Selected Crop Improvement</strong>&lt;br&gt;-Develop and multiply new and improved seeds and planting materials of selected crops; -Promote soil fertility management systems; -Promote an integrated pest and disease management system; -Update existing technological packages and promote environmentally sustainable cropping practices in agroforestry, land and water management in farming communities.</td>
</tr>
<tr>
<td></td>
<td><strong>-Low extension coverage</strong></td>
<td><strong>2. Ensure the development and strengthening of the requisite institutional capacity to support agriculture productivity</strong>&lt;br&gt;-Promote alternative extension approaches that will increase the proportion of both men and women farmers that are reached; -Establishment of extension information centers (EIC)</td>
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<td><strong>(b) Restoration of degraded environment and Natural Resource Management</strong>&lt;br&gt;-Degradation of the nation’s forest; -Over reliance on major species like Mahogany, Odom, Sapale, etc; -Fast depletion of the nation’s biomass without replacement -Inefficient use and management of natural resources; -Advancing/creeping desertification through bush fires, poor farming practices, energy use, etc; -Lack of awareness on climate change and its impact; -Destruction of the environment, pollution by illegal miners</td>
<td><strong>1. Ensure the restoration of degraded natural resources</strong>&lt;br&gt;-Encourage reforestation of degraded forest and off-reserve areas; -Promote the development and use of alternative wood products; -Promote plantation/woodlot development among communities to meet the needs of society; -Manage and enhance Ghana’s land and permanent estate of forest and wildlife protected areas while considering the effect on women and men farmers; -Ensure the involvement of communities and the relevant agencies in the implementation of National Action Plan to Combat Desertification; -Initiate measures to stem land degradation; -Initiate measures toward minimizing the impact</td>
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<td>(c) Land policy</td>
<td>-Inadequate gender consideration in land administration projects; -Duplication of functions within the land sector agencies; -Inequality in sharing of benefit from natural resources; -Lack of compensation to land owners; Inadequate involvement of communities, particularly women in resource management Lack of viable and efficient industries which utilize primary products; Inadequate exploration of mineral resources within the country; Over-dependence on the few precious minerals; -Degradation of land, pollution of water and air and high incidence of mining accidents; -Minimal stakeholder’s involvement in the management of mineral resources. -Weak institutional capacities for environmental management at all levels; -Low enforcement of environmental laws; -Weak collaboration among relevant agencies on natural resource management.</td>
<td>1. Build the requisite institutions and strengthen the regulatory framework to ensure sustainable natural resource management of climate change/variability; -Control menace of mining (especially illegal mining) -Ensure that the current land administration project is endangered; -Ensure socio-economic activities are consistent with sound land administration practices; -Promote equitable benefit sharing from land, forest and wildlife resources; -Ensure prompt, fair and adequate compensation of government acquired lands; -Maximize community involvement, especially women, in sustainable land, forest resources; -Promote the development of viable and efficient forest and wildlife-based industries, particularly in secondary and tertiary processing. -Enact relevant environmental laws to protect the environment at all times; -Enforce existing environmental laws; -Enforce the legality assurance scheme under the Validation of Legal Timber Program (VLTP); -Develop multi-agency approach to enhance resource management and the environment.</td>
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II. Support Services

<p>| (a) Science and Technology to support productivity and development | -Lack of science and technology culture in all aspect of the society; -Lack of national policy to promote the development of appropriate technology to support agriculture and small to medium scale enterprises. -Lack of national policy on commercialization of scientific research. | 1. Promote research and development at all sectors of the economy -Promote science and development at all levels of production; -Promote the development of appropriate technology to support agriculture and rural small and medium scale enterprises. |
| | 2. Build appropriate linkages between research and production to ensure that research output are utilized -Actively encourage the diffusion and transfer of technology development. | |
| | 3. Strengthen the appropriate institutions and regulatory -Provide support for business to adopt Research and Development as critical component of produc- | |</p>
<table>
<thead>
<tr>
<th>III. Lifecycle related vulnerability and exclusion</th>
<th>Framework to promote the development of science and technology research</th>
<th>1. Promote and protect the welfare of children in difficult circumstances</th>
<th>2. Protect children from direct and indirect physical and emotional harm</th>
</tr>
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<tbody>
<tr>
<td>The need to strengthen measures to eliminate the worst forms of child labor (WFCL) in the shortest possible time; Strengthen institutional and socio-economic bases for tackling all child labor</td>
<td>-Protect children from direct and indirect physical and emotional harm and promote their welfare; -Increase budget allocation to and strengthen the capacity of the MMYE, DSW and GNCC.</td>
<td>-Strengthen the legal framework and enforcement of laws that prohibit child labor; -Mobilize society to support the fight against child labor; -Strengthen and expand apprenticeship and skills training systems contribute to the elimination of WFCL; -Improve the knowledge base for planning, designing, implementing and evaluating child labor interventions; -Develop standards, protocols for withdrawal, prevention and rehabilitation of children in WFCL; -Funding sources such as the Social Investment Fund, Rural Banks and other potential partners are involved in targeting credit and entrepreneurship development schemes for families of children at risk of WFCL; -Conduct needs assessment for social protection among poor single mothers and female heads.</td>
<td>-Strengthen the legal framework and enforcement of laws that prohibit child labor; -Mobilize society to support the fight against child labor; -Strengthen and expand apprenticeship and skills training systems contribute to the elimination of WFCL; -Improve the knowledge base for planning, designing, implementing and evaluating child labor interventions; -Develop standards, protocols for withdrawal, prevention and rehabilitation of children in WFCL; -Funding sources such as the Social Investment Fund, Rural Banks and other potential partners are involved in targeting credit and entrepreneurship development schemes for families of children at risk of WFCL; -Conduct needs assessment for social protection among poor single mothers and female heads.</td>
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<tr>
<td>IV. Environment related factors in vulnerability and exclusion</td>
<td>-Desertification and drought Floods: loss of lives and property.</td>
<td>1. Deal with the effect of climate change especially drought and desertification</td>
<td>2. Reduction in bush fires</td>
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<td>-Destruction of farms, forest cover and property.</td>
<td>-Review, disseminate and enforce reforestation policy; -Develop policy on alternative livelihood opportunities; -Promote the development and use of alternative sources of energy (biogas); -Adopt policy framework on climate change and mainstream of the national action programme to combat drought and desertification.</td>
<td>-Intensify public education on the effects and laws on bush fires.</td>
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| Lack of awareness and enforcement of environmental regulations and policies. | 3. Facilitate multi-stakeholder commitment to natural resource management | -Develop policy on research, surveillance, training, early warning system and traditional knowledge;  
-Build capacity and create awareness on the prevention and management of all forms of disasters. |
|---|---|---|
| Duplication of functions by land sector agencies. | 4. Improve environmental and natural resources management for health, safety and increased sustainable production | -Adopt or enforce collaboration between EPA and MMDAs to better manage natural resources, environmental health and illegal mining;  
-Harmonic Action Plan of Public education on environmental management, disaster and building standards developed. |

| SECTOR POLICIES |
|---|---|---|
| **Food and Agriculture Sector Development Policy (FASDEP II)** | **1. Sustainable management of land and environment** | **-Mainstream sustainable land and environmental management practices in agricultural sector planning and implementation;**  
**-Create awareness about environmental issues among all stakeholders and develop an effective and efficient framework for collaboration with appropriate agencies to ensure environmental compliance;**  
**-Adopt an integrated approach in dealing with environmental issues, including an inclusive partnership-based coordinated approach with active and mutual involvement of NGOs and civic organizations, the private sector and the development partners;**  
**-Improve incentive and compulsion measures to encourage users of the environment to adopt less exploitative and non-degrading practices in agriculture;**  
**-Promote joint planning and implementation of programmes with relevant institutions to address environmental issues in food and agriculture;**  
**-Promote the development of community land use plans and enforce their use, particularly in urban and peri-urban agriculture;**  
**-Improve access of operators in urban agriculture** |

- Sustainable land and water management are not adequately integrated as part of agricultural extension services;  
- High environmental degradation and abuse due to inadequate understanding of environmental issues related to agriculture;  
- Lack of national agricultural landuse policy;  
- Ineffective framework for collaboration with appropriate agencies to address environmental issues related to agriculture.
<table>
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<tr>
<th>National Land Policy</th>
<th>1. Facilitating equitable access to land</th>
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<tr>
<td>General indiscipline in the land market characterized by the current spate of land encroachments, multiple sales of residential parcels, unapproved development schemes, haphazard development, etc., leading to environmental problems, disputes, conflicts and endless litigation; Indeterminate boundaries of stool/skin lands resulting directly from the lack of reliable maps/plans, and the use of unapproved, old or inaccurate maps, leading to land conflicts and litigation between stools, skins and other land-owning groups; Compulsory acquisition by government of large tracts of lands which have not been utilized and for which payment of compensation has been delayed. By this policy, landowners have been left almost landless, denied their source of livelihood and have become tenants on their own lands, giving rise to poverty and disputes between the state and the stools, as well as within the private land sector; Inadequate security of land tenure due to conflicts of interests between and within land-owning groups and the state, land racketeering, slow disposal of land cases by the courts and a weak land administration system; Difficult accessibility to land for agricultural, industrial, commercial and residential development purposes due to conflicting claims to ownership, and varied outmoded land disposal procedures; Weak land administration system characterized by lack of comprehensive land policy framework, reliance on inadequate and out-dated legislation, lack of comprehensive land policy framework, reliance on inadequate and out-dated legislation, lack to sustainable land and environmental management practices; Stimulate, support and facilitate adaptation and widespread adoption of farming and land use practices which, while in harmony with natural resources resilience, also underpin viable and sustainable production levels.</td>
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<td>-Review the phenomenon of landlessness and migrant farmers and take steps to eliminate, or at least minimize conditions contributory to migration and encroachment; -Collaborate with the traditional authorities and other land stakeholders to review, harmonize and streamline customary practices, usages and legislations to govern land holding, land acquisition, land use and land disposal; -Encourage, through appropriate incentives, stool/skins, clans and land owning families to create land banks for present and future generations; -Initiate the use of negotiable land bonds as an option for financing timely government acquisitions; -Pursue enactment of legislation to impose appropriate levies, penalties and/or taxes on allocated, but undeveloped lands, in order to reduce land speculation and fleecing and ensure equity in capital gains, death duties, etc., with regard to landed property; -Collaborate with, and support the traditional authorities and other land stakeholders to: Facilitate development of land management knowledge and skills among stool, skin, clan and family landowners; -Institute an administrative mechanism to guide the allocation and disposal of land by traditional authorities and family land owners throughout the country; -Develop systems that would facilitate proper rec-</td>
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of adequate functional and co-ordinated geographic information systems and networks, as well as of transparent guidelines; poor capacity and capability to initiate and co-ordinate policy actions among various land delivery agencies;
- Lack of consultation with land owners and chiefs in decision-making for land allocation, acquisition, management, utilization and development has generated intractable disputes between the state and the private land owning groups and within communities;
- Lack of consultation, coordination and cooperation among land development agencies;
- Inadequate coordination with neighbouring countries in the management of Ghana’s international borders, which normally reflects in cross-border activities, such as farming, human settlement, smuggling, cattle grazing, etc., and inadequate management of shared water bodies within the West African sub-region.

2.0 Security of tenure and protection of land rights

- With full participation of traditional and customary landowners undertake tenurial reform process, which documents and recognizes the registration and classification of titles under:
  - the alodial owner
  - Customary law freeholder
  - an estate of freehold vested in possession or an estate or interest less than freehold under common law
  - leasehold interest
  - interest in land by virtue of any right contractual or share cropping or other customary tenancy arrangement
- Speed up title registration to cover all interests in land throughout Ghana, and phase out deeds registration;
- Pursue the following actions to resolve or minimize land tenurial disputes and their associated
| 1. Conservation and sustainable development of the nation’s forest and wildlife resources for maintenance of environment and sustainable production of domestic and commercial produce | - Promotion of resource development programmes aimed at reforesting suitable harvested sites, rehabilitating degraded mining areas, afforesting denuded lands, regenerating desired wildlife species and habitats and sustainably developing wildlife potential; ©Regulation of utilization and trade in highly valued and endangered species in order to eliminate the threat of extinction, encourage regeneration and ensure future supplies; - Encouragement of local community initiative to protect natural resources for traditional, domestic and economic purposes, and support with the res-

| 3.0 Ensuring planned land use | - The Ministry of Lands and Forestry in conjunction with other relevant MDAs shall develop and implement comprehensive District, Regional and National Landuse Plan and Atlas, which zones sections of the country to broad land uses according to criteria agreed among various public and private land stakeholders. |

| 4.0 Developing effective institutional capacity and capability | - Establish the needed mechanism for enhancing active collaboration with the traditional authorities and all land stakeholders to educate all traditional landowners on the need to keep proper land records, conserve land for sustainable use, avoid protracted land disputes, litigation and conflicts, as well as involve them in making decisions affecting the allocation, disposal, management and development of their own lands |

| **Ethnic conflicts:** | - enactment of legislation to require stool, skin, clan, family and other land owners to survey and demarcate their land boundaries with the approval of the Survey Department - establishment of an Early Warning Mechanism to detect potential areas of land disputes for the purpose of taking preventive measures. |

| **Forest and Wildlife Policy** | - Permanent estate of forest and wildlife resources for preservation of vital soil and water resources, conservation of biological biodiversity and the environment and sustainable production of domestic and commercial produce; - Public awareness and involvement of rural people in forestry and wildlife conservation so as to maintain life-sustaining systems, preserve scenic areas and enhance the potential of recreation, tourism and income-generating opportunities; - Research-based and technology-led forestry and wildlife management, utilization and development to ensure resource sustainability, socio-economic |
growth and environmental stability;
-Effective capability at national, regional and district levels for sustainable management of forest and wildlife resources.

-Initiation of integrated planning by relevant agencies for joint action to prevent and suppress wildfires in fire prone areas, illegal farming and encroachment in protected areas, chemical and solid waste pollution by industrial and domestic activities;
-Promotion and implementation of public education programmes to increase awareness and understanding of the role of trees, forests and wildlife and the importance of conservation;
-Promotion of agroforestry among farmers and cultivators to enhance food and raw material production and environmental protection;
-Dissemination of research information to update the public on current knowledge regarding resolution of technical problems in growing, management and utilization of timber and wildlife products;
-Development of consultative and participatory mechanism to enhance land and tree tenure rights of farmers and ensure access of local people to traditional use of natural products;
-Promotion of national tree planting programmes as positive community-building actions which generate raw materials and income while improving the quality of the local environment;
-Initiation and maintenance of dialogue with all interests through a national advisory forum (i.e. the Forestry Commission) and related district conservation committees to ensure active public participation in forestry and wildlife matters;
-Initiation of continued contract and liaison with the local authorities and communities to pursue integrated development activities related to sustainable resource management;
-Promotion of user-oriented investigations into the
growth and success of important tree species and forest types, wildlife species and habitats, and the development of appropriate systems for their sustainable management under a wide variety of conditions;

- Encouragement of studies by institutions of higher learning to increase knowledge of the biological diversity of the country and its potential for future applications in socio-economic development.
Appendix 3: Land tenure

The term tenure may refer to landholding of any type. According to FAO (1989) tenure is a set of rights or “bundle of rights” which a person or entity holds in land or tree or in some other resource, and which are recognized by law and custom in particular societies or communities; but at the same time also suggesting that the landholder does not have absolute possession but derives the right from other entity or source. Some tenures consist of a fairly clearly prescribed bundle of rights as determined to a large extent by the type of contract between the parties, e.g. “leasehold”.

Specifically, land tenure is the perceived institutional arrangement of rules, principles, procedures and practices whereby a society or community defines control over, access to, management of, exploitation of, and use of means of existence and production (Dekker, 2005).

Land tenure is dynamic. It adapts to changing political, legal, societal, religious, economic, demographic and environmental circumstances. As a result, a variety of land tenure systems can be distinguished. A land tenure system can be described as the perception of all types of land tenure recognized by a national and/or local system of established rules and customary relationships in a social organization. As a result each land tenure system is unique and peculiar to a given society or community (Dekker, 2003).

The term tree tenure as comprehensively reviewed by FAO (1989) is of recent general usage. Tree tenure is a system of property rights in every sense as variable as land tenure. In many societies today, rights over trees are often different from those over land. Tree tenure, therefore, consists of a bundle of rights over trees and their produce which may be held by different people at different times. These rights include the right to own or inherit trees, plant trees, use trees and tree products, dispose of trees and exclude others from the use of trees or tree products.

A tree tenure regime may distinguish between planted trees and wild trees. The rights to trees depend, among others, on the species of tree, the nature and use, and the nature of the person or group with interest in it. Rights in a tree may be distributed among several individuals often according to provision of labour and other productive resources. In the off-reserve areas in Ghana, the provision of the 1962 Concessions Act which “vests all timber resources in the office of the President” gives the government the management rights over all naturally growing trees, and landowners and users cannot cut trees for commercial reasons. The environmental implication is that of the tendency of landowner and farmers to remove trees from off-reserve land, particularly given the usually uncompensated damage that logging causes to cocoa and other crops during harvesting of timber. This may constrain efforts in promoting tree planting in the cocoa growing areas. The key issue in tree planting on-farm, off-reserve, degraded forest reserve areas and cocoa landscapes is the extent to which the farmer has the security of tenure needed to invest in trees. Trees are slow maturing and therefore constitute a long-term investment. It takes a long time for their costs, including opportunity cost, to be recovered. Security of tenure is therefore required to ensure that farmers reap the requisite benefits.

More importantly, as Ghana embarks on its Readiness Preparation Proposal (R-PP) which outlines the process by which the Government will develop its national strategy for participating in and implementing an international mechanism for reducing emissions from deforestation and forest degradation, conserving stocks and sustainably managing its forests (REDD +), attention should be directed at enacting laws and legislation that will streamline securing land ownership and tree tenure in general, and in the cocoa growing areas in particular. This will promote sustainable investments in tree planting and position the cocoa farming communities to benefit from the proceeds from the carbon markets that would be developed.
To illustrate the application of these tenure arrangements in Ghana, Mirjam et al. (2010) present the following three scenarios of planted trees on farmlands, Modified Taungya System (MTS) in degraded forest reserves and non-timber forest products extraction in the Asankragwa Forest District. These are under the “Governance for sustainable forest-related livelihoods in Ghana’s High Forest Zone Programme “under the Tropenbos International (TBI) Ghana Programme and the EU-Ghana Voluntary Partnership Agreement (VPA) to combat illegal logging.

**Planted trees on farmlands**
If a landowner plants trees on farmlands, 100% of the crops (all types) and 100% of the tree benefits are for the landowner. However, if the farmer is not the owner of the land, the arrangement is that the farmer receives 67% and the landowner 33% of the tree and permanent crop benefits, whereas the supporting timber company has the first option to buy the mature timber at prevailing market prices. This arrangement applies to off-reserve areas where the trees are planted on farmland and includes farmers, landowners and a timber company.

**Modified Taungya System (MTS)**
The MTS is a legally-binding land lease and benefit sharing agreement for tree-planting schemes in which farmers receive parcels of degraded forest reserve areas earmarked for conversion to plantations to produce food and vegetable crops (maize, plantain and cocoyam but not cassava) and help replant the degraded forest areas. Intercropping is carried out during the first three years of plantation establishment, after which only tree growing is allowed. Under this scheme, the farmers are considered co-owners who are guaranteed 100% of the agricultural crop proceeds. The benefits from trees are shared on the basis of 40% for farmers, 40% for the Forestry Commission, 15% for the land owner and 5% for adjacent communities. This arrangement applies to degraded forest reserve areas and involves MTS farmers, the Forestry Commission and the stool authorities.

**Non-timber forest product extraction**
Villagers - both male and female - in forest-adjacent communities use various non-timber forest products, with the most important being pestles, canes, palm, spices and chewing sticks. Women mainly extract herbs and spices as well as medicinal plants for their own use. Extraction can take place for both domestic use and for sale. Permits acquired from the Wildlife Division for animal products and with the Forest Services Division for plants products are required when products are extracted from the forest reserve for commercial use. No permits are required for the extraction of NTFPs for domestic use, either from on-reserve or off-reserve areas. Income (either cash or non-cash) from NTFP extraction functions primarily as a safety net. Benefits for the government take the form of a permit fee when products are extracted for commercial purposes.

The focus of governance sustainable forest-related livelihood initiatives is on:

- ways to improve governance with a view to creating a conducive environment for sustainable and pro-poor forestry;
- ensuring conducive strategies (implementable policies and legislation) to improve people’s livelihoods in forest-fringe communities; and
- ways to minimize conflicts based on advocating constructive mechanisms to minimize or resolve conflicts arising from competing claims to forest and trees resources (e.g. law enforcement, institutionalizing constructive community resource management in forest policy and legislations, building the capacity of forest governors and actors in conflict management, etc).
The significance of the improved livelihood-improved governance nexus is a reduction in forest and tree-related conflicts, the reconciling of interests and the creation of partnerships between the various actors involved in forest governance and management (Mirjam et al., 2010).

**Current Land Tenure Practices and Policies**

Land ownership in Ghana (including the cocoa growing communities) is fundamentally based on the absolute allodial or permanent title system and all other lesser titles to, interest in, or right over land derive from it (MLF, 1999; Kasanga and Kotey, 2001). The allodial title is normally vested in a stool, skin, clan, family, and in some cases, individuals in reference to the particular area in the country where the piece of land is situated. The traditional arrangement for making land available and accessible for use in Ghana emanates from the exercise of the rights under the allodial title, which also limits the rights of usufruicts (MLF, 1999).

Land administration in Ghana is governed by both customary practices and enacted legislation. There are basically two types of land ownership: public or state and private lands. The public lands, which constitute about 22% of the total land area in Ghana acquired out of the traditional holdings (van Aspernen, 2007 & Kasanga and Kotey, 2001) in Ghana fall into two main categories. These are: (i) land which has been compulsorily acquired by the government for a public purpose or the public interest under the State Lands Act, 1962 (Act 125) or other relevant statute; and (ii) land which has been vested in the President, in trust for a landholding community under the administration of Lands Act, 1962 (Act 123). With land that has been compulsorily acquired, all previous interests are extinguished. Both the legal and beneficial titles are vested in the President and lump sum compensation should, under the law, be paid to victims of expropriation. In the case of “vested land”, the instruments create dual ownership where the legal title is transferred to the state whilst the beneficial interests rest with the community. Under the vesting order, the government does not pay compensation. However, any income accruing is paid into the respective stool land account and is disbursed according to the constitutional sharing formula which by the independent office of the Administrator of Stool Lands Act 481, established in 1994 is:

10% of the revenue accruing from stool lands to the office of Administrator of Stool Lands to cover administrative expenses;

The remaining revenue shall be disbursed as follows:

- 25% to the landholding stool through the traditional authority for the maintenance of the stool in keeping with its status;
- 25% to the traditional authority; and
- 40% to the District Assembly within the area of authority to which the stool lands are situated.

The skewed nature of the disbursement with a greater fraction going to the District Assembly without an effective mechanism for ensuring such revenues are used to improve the welfare of the communities that own the land has raised implicit beneficial concerns among the communities.

Currently all vested and public lands are administered by the Lands Commission at the National Level along with 10 regional Lands Commission and their Secretariats, as provided in the 1992 constitution (Article 20) and its Land Commission Act 1994 (Act 483).

**Implications of compulsory acquisition on sustainable land management**

In practice the theoretical distribution of beneficial interest and legal estate in relation to vested land does not work since both interests are transferred to the President, who then passes the management function to delegated authorities, including the Lands Commission and its Secretariats.
The provision by which the government has the power to acquire land once it is in the public interest (Article 20 of the 1992 constitution) may reduce tenure security, particularly cocoa farm lands in peri-urban sites, and discourage resource users from sustaining long-term investments on their lands for fear of eviction or insufficient compensation for their investments. Kasanga and Kotey (2001) observe that the power vested in the government has often been exercised in a non-transparent and adverse manner and argue that state management of land has generally benefitted the government bureaucracy to the detriment of the poor.

Moreover, even though the law guarantees compensation for the customary acquisition of private land, in several instances, land that government has compulsorily taken was not utilized for the explicit purposes for which it was acquired, and owners did not receive prompt and adequate compensation. Kasanga and Kotey (2001) suggest that powers of compulsory acquisition should be used sparingly and deployed only when land is required for public purpose, e.g., schools, health facilities.

**The Private or Customary Lands**

According to MLF (1999), the private or customary lands in most parts of the country are in communal ownership, held in trust for the community or group by a stool or skin as symbol of traditional authority or by a family.

Stool or skin lands are a feature of land ownership in the Akan traditional groups in southern Ghana and in most traditional groups in northern Ghana. In other areas, stool and skins are not recognized as symbolizing private communal land ownership. In such instances, the traditional arrangement is normally that of vesting land ownership in the clan, family or individual. This practice prevails in the Volta Region, some traditional areas in Central, Eastern, Greater Accra, Northern, Upper East and West Regions of Ghana.

The customary land tenure continues to operate and provide land for many people. It has a wider coverage than the state system and dominates particularly in rural areas and for agricultural purposes (Kasanga and Kotey, 2001). The customary lands form about 78% of the total land area in Ghana and consist of both stool and family lands. Family lands together with individual lands form about 35% of the total land in customary ownership (MLF, 2003).

The absolute ownership of land by traditional land owning authorities (stools chiefs, clan heads and skins) on behalf of their people makes outright land ownership a rare form of land tenure in Ghana including cocoa growing communities. However, leases and rentals over a satisfactorily period of time for economic/commercial activities are possible and involve permission by the allodial title holders to use the land.

Important features of the customary land tenure system with significant impacts on investments and adoption of environmentally sustainable cocoa production include the influence of inheritance (matrilineal and patrilineal) and access to land by migrant farmers (abunu, abusa, outright purchase and gift).

The matrilineal inheritance system is prevalent among the Akan speaking people of the cocoa belt. In this system, the allodial title to land is vested in the stool but passed down through individual female lines to brothers and nephews. The matrilineal system removes much of the incentive for investment in land when current operators are expected to pass the land to the matrilineal family rather than to direct descendants (children). They can only pass on cocoa land that they themselves establish. Therefore, farmers have an incentive to establish new cocoa farms rather than invest their resources in an inherited plantation. Furthermore, if immigrants clear a forest and plant cocoa, tradition requires that they share the plantings or harvest with the local landowner. Therefore, forest landowners have an incentive to allow immigrants to
occupy and convert their land to cocoa farms. This, in turn, may reduce the incentive for the farmers to maintain the productivity of their older cocoa farms.

In discussing changing tenure in the Western Region, Kasanga et al. (2001), indicate that in the Akan matrilineal system, virgin land was either bequeathed to nephews or allocated to other male members of the extended family, in accordance with the decision of the family head. Wives and children were left with no rights to a man’s property if he were to die intestate. Uncultivated fallow land, if not put into use, or under permanent tree plantations, would revert to the family. Recently, village land is increasingly being inherited directly by wives and children and even family land is often transferred to them with the consent of other family members. The process of individualization among the Akan matrilineal communities has been strengthened by the passing of the Intestate Succession Law (PNDCL 111) 1985. According to Otsuka et al. (1998) instead of the stipulations of the law, however, the local people prefer a formula based on giving one-third of the property each to spouse, children and maternal family.

In the Brong Ahafo Region short term hiring, renting and leasing of land are now on the increase. These arrangements are based largely on verbal, unwritten agreements, with family members acting as witnesses with the usual customary pouring of libations and related customary land granting procedures. The potential land conflicts emanating from unwritten arrangements between powerful landlords and unsuspecting migrants are said to be rising rapidly.

However in the Ashanti Region, the evidence suggests that land tenure is gradually moving away from family and share cropping arrangements to short term rental and hiring – thus introducing increased insecurity and reduced investment incentives.

The system also tends to foster disputes between would be inheritors. Such disputes can lead to land being neglected before and after the previous occupant’s demise. Where the land is invaded by bush, rehabilitation can be difficult unless sufficient resources are available (MASDAR, 1998).

The patrilineal inheritance is practised by the Krobo, Ga and Ewe in the cocoa growing areas. In this system individuals hold only user rights and paramount title belongs to the stool or family and land is passed down along the paternal line from father to son. The principal problem is that of fragmentation involving the breakup of land parcels into smaller pieces with each succession. The land may be too small for the efficient production of cash crops such as cocoa and may be turned over to food crops. In reviewing the relationship between land ownership and inheritance, MASDAR (1998) concludes that both fragmentation and the conditions of inheritance affect investment decisions and farm productivity. These negative effects have simply not yet been realized because cocoa farming is currently characterized by low investment and low productivity.

Migrant cocoa farmers can gain access to land under three main tenurial arrangements. These are:

- Share cropping (‘abunu’ and ‘abusa’)
- Gifts
- Outright purchase

These have been reviewed in detail by MASDAR (1998).

**Share cropping systems**

Land owners may recruit sharecroppers to assist with the management of a farm or with the development of new land. Two share cropping systems are recognized. These are locally known as abunu and abusa.
Under the abunu tenancy, the proceeds from the harvest where the tenant is involved in the management of the farm or the land, in the case of development of new land, are equally divided (1:1) between the tenant and land owner. Before the division, the harvest from the cover crops such as plantain and cocoyam is shared equally, usually after sales, between the landowner and the farmer. During the division of proceeds, the landowner has the first choice of the product as divided. The more common form of abunu involves the development of land by the cropper in return for subsequent 50% share. A time period is almost always specified, usually being 5 years for new land or 7 or more years for the rehabilitation of weedy farms. Abunu farmers are normally required to grow cocoa exclusively. This has at times left them with no land for growing food crops to feed their families. Under this arrangement, in return for free grant of land, the migrant farmer undertakes to establish a cocoa or oil palm plantation for the landowner. The farmer is responsible for maintaining the farm until the trees begin to bear fruit and has no claim to any portion of the farm. Usually the landowner provides the seeds or seedlings for establishing the cocoa or oil palm but nothing else.

Abunu is more common in newer cocoa areas to which migration has occurred. Where abunu is dominantly by land sharing, farms are smaller than where the crop itself is shared. In Western Region land sharing is the dominant arrangement. In many areas, abunu has replaced the tradition of outright purchase. It is slightly less common in the more established cocoa growing areas where the supply of land has greatly diminished except where farms have been severely neglected. Land sharing, however permits redistribution of land. In the case where land is divided between the owner and tenant, the cocoa trees on it belong to the tenant as long as the cocoa trees remain on the land. However when the cocoa trees die after many years (if not replanted) the parcel of land reverts to the initial owner.

Abusa caretakers are generally recruited to manage a farm for one-third of the crop. In this system caretakers are usually recruited where owners are old, absentee or possessing several farms. Most owners provide inputs but supply is usually inadequate. Insecurity of tenure is an issue for some caretakers, reinforced by low education and limited alternative work opportunities.

Access to land may also be obtained through gift by landowners to migrant farmers. This is done if the migrant farmer can establish that he belongs to the same clan as the landowning clan of the village where the land is sought. Grant of land may also be through marriage. No restrictions are placed on crops which can be cultivated on the land.

Land may also be obtained through outright purchases. The land for such transactions is demarcated by “boundary cutters” for a fee referred to as ‘drink’ money. The controversy is whether such a transaction gives absolute title to the land to the farmer. The need to control land rents led to the passing by the government of the Rent Stabilization Act (109) as amended in 1963 by Act 165 which authorized the appropriate Minister to fix rent on land subject to the act. It made it illegal to demand or receive higher rent than that prescribed by the Minister and prohibited the ejection of tenants without approval.

The cocoa Farm Regulation Act 1962 (Li. 186) and1965 (Li. 382) was the principal rent controlling regulation applied to cocoa land in the cocoa growing regions. The measures provoked disputes due to insistence on compliance on the part of the tenant, and the opposition by landowners. With a change of government in 1966, the Act was repealed by NLCD, 49. Consequently the landowner – tenant relationship reverted to the customary arrangement before the coming into force of Act 109.

These land tenure security issues need to be taken into account to guide efforts in providing solutions to the many problems associated with the land sector in Ghana, and particularly, in the cocoa growing areas. An effort to restructure the land tenure system to address the problems resulted in the adoption of National Land Policy (MLF, 1999). The long term goals were to stimulate economic development, reduce pov-
erty and promote social stability. An overview of the land sector problems provided by the National Land Policy includes indeterminate boundaries of stool/skin lands, weak land administration system, and inadequate security of land tenure. Several studies also report that customary ownership rights in rural areas are also becoming less secure, particularly with the recent increase in commercial transactions and development.

In dealing with the problems of security of tenure and protection of land rights, the National Land Policy guidelines (Section 4.3) gives credence to and recognizes as legitimate all traditional sources of land tenure and rights as well as those derived from common law.

The Land Policy also indicates that the best evidence of title to land, in any area declared as a land title registration district is the land title certificate issued in accordance with the provisions of the Land Titles Registration Law, 1986 (PNDC 152). In areas not declared land title registration districts, instruments registered under the Land Registry Act, 1962 (Act 122) should be sufficient proof of title. The policy action to address security of tenure (Section 5.3) envisages full participation of traditional and customary land owners to undertake tenurial reform process, which documents and recognizes the registration and classification of titles.

To implement the policy actions recommended in the National Land Policy document (Section 5) launched in June 1999, the Land Administration Project (LAP) was initiated by the Ministry of Lands and Natural Resources. The LAP is by far the most comprehensive programme to address land tenure issues with the objective of reforming land tenure institutions, titling and registration, and harmonization of land tenure legislation in Ghana. The development objective is to undertake institutional reforms and key pilots to lay the foundation for a sustainable land administration system that is fair, efficient, cost-effective, transparent and which guarantees security of tenure. One of the measures is the establishment of new or strengthening of existing Customary Land Secretariats (CLS; Antwi, 2006). At least one CLS has been established in each of the ten regions in Ghana (Fiadzigbey, 2006).

Pilots have been carried out in order to find optimal ways to register customary land rights (Antwi, 2006). The full impact of the introduction of LAP and CLS is however yet to be realized. As part of the initiatives of government and other agencies to address land tenure related conflicts and their underlying causes, the Ministry of Lands, Forestry and Mines in collaboration with other ministries set up the Land Bank Committee in 2006 to identify and document potential lands for investment throughout the country (MLFM, 2008).

Although some progress has been made in terms of land titling and registration, particularly in urban and peri-urban areas (van Asperen, 2007; Mends and Meijere, 2006) through these recent initiatives to address the land tenure issues in Ghana, solution to tenure security problems still remain elusive. On the other hand, although the Land Policy and LAP provide the general framework for addressing and implementing land tenure issues in Ghana, there is still no well defined national policy in respect of cocoa farm lands and land tenure arrangements in cocoa communities.

In the effort to promote environmentally sustainable cocoa farming in Ghana by the CCP/UNDP Environment Project, there will be the need to use these policy instruments as entry points for advocating for definite measures for accessing and ensuring tenurial security in cocoa growing areas in particular and agricultural lands in general. This, among other factors, will be relevant to getting the concurrence and commitment of farmers to adopt proven improved practices that promote sustainable cocoa production and revegetating degraded off-reserve lands. The process for accessing land particularly for cocoa and other farming activities and ensuring security of land tenure should be made simple, transparent, fair and
efficient. Land markets for various land uses need to be developed and efficient land management systems established.

The achievement of these goals will require the engagement of the relevant stakeholders in the cocoa industry including NGOs, traditional authorities, farmers, government Ministries, Departments and Agencies, COCOBOD, Research Institutes (CRIG), donor agencies, development partners, etc. to play various advocacy roles.

### Implications of Land Tenure and Tree Tenure for Environmentally Sustainable Cocoa Production

The “vesting of all timber resources in the office of the President” gives the government the management rights over all naturally growing trees in the off-reserve areas where cocoa farms are established. Land owners cannot cut trees for commercial reasons. The consequences are:

There is the tendency of land owners and farmers to remove trees from off-reserve land particularly in the absence of compensation for damage to cocoa trees through logging. The greening of the off-reserve and on-reserve sites will be adversely affected in addition to the associated environmental and biodiversity benefits.

Without tree tenure security, efforts in promoting the rehabilitation of cocoa farms and degraded forest sites through tree planting with the view to creating conducive conditions for environmentally sustainable cocoa production would be constrained.

Stewardship for maintaining the forest ecosystem by the communities in cocoa growing areas will diminish to provide incentive towards non-shade cocoa farming. In the absence of tree cover, carbon sequestration and the implementation and achievement of REDD plus objectives as envisaged by the government would be adversely affected.

The compulsory acquisition of land without using it for the explicit purpose for which it was acquired may reduce tenure security and discourage resource users from sustaining long-term investments on their land for fear of eviction or insufficient compensation for their investments.

Land tenure systems that constrain tenurial security impact negatively on long-term investments in land improvements. They also limit the realization of the requisite environmental conditions for achieving sustainable cocoa production. Some of the issues relating to customary land tenure are insecurity of tenure, high rents and uncertainty about terms of the contract. Others are non-registration of oral customary law transactions, bad maps and site plans, corruption, lack of documentation of land titles that facilitate ownership and weak institutions at the community level, unable to protect and ensure the security of farmers and their farmlands.

Fragmentation of farm lands due to ownership by inheritance (especially patrilineal) results in small farms which constrain the possibility of developing large scale farms that not only provide the farmer with more income but also has the potential to provide employment at the community level.
Appendix 4: Tree tenure

Tenure and rights on tree ownership

Characteristics of the tenure system

Ghana’s land tenure system is characterized as one of legal pluralism in which customary and statutory laws co-exist in a complex mix, with a range of institutions and regulations having authority over land rights and multiple bodies through which disputes are resolved (Lavingne-Delville, 1998). Customary and statutory land tenure may be described in terms of characteristics and forms of management which distinguish them (Bentsi-Enchil, 1964, Woodman, 1996; Agbosu, et al, ISSER 2007: 30). The former is characterized by its largely unwritten nature, based on local practices and norms that are said to be flexible, negotiable and location-specific (Agbosu, et al, ISSER: 30). Customary land tenure is usually managed by a traditional ruler, earth priest, council of elders, family or lineage heads. Its principles stem from rights established through first clearance of land, conquest or settlement (Agbosu et al, ISSER 2007: 30). The State tenurial land system, on the other hand, is usually codified, written statutes and regulations, based on laws having their roots in the colonial power, which outlines what is acceptable and provides consequences for non-compliance. Management of such codified systems is usually in the hands of government administrators and bodies having delegated authority. The principles guiding this system are derived from citizenship, nation building, and constitutional rights. Land rights are allocated and confirmed through the issuance of titles or other forms of registration of ownership (Agbosu, et al, ISSER 2007: 30).

Effect of Land Tenure on Agriculture and the environment

The land tenure system has significant effect on the livelihoods of people, both in the rural, peri-urban and urban sectors. It is estimated that the livelihoods of over 70% of the population in Africa are mainly linked to land and natural resources exploitation (Economic Commission for Africa, 2004). A major effect of tenure on livelihoods is the decline in agricultural production for domestic food and industrial needs. Under the traditional customary land tenure system, each member of the community was guaranteed the right to access land for farming, housing and the enjoyment of other tenurial rights because usually there was sufficient supply of land and access to it did not pose a problem, especially in one’s home village (Kasanga, 2002: 28). Therefore, this egalitarian tenurial system sustained the social security of most Ghanaians in the absence of any insurance benefits, as well as providing them with a sense of community. Rural people found solace in the land, which is also the last resort for redundant urban workers. Furthermore, the Ghanaian tenurial system encouraged the free movement of people and thus may be seen as a progressive vehicle for national unity (Kasanga, 2002:29).

However, developments in Ghana’s land tenure system in colonial and post independence era has resulted in food insecurity and insecure tenure which manifest in the unequal distribution of land, sub-optimal utilization of land and landlessness. With respect to food security for example, emerging trends in the peri-urban sectors where stool farm lands are converted into residential lands leased to strangers has led to the total disappearance of farm lands (Ubink: 27). A good example is the situation reported in villages close to Kumasi, in the Ashanti Region. It is on record that the conversion of stool farm lands to residential land leased to tenant farmers in Kumasi area has led to near total disappearance of farm land, creating increas-
ing income insecurity for the community members. Members of the community are no longer able to grow their own food and generate some income by selling the surplus at the market (Ubink: 27). Most of the mainly less educated farmers become jobless or resort to petty trading. The price of food in these communities rises, leading to increased costs of living. Additionally, local folks are not in the position to compete with richer outsiders for a plot of land, making it very difficult for them to find land for agricultural purposes in their own villages. In their desperation by virtue of having been deprived of their communal land, most local and forest dwellers migrate to the city centres in search of non-existent jobs.

**Migrants versus Traditional Land Owners in Cocoa Farms**

Most if not all of cocoa production in Ghana is coming from small-holders, which typically involves clearing of virgin forest to plant new cocoa trees, and later replacing old cocoa plantations with food crops. There is abundant evidence of cocoa-led deforestation which has become major problem to both the cocoa industry and the environmentalists. Once cocoa trees are planted, they have a productive life of up to 30 years (or a little more), with yields per tree rising gradually and eventually falling as the tree grows older. Breeding programs have generated new varieties that can grow faster and be more responsive to soil fertility and pest control.

Conflicts over the ownership of cocoa fields often involve disputes between the migrant farmers and the land owners who have the traditional right of ownership. It is sometimes the case in Ghana that new cocoa farms are developed by migrants. This often leads to new rules for land tenure, especially when conflicts arise in distinguishing between the rights of migrants and those of indigenous farmers. Studies have confirmed that migrant farmers are more interested in faster and higher returns to their efforts than land owners whose interest lies on secure property rights which gave them a greater incentive to preserve land quality over time. Cocoa plantations are larger and less shaded in high migration parts of Ghana, which often led to soil erosion, infertility, and shorter life span for the cocoa trees. IUCN used its Livelihoods and Landscapes Strategy (LLS) to facilitate community rights to shade tree tenure on farms in Ghana. More specifically IUCN and other partners have been working with the Plantations Unit of the Forestry Services Division of Ghana’s Forestry Commission to operationalize the Community Taungya scheme by ensuring that cocoa farmers effectively plant trees on their farms, including *Allanblackia parviflora* and obtain ownership documentation over such trees.

**The Role of the State**

The State’s power to compulsorily acquire lands in the public interest by virtue of its power of eminent domain under the Constitution and the State Land Act 1962 (Act 125) and the Administration of Lands Law 3

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3 The Livelihoods and Landscapes Strategy (LLS) is a global IUCN program that includes Ghana. It responds to two major challenges facing sustainable development. The 1st is to find practical ways to support governments and donors so that the benefits of national poverty reduction strategies reach the rural poor, in particular those highly dependent on forests and trees. The Strategy addresses many of the issues that influence the extent to which forests contribute to poor people’s lives, including rights and tenure, governance arrangements, making markets work for low income producers, and optimizing the flow of ecosystem services that people and nature depend on. By strengthening the link between forests and rural poverty reduction, the Strategy responds to the 2nd global challenge: to reverse the current lack of momentum in implementing international commitments on sustainable forest use and conservation.

4 *Allanblackia parviflora* is an evergreen tree in the humid tropical forests of Ghana as well as in other West, Central and East African countries. The oil extracted from Allanblackia seeds is a new commodity with the ability to replace palm oil in some edible foods such as margarine, and inedible products such as soaps and detergents. Allanblackia oil is attractive as it can be used without undergoing the chemical hardening and re-fractionation usually needed to process palm oil. This reduces energy use and chemical waste and lowers operating costs and the ecological footprint. Products from Allanblackia oil are already marketed by Unilever.
Act, 1962 (Act 123) has adversely affected the livelihoods of many communities. The consequence of this has been the emergence of landlessness and the sub-optimal utilization of the lands, which has in turn has resulted in the creation of a landless class who face serious social and economic insecurity, particularly given the absence of alternative employment opportunities outside agriculture in these rural areas (Kasan-ga 2002: 29). This sometimes also has environmental consequences since displaced farmers tend to result to burning of the lands – a case of if I cannot have it I can destroy it. The Constitutional and statutory arrangement for the collection and disbursement of revenue from stool lands by the state has significant implications for land tenure in Ghana. Article 267(2) of the 1992 Constitution, which establishes the regime for the management of stool land revenues by the state provides that all revenues due to the stools in the form of rents, compensation payments and so on are first of all paid to the Office of the Administrator of Stool Lands, which then disburses the revenue according to a pre-determined constitutional formula.

The Office of the Administrator of Stool Lands Act 1994 (Act 481), establishes said Office (OASL) and gives it the responsibility to collect and disburse all rents, dues, royalties and other payments, whether in the nature of income or capital, accruing from stool lands. In practice, the objectives of article 267 are far from being achieved and the OASL is currently able to collect only a fraction of the actual revenue received by stools for the disposition of stool lands (Agbosu et al, ISSER 2007:82). Agbosu et al have further noted that in accordance with the constitutional formula, only 22.5% of the revenue is paid to land owners, while as much as 59.5% of the revenue is retained by the state. The remaining percentage is paid to the traditional council of the area where the land is situated. The percentage of the income which accrues to the stool in trust for the community is radically reduced upon disbursement by the state and consequently an even smaller percentage, if any, is actually expended on development projects for the improvement of the lives of the community. Furthermore, the absence of an institutionalized mechanism for monitoring the use of such revenues has deprived communities of the benefit of the revenue accruing from the land (Agbosu et al, ISSER 2007:83).

With respect to the management of vested lands, it has been observed that revenues accruing from them are also not being channeled to the land owners as envisaged by the legislation, resulting in tension between chiefs who hold the title and the state agencies. Also, there is no effective mechanism for ensuring that stool land revenues allocated to District Assemblies are in fact used to improve the welfare of the communities that own the land (Kotey and Kasanga, 2002; Agbosu et al, ISSER 2007:79).

In off-reserve areas, farmers are the de facto managers of the tree and forest resources, and therefore strongly influence the density and diversity of tree species found in the landscape. This is because the forest-farm mosaic is one in which farmers actively manage natural processes of forest succession by selecting and nurturing tree seedlings, coppice sprouts, and mature trees to provide shade and other products on their farms (Asare and Asare 2008; Amanor 1996). Despite their clear role in influencing the off-reserve landscape, farmers are not entitled to any of the stumpage fees from trees that they nurture. Because land owners and land users have no economic rights to naturally regenerated trees, farmers have few reasons to retain or maintain high value economic species that are likely to be felled for timber. In fact, most farmers say that they intentionally eliminate timber species so as to avoid future damage to their tree crops and conflicts with timber companies. Under the current system, trees on farms represent a risk to farmers, as opposed to an asset or a secure investment. The perverse incentives surrounding timber trees on cocoa farms was documented by Richards and Asare (1999).

Outside forest reserves, the main priority is tree tenure reform, so that farmers (and especially cocoa farmers) have positive rather than perverse incentives as regards maintaining timber or other trees as shade trees. People should be able to own, and benefit from, naturally regenerated trees on their lands, including by ownership of the carbon credits. More broadly, the legal and cultural systems encourage deforestation because trees can legally be felled for agricultural expansion, but not otherwise. Similarly,
user rights to land become weaker and are more easily contested or nullified when land is left uncleared or in fallow for an extended period. For example, a sharecropper will lose his rights to a parcel of land (on which he has an agreement) if he does not clear the vegetation in a relatively short period of time.

**Community Forest Practices and linkage to Tenure**

Generally, the connection between community forest practices and involvement of the community is linked to the tenure regime recognized and practiced in those communities. Customarily, community resources such as forest are vested in the community represented by the stools, skins, families and communities and their personifications such as chiefs and traditional functionaries such as traditional and land priests. Therefore, the protection of the natural resources and the environment including the forest and rivers is the responsibility of the entire community in traditional societies. This protection is deemed as a duty to the ancestors and those yet unborn to maintain its integrity (the thrust of the concept that environmental lawyers refer to as intergenerational equity). The result is that where communities reckon that the forest and its resources are vested in them they are proactive in fashioning practices to conserve and protect it. On the other hand, where the community is deprived of controlling or accessing these resources they tend to be apathetic or actively involved in plundering them.

Community practices underpinned by customary law play a significant role in conserving the forest and its resources, particularly in the off-reserve forests of Ghana. In forest communities, customary law sets rules for gaining access to the forest resources, enforces these rules and punishes infractions. The authority or legitimacy of the rules is normally expressed in religious terms in the form of taboos. Violation attracts social and spiritual rather than formal legal sanctions. These forest practices can be classified into various groups, namely, rest days and rest period taboos, restricted area taboos and yield restriction taboos (IUCN, 2007a).

**Tree Tenure**

The rights of trees outside forest reserves remains a key stumbling block for forest policy and legal reforms in Ghana. Deforestation accelerated in the second half of the 20th century and the stock of trees outside forest reserves declined rapidly (Forestry Commission 2010). At least part of the reason for this was a change in the way that tree ownership was defined and revenues were shared. Prior to 1962, landowning communities were entitled to no less than two-thirds of the gross revenue generated in forest reserves. Under the 1962 Concessions Act, however, that entitlement was cancelled and revenue was used to first pay the running costs of the Forestry Department, with a proportion of any remaining money returned to local authorities and communities. More significant, perhaps, was a provision in the Concessions Act to “vest of all timber resources in the Office of the President. Concessions Act gives the governments the management rights over all naturally growing trees, and landowners and users cannot cut trees for commercial reasons. This institutionalized the myth that farmers had no rights over naturally occurring timber trees growing on their land.

The result has been that landowners and farmers thus have an incentive to remove trees from off-reserve land, particularly given the usually uncompensated damage that logging companies cause to cocoa and other crops when they harvest timber.

Tree tenure not only poses a problem for cocoa farmers – looking ahead to any REDD carbon projects, tree tenure and associated carbon tenure will be an effective stumbling block for any benefits or permanence of any emission reductions to be achieved.

IUCN through the Landscape and Livelihoods project in Wassa Amenfi West District, has in partnership with the forestry commission and forest communities addressed tree tenure through the Farmer Tree Certification Programme. Farmers who have planted or managed trees on their own farms can have secure
rights of use and disposal over those trees – a right which was before vested in the government – especially for timber species. The pilot has been successful with minor modifications in providing duplicate copies of the certification. The increased benefits are seen to be multiple – increased income, biodiversity, connectivity across agricultural landscapes and enhanced carbon stocks.
## Appendix 5: Alternative Crops

### Table 1. Characteristics and market insights into select NTFPs

<table>
<thead>
<tr>
<th>Plant type</th>
<th>Plant habit (meeters)</th>
<th>Country Production Volumes</th>
<th>Export Volumes</th>
<th>Optimal density with cocoa</th>
<th>Time to maturity</th>
<th>Price per kg/g (US$)</th>
<th>Suitability for intercropping in cocoa</th>
<th>Rehabilitation of degraded off-reserve sites and forest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allanblackia</td>
<td>10</td>
<td>70 -120 t of seeds from the wild</td>
<td>20-40 t of oil</td>
<td>-</td>
<td>15 years in wild &amp; 5 yrs domesticated</td>
<td>$0.40</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Voacanga</td>
<td>3-10</td>
<td>300-1000 t seeds</td>
<td>$5 m</td>
<td>NA</td>
<td>3 years</td>
<td>2.5 to 7.00</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Griffonia</td>
<td>2</td>
<td>300 t seeds</td>
<td>$2.4 m</td>
<td>NA</td>
<td>-</td>
<td>$4.5</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Aframomum</td>
<td>1.2</td>
<td>50 t seeds</td>
<td>$0.2 m</td>
<td>Understorey crop</td>
<td>9-11 months</td>
<td>$4</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Thaumatococcus</td>
<td>-</td>
<td>300-500kg thaumatin</td>
<td>600 m to 1 billion</td>
<td>Understorey crop</td>
<td>-</td>
<td>$2000/g thaumatin</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Black pepper</td>
<td>12</td>
<td>80 t/annum</td>
<td>$0.4 m</td>
<td>NA</td>
<td>6-8 yrs seed or 3 yrs cuttings</td>
<td>$5</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Pycananthus Kombo</td>
<td>40</td>
<td>Demand driven 100 t nut, 30 t Kombo Butter</td>
<td>Nut $30,000</td>
<td>Grows wild</td>
<td>Nut $0.3</td>
<td>Y (Shade)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Miracle Berry</td>
<td>3.5</td>
<td>100 kg</td>
<td>$10,000</td>
<td>NA</td>
<td>6 – 8 yrs seed or 2-3 yrs stem cuttings</td>
<td>$100</td>
<td>NA*</td>
<td>Y</td>
</tr>
</tbody>
</table>

Key: Y = Yes; N = Not suitable; NA = Not applicable (research needs)

### Allanblackia purviflora

#### Distribution and description

The genus *Allanblackia*, which belongs to the Clusiaceae family (which worldwide contains ~ 40 genera), appears to consist of nine (possibly 10) tree species, all restricted to Africa. Taxonomy within the genus appears somewhat complex, with some species having numerous synonyms, and the divisions between
taxa being indeterminate. To help delineate the relationships and boundaries between species, molecular genetic studies are currently underway, though no results are available. All members of the genus are apparently dioecious (separate male and female trees), with trees being single stemmed, up to 40 m tall, with whorled branches, long-leaved and long-fruiting, with the biggest fruit of all trees in the African rainforest (particularly *A. stuhlmannii*). The species is mainly distributed in the High Forest Zone of Ghana (incidentally the cocoa growing belt of Ghana) i.e. the wet evergreen rainforest, moist evergreen, moist semi-deciduous south east and moist deciduous North West (and, sometimes, surrounding farmland) in the Western, Central, parts of Eastern, Brong Ahafo and Ashanti regions. The tree has several local names in Ghana depending on the region. It is known as Sonkyi in the Ashanti, Brong Ahafo and Western regions; Atrodua in the Eastern region, Osono dokono, kusieadwe or kusieaduane, Apeseaduane and Bohe in the Western region. The species’ commercial importance rests with its nuts, which have a special fatty acid composition of about 60% stearic and 35% oleic acids - gives the oil special physical and nutritional properties and a great potential for use in novel products. A fully grown matured tree can produce between 25 to 30 kgs of seeds. This however varies from year to year. The Allanblackia nut oil yield is established at 35% and the yield of oil per tree estimated at between 10 – 12 kgs. In Ghana, Allanblackia starts flowering from April, fruits in June and starts dropping from October or November and continues depending on the area, till April the following year.

**Uses of the Allanblackia tree and oil**

Allanblackia has many uses: nutritional – cooking, alone or mixed with palm kernel oil; making margarine; medicinal - heated fat smeared on aching joints and wounds, dried leaves as medicinal tea against chest pains, energy – fuel-wood and fat for lighting; building materials - timber for building and others - hunters appreciate the tree as fallen fruits attract a lot of animals, seeds used as bait in traps for Giant Gambian Rats, and for making soap. The price per kilogram of dried Allanblackia seeds has seen gradual increases from GH¢0.10 in 2002 when the Allanblackia program started, to the present price of GH¢0.30 per kg. The oil is purchased by Unilever and in Ghana, Novel Development Ghana Ltd is the lead organization driving the development of the business. A supply chain for the oil has been established and is fully operational by Novel Development Ghana Limited. Unilever the main buyer now and AAK of Belgium offer a sizeable and commercially attractive market thus providing a financially sound basis for the future. In the short term, Allanblackia seeds are gathered from existing tree – populations, while in the longer term, small holder agro-forestry systems will be developed.

**Allanblackia and biodiversity conservation – An agricultural landscape approach**

Allanblackia is common in the wild, and frequently used as a shade tree in cocoa farms. The cocoa farms reportedly reduce encroachment into protected areas, provide ecological connectivity among such areas and provide on-farm habitat for certain species. In addition, well-managed farms can maintain soil and hydrological services as well as act as carbon sinks. The use of Allanblackia in agro-forest systems offers possible solutions to the need to improve farm production and income at the small-farm level and combat environmental degradation, leading to the conservation of biodiversity. However, research is needed into cocoa–Allanblackia interactions, in order to understand the beneficial or impacts of Allanblackia planting in Ghana. Here germplasm collection of Allanblackia is necessary in order to evaluate its potential value in agro-forestry systems. The provision of superior tree germplasm can facilitate the uptake of, and return from, agro-forestry systems, bringing increased resources to farmers as well as providing other, environmental, benefits. Environmental benefits include the protection of biodiversity, by decreasing exploitation of primary habitats and via *circa situ* conservation. Allanblackia also holds out the potential to provide a novel source of additional household income for rural populations, while contributing to forest landscape restoration. Barriers so far identified against the production of Allanblackia include the availability of planting materials (improved variety that will fruit in 5 years), the long time it takes to mature to fruiting (reports have it that it takes between 12 – 15 years in the wild to mature and fruit) and the problem of dioecism (only half of mature trees are likely to fruit) and possible masting.
(year-to-year variation in fruit production). However, efforts are underway to deal with the barriers. Firstly, rural resources centers (5 have been established so far by Novel Development Ghana Ltd) where Allanblackia seedlings are produced using various vegetative means (grafting, and cuttings) to provide the planting materials to interested farmers within the species’ endemic belt which is also the cocoa growing belt in the country. The good news is that a grafted tree of three years old at an abandoned rural resource centre in Appeasuman (Western Region) has fruited. This gives hope to farmers that a grafted tree is capable of fruiting in such a short time. Targets set by the Allanblackia NOVEL Partnership in Ghana stand at planting 200,000 seedlings in 2010, 400,000 in 2011 and 2012.

Voacanga africana

Distribution and description

Voacanga africana, commonly called Voacanga and “obonaiwa” as the local Akan name, belongs to the family Apocynaceae. It is a medicinal tree/shrub of export value found in the West African sub-region. It thrives well under forest conditions. In Ghana, voacanga is widely distributed in all the cocoa growing regions within the high rainforest, moist-semi-deciduous and transition zones. It is common in secondary forests. Voacanga grows to between 3 and 10 metres tall and produces white and yellow flowers and small green circular pods filled with an orange pulp when ripe. The seeds, which are the most economically important part of the plant, are numerous, small, dark brown and ellipsoid in shape embedded in pulp. The leaves are light green, narrow and long with a non-waxy texture. Voacanga is an easy growing plant which matures in 3 years and produces for a period of about 30 years. The fully grown plant yields between 2000 and 3000 pods with 110-120 pods giving a kilogram of dry seeds. The yield per tree is about 10-23 kg of dry seeds and about 2.5 t/ha.

The maturity of the pods and harvesting periods vary with ecological zones. However, voacanga generally starts fruiting from April/May and matures in July. The major season for harvesting spans from July to September, and November to December for the minor season. Voacanga generally grows in the wild and is therefore subject to degradation through land clearance for farming, bushfires and unsustainable harvesting methods.

In the past, voacanga was used as shade crop in young cocoa plantations in Ghana. Since the plant was of no commercial value to the cocoa farmer, the plants were removed after cocoa canopy closure.

Uses

Voacanga Africana has long been used in West African traditional medicine and only recently has been used for modern applications in countries like United States and Japan. Its medicinal properties come from the ten alkaloids found throughout the plant. Vincamine and vinburnine are memory enhancers that may alleviate symptoms of Alzheimer’s and Parkinson’s disease. Voacamine and voacangine are used in the pharmaceutical industry to treat hypertension and stimulate cardiac action. Other alkaloids like Ibogaine and Ibolutine can help to treat drug addiction. Traditional medicine uses every part of the plant, including the root (for hernia and heart troubles), and bark sap (for skin sores and abscess), as well as the seeds for memory enhancement. More recently voacanga has been used as a good plant source for the manufacture of energy drinks on the US market.

Cocoa establishment and Voacanga intercropping: potential environmental sustainability and biodiversity conservation

Voacanga is one of the plants deliberately retained on the farm during the cocoa establishment phase in Ghana to provide shade. However, since the commercial value of the plant is not known, farmers tend to eliminate them after cocoa canopy closure. Yet several studies report that there is enormous potential to
diversify and enhance productivity and environmental resilience of tree-based cropping systems including cocoa agroforests (ICRAF, 1987; Duguma et al. 1990; Duguma, 1994). The potential environmental benefits in the cocoa-voacanga intercropping system include; provision of shade to create the conducive environment for cocoa seedling growth; reduced non-productive evaporation from base surfaces in the early establishment phase of cocoa and soil moisture conservation; serves as carbon sink to sequester carbon; greater above-ground plant biodiversity and below-ground microfauna than that in food crop fields. Research is however needed to establish the optimum density of Voacanga trees and shade for sustained cocoa production, genetically improved varieties to enhance product quality and quantity, assess pests and diseases and ascertain the environmental benefits and biodiversity enhancement of the cocoa-voacanga interaction.

A major barrier to the promotion of the cocoa-voacanga intercrop is the availability of planting material. However, ASNAPP-KNUST has developed the needed protocols and propagation techniques and currently produced planting materials for the communities under the ASNAPP-FC project. Over 50 acres of voacanga have been established (ASNAPP, 2007).

**Voacanga africana and Export Trade: Income generation, employment and livelihood enhancement**

Voacanga is the leading plant exported into international market from Ghana and currently constitutes about 70% of the total medicinal plant export value. It is one of the most established and increasingly stable internationally exported medicinal plans in Ghana. The market has grown from about 300 tons to over 1,000 tons within a decade. Seeds are collected from the wild but recent increase in demand has attracted establishment of plantations.

The increase in demand for the raw material (seeds) has resulted in a sharp increase in the price of the commodity, from about USD $1.0 in 2001 to over USD $7.0 in 2007. The number of buyers of voacanga has increased with new entrants from China and other European countries. Linnea and Covex (Spain) and Omnichem (China) are the main buyers of voacanga.

The voacanga trade in Ghana currently employs over 5,000 collectors, 100 agents and 10 exporters. About 40% of the collectors are women. The Voacanga business generates over USD $5 million to the national economy in terms of export earnings and produces over USD $3.5 million directly to collectors at the community level.

Field data collected by ASNAPP in 2007 indicated that collectors of Voacanga are able to generate between USD $500 and USD $2,000 per season (July to September) whilst agents or wholesalers within communities generate between USD $1,000 and USD $25,000 over the same period earning between 10-20% profit margin.

The price of voacanga reduces from the exporter to the collector. The collectors receive between 40 and 60 percent of the export value of the seeds. The price per kilogram (USD$) ranges from 2.5 to 4.5 for collectors/farm gate, through 3-5.5 for agents/wholesalers to 6.5 to 7.0 for exporters. Those figures show that using voacanga in cocoa agroforests or in rehabilitating degraded forest and off-reserve sites can potentially enhance the incomes and livelihoods of farmers in addition to potential environmental services.

**Griffonia simplicifolia**

**Distribution and description**

*Griffonia simplicifolia* belongs to the family Leguminoceae, sub-family Ceasalpinaceae. The local names are Kagya (Twi), Atooto (Akan), Kanya, Gbobloto (Ga) and Gbobotri (Ewe). The plant is principally found in the West African countries of Ghana, Ivory Coast and Togo. It is indigenous to Ghana and grows
widely in a range of agro-climatic conditions including the forest, transitional and coastal savanna zones. It also grows in secondary forest, scrub and thicket and thrives well on termite hills and on mountain slopes. Griffonia grows in the wild and is very common in all cocoa growing areas in Ghana.

Griffonia behaves both as a shrub and a climber. In the coastal plains of Ghana, Griffonia is shrubby and grows to a height of two metres or more. In these areas, Griffonia with its short woody tendrils entangles other thorny plant species such as Lantana delicatissima and Lantana camara to form thickets which are very difficult to penetrate. In the forest zone, the plant behaves as a climber, climbing any tall tree growing nearby and with which it comes into contact.

The leaves are simple, glabrous and shiny in appearance. They are ovate and elliptic in shape with a leaf size of about 14cm long and 5cm wide. The plant has a deep tap root system which facilitates uptake of nutrient and water from deeper layers. The leaves remain turgid and green even under water stressed conditions. As a shrub, Griffonia may branch 30-40cm above soil surface with up to 4 or more branches. In the forest zone, the stem grows as vines of no more than 15cm diameter without branching till it colonizes the crowns of the companion trees. Griffonia flowers profusely between July and August. The flowers are green in colour and arranged in pyramidal racemes and reflexed at its length with curles hook-like branches at its base.

The pods develop between August and November and mature by December. They are about 6cm long, inflated and green in colour when fresh. At maturity the pods turn black and explode with a loud noise when dry. Harvesting is between December and mid-March.

The seeds of Griffonia are flat and round. They are green in colour when matures and turn brown to black when dry. Number of seeds per pod ranges from 1 to 7 with 3 to 4 being common. Assessment of seed yield is difficult as the plant grows in the wild. However some indicators provided by researchers at the Department of Crop and Soil Sciences at KNUST, Kumasi show that: 100 seed dry weight ranges from 41 to 61g. A milo tin of dry Griffonia weighs about 400g (0.4 kg). 100 milo tins of Griffonia dry seeds is equivalent to 1 bag of 40 kg weight. 25 bags (40 kg each) give 1 ton of dry Griffonia seeds.

**Uses**
Griffonia is used in Western medicine to treat depression, insomnia, migraine and attention deficit disorders. It is also used as an appetite suppressant. The active ingredient – 5-Hydroxy-L – Tryptophan (5-HTP) extracted mainly from the Griffonia seeds, is a precursor of serotonin – 5 – Hydroxy Tryptamine (5-HT) which is associated with decreased depression, improved sleep and alleviation of anxiety. Griffonia is also a source of lectin used for blood grouping test. Traditionally the stem is used as chewing stick, fuelwood and for rope making. The leaves, used for fodder for sheep and goats, are said to stimulate their reproduction.

The medicinal values of the plant include chewing the roots as aphrodisiac, the stem to cure dizziness and few seeds to cure stomach ache.

**Cocoa establishment and Griffonia intercropping: potential environmental sustainability and biodiversity conservation**
The growth habit and cover attributes of Griffonia make it more suitable for rehabilitating degraded off-reserve sites, enrichment planting in degraded secondary forest and farmlands. As an intercrop in cocoa agroforests, the plant will colonize the crowns of the cocoa trees and reduce yields. It is therefore not recommended.
The research areas, environmental and biodiversity conservation benefits listed under voacanga are also relevant to Griffonia. However, as a legume, its potential nitrogen fixing attribute need to be ascertained in relation to soil fertility improvement. Up to date, there is no known Griffonia plantation in Ghana. However, ASNAPP-KNUST has developed the protocols for producing seedlings in the Goaso lath house for distribution to farmers. So far seedlings have been distributed for 5 acres to farmers for intercropping into their staple food crop farms such as maize and plantain. The limited research to reduce the climbing attribute of the plant through training the plant, shows the plant to branch and maintain its shrubby nature.

**Griffonia and Export Trade: Income generation, employment and livelihood enhancement**

Griffonia is one of the most established commercial medicinal plant exports in Ghana. It is second only to Voacanga in terms of volume and value. Chinese companies champion Griffonia in the international market. China serves as the intermediary country for the value chain of the Griffonia business. Most of the raw materials are shipped to China, processed into extract and resold to US buyers.

Like Voacanga, *Griffonia simplificofolia* provide significant economic benefits to collectors in rural communities in Ghana. There are currently more than 3,000 collectors, 100 agents and 8 exporters engaged in the Griffonia business.

A sample of communities monitored by ASNAPP in 2006 indicates that over 300 tonnes of the seeds were mobilized by 26 communities representing an average of 12 tonnes per community at an average price of $2.0/kg. On average, each community surveyed generated about $20,000 within the season (January to March). Individual collectors received between $300 and $1500 within the season. 296. In all, Griffonia sales in 2006 were valued at $2,400,000 at an average price of $4.5/kg FOB. The price of Griffonia per kilogram dry seeds varies from $1.5 to $2.5 for collectors/farmgate, through $2 to $2.5 for agents to $3.5 to $4.0 for exporters.

Unlike Voacanga, Griffonia season occurs from December to March, the dry season in Ghana where farming activities almost come to a halt in most places in Ghana. As a result, almost every community member gets into the business of Griffonia during the harvest season.

ASNAPP and its research partners at the Department of Crop and Soil Sciences, KNUST have conducted training programmes for the collectors, agents and exporters of Griffonia. The training programmes have mainly focused on good harvesting techniques, post harvest handling practices and business management.

**Aframomum maleguetta**

**Distribution and description**

Aframomum belongs to the family Zingiberaceae with Grains of Paradise, Guinea pepper, Alligator pepper and Maleguetta pepper as the commercial names. Local names (Akan) include Fomwisa, Wisa, Apokuo and Efom wisa. Maleguetta pepper or Afromomum is a spice native to tropical West Africa. The species is a shade-loving plant found in the forest belt of Eastern, Ashanti, Western, Volta and Brong Ahafo regions usually found as under storey crop in cocoa plantations and also in swampy areas. Aframomum is a tufted leafy herbaceous perennial. The plant has a short scaly rhizome with a surface root system. The stem is about 0.9 to 1.2 m high, covered by sheaths up to 2m in length with alternate and sessile leaves. The fruits are ovoid in shape and tapers to a point surrounded by a permanent calyx. Mature fruit is red and contains a white pulp that surrounds 500-700 seeds. Flowering begins in September and fruiting in December. The seeds are small, highly aromatic with grainy testa and white kernel and have a very hot taste.
Aframomum is cultivated by seed or by rhizome division. Cultivation of Aframomum under cocoa plantations is a common practice in the Eastern Region, particularly in the Akanteng area. Division of rhizome is the preferred method of propagation. Pruning of old leaves is crucial for sustained plant growth. Seeds normally emerge 7-12 days after sowing. Seedlings can be transplanted to the field after 6-8 weeks. The first crop can be harvested 9-11 months after transplanting. Under good management this plant can be cropped for up to 10 years. It is harvested between February and June when the pod changes colour from green to red. Green pods contain pale brown immature seeds that do not have the characteristic flavour. Red pods however contain dark brown mature seeds that have a pungent taste.

**Uses**
In Ghana, the seeds of Aframomum are widely used in spicing meat, sauces and soups and mixed with other herbs for the treatment of body pains and rheumatism. Internationally it is used as a spice in the catering industry. Traditionally, the seeds are chewed to cure dysentery, as a sedative against toothache, to guard against rheumatism and migraine and cure fever. The rhizomes are also used in many herbal medicinal formulae. The seed is ground into a soft paste which has anti-biotic properties. The essential oil of Aframomum has exhibited activity against gram-positive and gram-negative bacteria as well as candida albikans.

**Cocoa establishment and Aframomum intercropping: potential environmental sustainability and biodiversity conservation**
Its cultivation has long been associated with cocoa plantations. In the Eastern Region, especially in the Akanteng area, Aframomum is cultivated as an under storey cover in cocoa plantations, mainly for its economic benefits. Division of rhizome is the preferred method of propagation. Seeds normally emerge 7-12 days after sowing, and seedlings can be transplanted after 6-8 weeks. The first crop can be harvested 9-11 months after transplanting. Under good management, Aframomum can be cropped for up to 10 years. The environmental benefits include total soil cover, prevention of runoff, moisture conservation and keeping the floor of the cocoa plantation moist all the time. It has the potential to sequester carbon and suppress weeds in the farm. It presents an agro-diverse system with a potential enhancement of below-ground microfauna diversity. These potential benefits and others need to be ascertained through research. Seedling production for farmers is an on-going activity by the ASNAPP-KNUST collaboration; particularly for communities in the Goaso District.

**Aframomum maleguetta and Export Trade: Income generation, employment and livelihood enhancement**
Grains of Paradise is among the commonly traded spices within the West African sub region. Although brisk business occurs at the local scene, especially in Akanteng, there are, however, limited statistics on the exports of these products in Ghana. In 2006, the estimated volume exported per annum was 50 tons valued at $200,000. Currently, experts estimate over $ 2 million trade.

**Thaumatococcus danielli**

**Distribution and description**
Thaumatococcus belongs to the family Maranthaceae. The local names in Twi are Anworam; Aworamaba, Anworamase; and in Ewe: Aklamakpa. Thaumatococcus occurs under cover in most rainforest regions in West Africa especially in Ghana, Nigeria, Côte d’Ivoire and Liberia. In Ghana, it grows in the semi-deciduous and deciduous forests where rainfall does not exceed 2000 mm annually. These agro-ecological zones cover the cocoa growing region of Ghana.
Thaumatococcus is a herb with a creeping rhizome. The leaves are ovate-elliptic, 50 cm long and 30 cm wide and papery with numerous parallel nerves diverging from midrib. The parent rhizomes continue to produce lateral rhizome and on surface of soil. Each spike is rough as a result of scars of fallen flowers. The fruit is crimson, 3 winged at or just below ground level. The seeds are black with cream coloured aril, hard and shining, surrounded by very sweet gelatinous pulp.

**Uses**

In Ghana, the sweet pulp on the seed and axil is eaten because of its very sweet taste. The seed is put in pap, tea, coffee or mashed kenkey. It is used as a sweetening agent. The leaves are used in wrapping food. The decoction prepared from the roots is believed to have sedative action on mental patients in Congo. The sweetening principle of Thaumatococcus is an active protein known as Thaumatin. Its sweetness relative to sucrose is 750-1600 times (ion weight basis).

**Thaumatococcus and Community Agroforestry Project**

Samartex’s have reforested over 450 ha off-reserve adjacent to one of its forest reserves. This project involved 300 local households as farmers. These farmers have entered into agreement with the company and the paramount chief to work on the project land released by the paramount chief. The farmers plant short to medium-term food and cash crops together with tree seedlings provided by the company on the same piece of land. While the farmers get hundred percent short and medium-term intermediate income from the food and cash crops they plant, they also have a share in the final tree crops which they have helped to tend as a long-term investment. According to the company, the agroforestry project has so far achieved the following:

- Communities have an understanding about environmental impacts of unplanned farming practices.
- Participating farmers alternative means of accessing land by facilitation of agreements between the chiefs and farmers.
- Created employment for about 150 youth including women working on NTFPs. Shifting cultivation has reduced in and around the project communities. This is evidenced by the fact that 95% of the farmers neither practice slash and burn nor shifting cultivation. Farmers in and around the project area have benefited from weekly extension services provided by project staff. Income levels of the communities have increased following the introduction of beekeeping, snail farming and fish farming. Four hundred hectares of plantations have been developed. Farmers are currently operating forty beehives, with an annual production of approximately 240 kg of honey. The project provides a ready market for the produce for both domestic and international markets.

**Thaumatococcus and Export Trade: Income generation, employment and livelihood enhancement**

In Ghana and Côte d’Ivoire, the fruits of Thaumatococcus are harvested from the wild and exported to France and Switzerland. Currently, over 100 acres is under cultivation by Samartex Timber and Plywood Company Limited based in Samreboi, in the Western Region of Ghana. Samartex has recently formed the Thaumatin Company, as part of its strategy to diversify into Non-Timber Forest Products (NTFPs). It is the first food company to be certified in Ghana by SGS to the ISO 22000:2005 standard.

The Thaumatin in Thaumatococcus is processed into a sweetening agent called Talin. The price of Talin in the international markets exceeds $2,000/g. Once the project becomes fully functional, the communities living within the fringes of the forest reserves in Western Region of Ghana are estimated to be able to earn up to $300,000 per annum from the company’s proposed Thaumatococcus out-grower scheme.

The company’s Non-Timber Products (NTFP) (*Thaumatococcus danielli*) processing activities generate income and employment for women at the processing factory. The processing facility currently turns out
300-500 kg of natural Thaumatin from T. danielli fruits. It has plans to step up production to around 800 kg. Currently, 100 women are directly employed as “cutters” (removal of the outer fruit pulp) while around 1,000 to 1,500 individuals from the forest fringe communities are involved in the collection of between the 240 to 400 tons of fruits needed for current production. This does not only ensure the flow of income to the forest fringe communities involved in the fruit collection activities but has helped to enlist their support to guarding the company’s concessions against unauthorized activities by outsiders.

**Black Pepper (Piper nigrum L.)**

**Distribution and description**

*Piper nigrum*, popularly known as “King of spices” and commonly called Black pepper, belongs to the family Piperaceace. The local names are Sorowisa (Twi), Sasema (Fante), and Kale or Kukuabe (Ewe). Black pepper, a shade-tolerant plant, is a climbing vine that can grow up to 12 metres high on trees, climbing by means of small rootlets (adventitious roots) developed along its woody stem at the nodes. The leaves are dark green, oval shaped and glossy and range from 13-25 cm long. It produces white flowers and aromatic fruits (peppercorns) which are red-brown when ripe and black when dry.

Black pepper is native to the damp jungles of South-Western India but has been very successful in Sri Lanka, Malaysia, Indonesia and Brazil. It grows in warm tropical areas with an average temperature of 25°C and annual rainfall ranging from 2000 – 4000 mm. It was introduced to Ghana during the colonial times, and has become adapted to the forest ecology. It grows well in the Eastern, Ashanti, Brong Ahafo and Western Regions which cover the cocoa growing areas in Ghana. The most suitable areas in these regions are those with rainfall exceeding 1200 mm per annum. The African Black pepper (*Piper guineense Schum & Thonn.* ) is much similar to the Asian type in morphology and habit but produces much smaller peppercorns. This species grows wild in the forests along the West Coast of Africa.

The Black pepper plant produces two types of vines; vegetative and reproductive. The vegetative vines are the ones used for propagation. Two main varieties have been introduced into Ghana; “Kalluvali” and “Balancotta”. The Balancotta, with lanceolate leaves, is higher yielding and produces larger peppercorns than the Kalluvali. Seedlings can be raised from mature seeds but such seedlings take much longer (6 – 8 years) to start fruiting. Seedlings from vine cuttings start bearing in the third year with a peak from 6 – 8 years. The plant can bear fruits up to 30 years. In a season, a single plant in the wild can produce about 2 kg of peppercorns while commercially planted peppers yield up to 10 kg.

Black pepper is a vine and therefore requires a permanent stake. *Gliricidia sepium*, provides the best life stake for Black pepper. The vine is trained to climb the Gliricidia to a height of about 3.5 m and the Gliricidia pruned periodically to keep the plant within a convenient height that can be harvested.

**Uses**

Black pepper has a variety of uses. From the ancient use in embalming, it is now largely used by meat packers and in canning, pickling, baking, confectionary and preparation of beverages. The active principles in Black pepper responsible for its peppery taste are piperidine and piperine. Black pepper constitutes an important component of culinary seasonings of universal use and an essential ingredient of numerous commercial foodstuffs. The oil of black pepper, obtained by the steam distillation of crushed black pepper or as a by-product in the manufacture of white pepper by steaming, is a valuable adjunct in the flavouring of sausages, canned meat, soups, table sauces and certain beverages and liquors. It is also used in perfumery. White pepper commands a higher price for use in such products as mayonnaise.

**Medicinal uses**
The fruits are used to treat lumbago, bronchitis, catarrh, laryngitis, fibroid, schizophrenia; seeds for male sexual impotence (partial) and boils; leaves for treatment of wounds; roots for chest pains and stem bark for dyspepsia.

**Black pepper as an Intercrop in Cocoa Plantations**

As a vine Black pepper requires a permanent stake. *Gliricidia sepium*, commonly used as a shade plant during the establishment phase of cocoa, is the best life stake for Black pepper. The vine is trained to climb the Gliricidia at a height of about 3.5 m and the Gliricidia pruned periodically to keep the plant within a convenient height to facilitate the harvesting of the Blackpepper. The use of Gliricidia as a shade plant in cocoa offers the opportunity to introduce Black pepper into cocoa agroforest as an intercrop. Instead of getting rid of Gliricidia shade at cocoa canopy closure, the plants can be pruned to serve as stakes for the trained Black pepper to from Black pepper columns within the cocoa plantations. A model cocoa-Black pepper intercrop is located at Osino, in the Eastern Region. Such an intercrop can provide additional income for cocoa farmers and contribute to livelihood enhancement and agro-diversity. Research would however be required to ascertain the optimum density and compatibility of the crop clusters. ASNAPP and its KNUST partners are already providing planting materials for supply to farmers alongside the provision of the requisite propagation and management protocols. This base can be broadened by collaborating with the seed production unit of COCOBOD.

**Black pepper and Export Trade**

Black pepper is one of the largest commodities in the International spice trade. Of the total world trade in spice of about US$ 270 million, 37% is pepper. Ninety percent of the trade is supplied by India, Malaysia, Indonesia, Brazil and Sri Lanka. Two types of commercial pepper can be prepared from the berries: Black pepper from the fully mature but unripe (green) berries, sun-cured in polythene for 2 days to turn black and dried. White pepper from the fully mature ripe (red) berries, soaked in water to remove skin and dried.

Ghana exports Black pepper to Burkina Faso and Mali. Estimate volume traded is about 80 t/annum valued at $400,000. Indications are that as a result of recent growth in the tourism industry and fast foods, current demand cannot be met. A market survey in Ghana and in the West Africa sub-region would be required to provide the necessary information for promoting the cultivation of Black pepper.

**Pycnanthus angolensis**

**Distribution and description**

*Pycnanthus angolensis* also known as Pycnanthus Kombo, belongs to the family Myristicaceae. The local names are Otie (Twi) and Etsiw (Fante). Pycnanthus is one of the lesser known timber species in Ghana which grows to a height of about 35 to 40 metres. It is a humid dense forest species widespread in the cocoa growing areas in Ghana. Currently, it generally grows in the wild. The plant has a straight cylindrical bole and rough bark. The leaves are oblong covered underneath with ferrugineous hair. The fruits are oblong and break into two thick halves when matured and dry. The seeds are black with a pink aril.

**Uses**

Kombo has several medicinal uses. The leaves are used to treat thrush; the stem for threatened abortion, anaemia, chest pain, headache; and the roots for helmintiasis. The seeds of the plant have no known traditional use. In an attempt to develop new plant products from West Africa and explore international market demand, ASNAPP and its partner Bio Resources International (BRI) Ltd. extracted the Kombo butter from the seed. The Kombo butter is unique as a major plant source of Kombic acide (cetylmy-
ristoleic acid (CMO)) composed approximately 50% CMO. Apart from CMO, there is also CMO precursors which stimulate the production of CMO for the treatment of arthritis and gout.

Kombo butter is also used in the management of body pains and for cosmetic applications. Potential applications of Kombo products include the manufacture of paints and polish. Kombo is also used in the horse industry as a feed supplement.

**Cocoa establishment and Pycnanthus angolensis as a shade tree**
Kombo is one of the plants that farmers deliberately retain on the farm during cocoa establishment to provide shade. It is among the desirable forest trees recommended for shade in cocoa agroforests by the Cocoa Research Institute of Ghana (CRIG). Apart from the environmental attributes of shade and biodiversity enhancement presented earlier under voacanga, Kombo offers opportunities for increasing the incomes and improving the livelihoods of farmers in the cocoa growing communities in Ghana through wildcrafting of the Kombo seeds and processing of Kombo butter for export.

**Pycnanthus angolensis and Export Trade: Employment, income generation and livelihood enhancement**

No commercial use had been found for the Kombo nuts until BRI collaborated with ASNAPP to develop commercial products out of the seeds. These novel products include Kombic acid and CMO precursors and their uses.

BRI has secured a market in the US for refined Kombo and is partnering with ASNAPP, Kwame Nkrumah University of Science and Technology (KNUST) and Rutgers University to deliver high quality refined Kombo butter to the market. In 2007, ASNAPP and its partners sourced for 30 t of Kombo butter by working with two women groups (a total of 50 processors) to source and process 100 t of Kombo nuts. Two hundred people were involved in the wild collection of Kombo nuts which generated over $30,000 and the two women’s groups generated over $50,000 from processing the Kombo butter. Currently a Kombo processing facility has been constructed in Begoro to process raw materials from the Kibi and Atiwa catchment areas in the Eastern Region. These activities are providing incomes for women groups as well as collectors of the nut.

There is the need for awareness creation in the cocoa growing communities to take advantage for collecting and processing the nuts of Kombo trees in the farms for additional income generation. Since harvesting of Kombo occurs between November and April, an off-farming period, most communities can engage in the Kombo business.

**Syncepalum dulcificum**

**Distribution and description**

*Syncepalum dulcificum*, commonly known as Miracle Berry, is native to West Africa. The common name is Asaa, Asawa (Twi) and Ledidi (Ewe). In Ghana it is found throughout the South from the Savanna to the fringes of the forest zone. Large populations are reported in Aburi – Akwapim ridge. It is also widespread in Bunso, Asamankese, Kibi, Komenda, Kpando, Nkonya, Wora wora, Afram Plains, Ankansa forest and Mpraeso. Small plantations have been established at Bunso cocoa station and Nsawam.

Miracle Berry is a perennial shrub growing up to 2 – 5 metres in height. The leaves form dense foliage clustered around the tip of the branches. The plants flower and bear green oblong shaped fruits twice in a year (February – June and September to December). The fruits, about 2 cm long are borne individually surrounded by a cluster of leaves. The skin turns bright red when ripe. The active principle, Miraculin, is
contained in the pulp surrounding the large olive seed. Miraculin has a taste modifying properties which turn sour foods and drinks sweet if eaten prior to taking the food or drink. The fruits deteriorate and lose their taste-modifying properties after a few days of harvest.

The plant is propagated from seed and takes about 6 – 8 years to come into fruiting. This has not made it an attractive crop for investment. Research by KNUST – ASNAPP partnership has succeeded in producing seedlings from matured cuttings which started bearing in 2 years.

Uses
Miraculin has diverse potential applications as a taste-masking and sweetening agent, flavour enhancer, condiment, appetizer, food, pharmaceutical as well as ingredient in cosmetics.

The economic potential of the plant and its use as an intercrop in cocoa farms have not received much attention. The promotion of the crop will require, among others, sourcing for well-organized local and export markets, research into vegetative propagation and cultivation, compatibility as an intercrop in cocoa to generate additional income and provision of logistical support for industrial processing of the Miraculin and organized infrastructure for quick delivery of berried to processing centres.
Appendix 6: Environmental Curriculum Stakeholder meeting

**SUMMARY REPORT ON STAKEHOLDERS’S MEETING ON COCOA MANUAL**  
16th September, 2010 at the Mac Dic Royal Hotel, Koforidua

The stakeholders’ meeting was organized under the auspices of Cocoa Research Institute of Ghana (CRIG). The meeting was chaired by Mr. I.Y. Opoku and it started at about 8:54 am. The aim of the meeting as echoed by the chairman was to enable the various stakeholders present to go through the proposed cocoa manual and then make appropriate recommendations where necessary. The meeting was divided into two sessions. The first session which was facilitated by Dr. F. Baah aimed at reviewing the entire document. The review was done in a chronological order of the chapters. The second session was facilitated by Dr. James K. Adomako. He concentrated on environmental issues with cocoa cultivation.

The review started with Dr. K. Opoku Ameyaw. He gave a brief overview of the entire manual. The first aspect of the manual which was looked at was the cover page. The meeting suggested that the cocoa picture on the cover page be changed for a better picture of a healthy cocoa.

For chapter One, the meeting suggested the need to make reference to the sources of information given in the book to avoid plagiarism. Also the sources of the pictures and graphs shown in the book should be indicated.

On chapter two, the meeting suggested the need for a glossary to explain the technical terms used since the chapter appeared very scientific. It was also suggested that the entomologist provides a list of all the insect pollinators.

On chapter three it was suggested by the meeting that a chart is needed to match the phenology of the crop to the main climatic pattern that exists in the country. It was also suggested that emphasis be given to the production requirement in the marginal areas as opposed to the more productive zones.

It was suggested on chapter four that the source of seed for nursery and the age of transplanting be stated. Attention was drawn to the fact that some of the pictures and writings appeared more biased in favour of using poly bags as against seed beds. It was also suggested that the manual should indicate the sources of top soil for nursing cocoa.

The meeting suggested on chapter five that a modern soil classification be made available to replace what already exists in the book. It was also agreed that some indigenous knowledge was needed on soil selection for cocoa production. On the issue of not getting the right pictures to make the best representations, the meeting suggested that sketches be made to do that job. It was suggested that a list of compatible multipurpose trees be provided to give shade in cocoa farms. The recommended density for identifying compatible food crops and intercross should also be provided. The meeting also stressed the need for environmental issues such as not planting in forest reserve, on steep slopes and along the banks of rivers.

In chapter 6 to 8, the meeting also expected to see an easy way to understand how shade trees provide levels of shade in cocoa production and also proper management of the use of *gliricidia* as shade. It was also expected that a sketch of how cocoa planted in artificially established shade tree should look like. It was also established that there should be an illustration on various tools used for specific purposes such as for pruning, mistletoe removal and others. The meeting also expected the manual to establish that good canopy closure is good for weed control.
The meeting suggested that chapter eleven be renamed as soil fertility and plant nutrition. It was also established that the method for effective fertilizer storage was also needed. The sources of organic fertilizers were also expected to be stated in the manual. It was suggested vehemently in chapter twelve that the statements and its associated pictures which suggested the use of traps by farmers to kill rodents be removed. This was to bring the manual into conformity with the wildlife conservation laws of Ghana.

For chapter 13, it was strongly advocated that a clearer picture depicting the symptoms of Cocoa Swollen Shoot Disease (C.S.S.V.D.) be used as well as confusing symptoms of C.S.S.V.D. It was also suggested that local names of the disease be introduced into the manual where possible.

On chapter fourteen, it was suggested that the photograph of the standard pruners of mistletoes removal be made available.

On chapter fifteen the meeting generally agreed that a lot more information on rehabilitation methods was required. Also the option of rehabilitation was needed to be included in the manual. It was also stated that the CSSVD control program and the rehabilitation program be well highlighted. It was also indicated that it was also important to show all the indicators that suggest that a field or farm should be rehabilitated.

The second section dealt with environmental issues and Dr. James K. Adomako presented a brief introduction on some environmentally sustainable cocoa cultivation thematic areas. The meeting was then divided into three topical groups, with the environment as the focal point. The groups fell under the following topics:

**Group One - Establishment of old and new farms**

On the establishment of old and new farms, the group identified the following environmental issues:
(1) Destruction of available forest for the cultivation of cocoa; (2) Loss of biodiversity; and (3) No protection of water bodies.

The following best environmental practices were also suggested by the group:
(1) Agro forestry; (2) Landscape restoration; (3) Creation of buffer zones around water bodies; and (4) not cultivating along hilly areas.

The group also suggested that farmers be given the requisite training and incentives to adopt the best environmental practices.

**Group Two - Management of pest and diseases**

The group suggested that the following be included in the manual as part of pest and disease management:
(1) Safe use and disposal of pesticides and containers respectively; (2) Emphasis on prevention of pest and diseases, taking into account, sanitation; and (3) Protection of water bodies from chemicals use of unapproved pesticides.

The group also listed some gaps in environmental best practices as follows:
(1) Pheromones; (2) Botanicals Microbial (pathogens) (3) Leaching rates of chemicals applied on cocoa (4) Traditional knowledge of pest control; and (5) Development of materials to address specific problems.

Some of the barriers established by the group are listed below:
(1) Lack of sufficient knowledge; (2) Lack of resource for the implementation of some of the best practices; (3) Inadequate labor; and (4) Low extension to farmer ratio.
The group stated some best environmental practices as far as soil management is concerned:
(1) The correct rate of application of fertilizer; (2) Buffer zone establishment; (3) Erosion control; and (4) Accurate farm sizes for correct fertiliser requirements.

The group stated some of the reasons why farmer do use the best practices as including:
(1) Lack of knowledge; (2) Lack of funds and credit facilities for farmers; and (3) Land tenure systems.

Within the limited time, the meeting was able to identify the best environmental practices and ways of encouraging their adoption. The review ended with the chairmen urging the entire participants of the meeting and the stakeholders present to keep reading the draft manual and send any suggestions via email to the technical team within a period of two weeks. This was expected to aid the technical team develop the best and most concise document for better cocoa extension purposes. The chairman also stated that the manual is the first edition and that he expected there would be a need for further editions to improve knowledge.

**LIST OF PARTICIPANTS**

<table>
<thead>
<tr>
<th>Humphrey Ayisi</th>
<th>Frank Kuklinski</th>
<th>E. Owusu-Bennoah</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samuel Kofi Nyame</td>
<td>Vince Mc Aleer</td>
<td>Henry Dzahini-Obiatey</td>
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<tr>
<td>V.M. Anchirinah</td>
<td>G. J. Anim-Kwapong</td>
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<tr>
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<tr>
<td>F.K. Oppong</td>
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Appendix 7: International Review Environmental Practices in Cocoa

The review is structured as follows:

1. An overview of Environmentally Sustainable Practices in relation to;
   - Integrated Cocoa Farming and Optimal Shade Management
   - Water management
   - Soil management
   - Climate change
   - Pests and diseases of cocoa
   - Post harvest activities
   - Biodiversity habitat management
   - Carbon management and payments of ecosystem services

2. Economic Analysis of Good Environmental Practices in relation to;
   - Disease management
   - Comparison of shaded versus unshaded cocoa
   - Comparison of organic verses inorganic fertilisers
   - Solar drying technologies

3. Effectiveness of Additional Tools for Environmental Best Practices
   - Certification
   - Improving capacity building and extension
   - Samples of policy, legislation and incentives

4. Summary
   - Best environmental practices used and under development
   - Benefits to cocoa and environmental services provided by shade trees

1. Overview of Environmentally Sustainable Practices in Relation to Cocoa Production

This appendix reviews international environmental issues facing cocoa production and the range of options for dealing with such issues on a more sustainable basis. The scope of the review covers water and soil management, crop diversification, climate change, pests and diseases, post-harvest issues, integrating conservation with cocoa production and ways of making conservation strategies financially attractive to farmers. Practices currently employed are highlighted as well as schemes under development and possible future options. The financial feasibility of some of the environmental best practices is examined, and the effectiveness of some tools to encourage adoption of sustainable practices is explored.

1.1 Integrated Cocoa Farming and Optimal Shade Management

Integrated cocoa farming, (i.e. growing additional crops alongside and/or within cocoa growing systems) has the potential to reduce pressure on forest clearing by providing increased income and food for the farmer. In order to achieve maximum productivity optimal management of shade and/or companion crops is needed. The ways in which additional crops may be grown in conjunction with cocoa can be classified as follows:
   - Use of tree crops as overhead shade
   - Planting of crops on parts of the farm which may not be suitable for cocoa
   - Use of barrier crops to protect against the spread of cocoa swollen shoot virus
1.1.1. Establishment Phase
During the establishment phase, cocoa plants are more susceptible to environmental stresses due to the fact that there is little or no self-shading within the plant (overlapping of leaves) and the root system is not well developed. Plantain is commonly used as a temporary shade worldwide; it provides good early shade but is also a heavy feeder. Additional crops which may be grown in conjunction with cocoa in West Africa include cocoyam, maize, cassava, yam and various vegetative crops (Appiah and Pereira, 2004). These crops provide an income for the farmer during the non-yielding phase of cocoa establishment. For example, Opoku-Ameyaw et al. (2005) calculated the costs and benefits associated with intercropping cocoa with various combinations of plantain, maize and cassava in Ghana, which are summarised in Table 2. Since considerable inflation has occurred in Ghana during the past ten years, a relative benefit index is also included in this table. The use of such temporary shade also reduces the need for weed control and potential herbicide usage.

Table 2. Economics of intercropping food crops with cocoa during the first three years of planting. Figures are in New Ghana cedis for the seasons 1998/9 to 2000/1 (adapted from Opoku-Ameyaw et al., 2005)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Net benefit</th>
<th>‘98/99 (year 1)</th>
<th>‘99/00 (year 2)</th>
<th>‘00/01 (year 3)</th>
<th>Cumulative</th>
<th>Relative benefit*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sole cocoa</td>
<td>-20.96</td>
<td>-17.22</td>
<td>-22.96</td>
<td>-66.14</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Cocoa/ plantain</td>
<td>-26.20</td>
<td>+118.5</td>
<td>-27.44</td>
<td>+64.84</td>
<td>1.98</td>
<td></td>
</tr>
<tr>
<td>Cocoa/ cassava</td>
<td>+200.0</td>
<td>-1.01</td>
<td>-3.445</td>
<td>+195.6</td>
<td>3.96</td>
<td></td>
</tr>
<tr>
<td>Cocoa/ maize</td>
<td>+69.82</td>
<td>-44.35</td>
<td>-37.70</td>
<td>-12.23</td>
<td>0.82</td>
<td></td>
</tr>
<tr>
<td>Cocoa/ cassava/plantain</td>
<td>+181.0</td>
<td>+122.8</td>
<td>-9.67</td>
<td>+299.1</td>
<td>5.52</td>
<td></td>
</tr>
<tr>
<td>Cocoa/cassava/maize</td>
<td>+296.0</td>
<td>-26.34</td>
<td>-19.77</td>
<td>+250.0</td>
<td>4.78</td>
<td></td>
</tr>
<tr>
<td>Cocoa/plantain/maize</td>
<td>+59.86</td>
<td>+139.9</td>
<td>-40.81</td>
<td>+159.0</td>
<td>3.40</td>
<td></td>
</tr>
<tr>
<td>Cocoa/plantain/cassava/maize</td>
<td>+201.6</td>
<td>+52.75</td>
<td>-35.19</td>
<td>+219.2</td>
<td>4.31</td>
<td></td>
</tr>
</tbody>
</table>

The benefit ratio (+) or loss(-) in comparison to the cost of establishing sole cocoa [i.e. (a-b)/-b]

1.1.2. Tree Crops as Overhead Shade
The amount of overhead shade used on cocoa farms varies greatly from region to region and also between farms within a region. Shade trees have the potential to ameliorate the microenvironment of high temperatures, low relative humidity and soil water stress and hence reduce physiological stress in cocoa trees (which can also lead to greater pest and disease incidence). Shade usage can also be an important part of soil and water management [see also sections 2.2 and 2.3]. Trees used for overhead shade should ideally have the following attributes (see Table 3):

The light environment under the canopy should be fairly even both spatially and temporally (i.e. the trees need to maintain their leaves during any dry season). This ensures the cocoa canopy is not excessively shaded during the wet season (leading to low yields and conditions favourable to fungal diseases) or exposed to high light levels (causing photoinhibition) during the dry season. The root system should be deep, thus reducing competition for water and nutrients with the cocoa trees. The shade trees should have positive allelopathic affects and not harbour significant pests and diseases of cocoa.

Some attempts have been made to quantify the best planting arrangements of cocoa with fruit trees. In Ghana, for example, the optimal planting combination for a cocoa and coconut intercrop system was found to be 3 *3 m (square planting) for cocoa and 9.8 m triangular planting for coconut (Osei-Bonsu et al., 2002). Examples of advice on the density of other complementary species of cocoa (timber and fruit tree species) are given in Sonwa and Weise (2008). However, further research is needed to optimise the
planting arrangement of other economic tree species with cocoa. If appropriate species are utilised along with optimal husbandry practices, the potential exists for farmers to increase their income but also to diversify their income thus providing a buffer against, for example, lower cocoa prices or unexpected cocoa losses. Examples of complementary crops used at the establishment phase and with mature cocoa are given in Table 4, whilst forest trees recommended and not recommended by CRIG in Ghana are summarised in Table 5.

There is some evidence that particular cocoa varieties may be better suited than others for growth under shade. For example, different cocoa genotypes have been shown to vary in their quantum yield (i.e. the photosynthetic performance at low light levels) (Daymond et al., 2010). Cocoa genotypes also vary in their canopy characteristics (Daymond et al., 2002); those with more open canopies will be better suited to growth under shade. Data from field trials on the response of different cocoa varieties to shade intensity is currently limited.

Research in Costa Rica has shown that there are various ways in which both the cocoa and shade may be manipulated to maximise the productivity of cocoa under shade. Growing the cocoa at an appropriate density and pruning to ensure lower branches are illuminated will reduce the amount of self shading thereby ensuring that a large proportion of the leaves are receiving enough light to photosynthesise. Additionally, careful timing of the pruning and pollarding the shade trees will ensure that the cocoa trees receive maximal light times when their light requirements are greatest (e.g. during flowering and pod setting) (Somarriba, 2007).

Table 3. Ideal shade characteristics for optimisation of cocoa production

<table>
<thead>
<tr>
<th>Shade component</th>
<th>Ideal characteristic</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canopy</td>
<td>Even distribution of light needed over space and time</td>
<td>Good light distribution:</td>
</tr>
<tr>
<td></td>
<td>Spreading habit with a sufficiently large crown to shade cocoa trees</td>
<td><em>Terminalia ivorensis</em> (wide crown,</td>
</tr>
<tr>
<td></td>
<td>Not too dense</td>
<td>retain leaves until end of dry season)*</td>
</tr>
<tr>
<td></td>
<td>Height of canopy needs to be sufficiently clear of cocoa</td>
<td><em>Gliricidia sepium</em> (small leaves)</td>
</tr>
<tr>
<td></td>
<td>Evenly distributed and/or small leaves</td>
<td><em>Albizia adianthifolia</em> (light canopy)</td>
</tr>
<tr>
<td></td>
<td>Retention of leaves during the dry season</td>
<td></td>
</tr>
<tr>
<td>Roots</td>
<td>Minimal competition with cocoa for water and nutrients</td>
<td>Deep-rooted trees:</td>
</tr>
<tr>
<td></td>
<td>Deep root systems</td>
<td><em>Entandrophragma angolense</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Petersianthus macrocarpus</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Grewia mollis</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Competitive species:</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Ficus exasperate</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Triplochiton scleroxylon</em></td>
</tr>
<tr>
<td>Biotic factors</td>
<td>Should not be host to significant pests and diseases</td>
<td>Trees which harbour significant pests</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Triplochiton scleroxylon</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Cola chlamydantha</em> (CSSV host)</td>
</tr>
</tbody>
</table>

Table 4. Examples of complementary crops grown with cocoa at the establishment and mature phases (either as shade or in adjacent plots)

<table>
<thead>
<tr>
<th>Establishment phase</th>
<th>Mature phase</th>
</tr>
</thead>
</table>

99
Table 5. Forest trees recommended and not-recommended by the Cocoa Research Institute of Ghana (Mannu and Tetteh, 1987)

<table>
<thead>
<tr>
<th>Recommended</th>
<th>Not recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminalia ivorensis</td>
<td>Adonsonia digitata</td>
</tr>
<tr>
<td>Terminalia superb</td>
<td>Blighia sapida</td>
</tr>
<tr>
<td>Milicia excels</td>
<td>Canthium glabriflorum</td>
</tr>
<tr>
<td>Albizia coriaria</td>
<td>Carapa procera</td>
</tr>
<tr>
<td>Entandrophragma angolense</td>
<td>Ceiba pentandra</td>
</tr>
<tr>
<td>Funtumia elastic</td>
<td>Cola chlamydantha</td>
</tr>
<tr>
<td>Alstonia boonei</td>
<td>Cola gigantia</td>
</tr>
<tr>
<td>Pychnanthus angolensis</td>
<td>Lecaniodiscus cupanoides</td>
</tr>
<tr>
<td></td>
<td>Musanga cecropioides</td>
</tr>
<tr>
<td></td>
<td>Myrianthus arbores</td>
</tr>
</tbody>
</table>

1.1.3. Cultivation of Supplementary Crops
Farmers may cultivate parts of their farm with additional crops if those parts are unsuitable for cocoa cultivation (e.g. due to topography), either to generate additional revenue or to satisfy domestic food needs. The farmer may also choose to grow economic trees species (fruit or timber species) in separate areas if they do not intercrop well with cocoa thereby maximising the utility of the farm.

The planting of crops as barriers around the edge of the farm should be practiced to prevent disease spread and soil erosion [see sections 2.3 and 2.5].

1.1.4. Summary of Implementable Strategies
The following environmental best practices are recommended in terms of integrated farming:-
- Use of complementary crops during the establishment phase
- Use of shade trees species with an economic value to provide additional income
- Optimisation of the management of both the shade species and the cocoa to maximise productivity
- Cultivation of supplementary crops on parts of the farm not suitable for cocoa cultivation

1.2. Water Management

1.2.1. Regional Variation in Water Stress
Cocoa is sensitive to water stress. This is particularly the case at the establishment phase when root-systems are poorly developed and there is little self-shading within the canopy. In mature cocoa, since water stress results in reduced photosynthetic assimilation prolonged periods of water stress can bring about subsequent reductions in yield and bean size.

In many cocoa-growing regions of West Africa and parts of Central and South America there is a distinct dry season (see Table 6). In most of West Africa, this lasts for two-three months. Climate change is predicted to bring about more intense dry periods in parts of West Africa (Bates et al., 2008).
Table 6. Summary of major annual rainfall distribution in cocoa-growing regions (source: Wood, 1985a and references within)

<table>
<thead>
<tr>
<th>Growing Region</th>
<th>Annual Rainfall (mm)</th>
<th>Number of consecutive months when rainfall less than 50 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>WEST AFRICA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cameroon – Yaoundé</td>
<td>1,711</td>
<td>2</td>
</tr>
<tr>
<td>Ghana- Tafo</td>
<td>1,600</td>
<td>1</td>
</tr>
<tr>
<td>Ivory Coast- Gagnoa</td>
<td>1,326</td>
<td>2</td>
</tr>
<tr>
<td>Nigeria- Ondo</td>
<td>1,634</td>
<td>3</td>
</tr>
<tr>
<td>SOUTH AMERICA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil- Itabuna, Bahia</td>
<td>1,720</td>
<td>0</td>
</tr>
<tr>
<td>Ecuador- Pichilingue</td>
<td>2,046</td>
<td>5</td>
</tr>
<tr>
<td>SOUTH EAST ASIA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malaysia- Lower Perak</td>
<td>1,951</td>
<td>0</td>
</tr>
</tbody>
</table>

1.2.2. Adapting to Water Stress
Environmentally sensitive strategies to deal with water stress may involve the following:

i). Reduction of water loss through, for example, the use of mulching and overhead shade

ii). Use of systematic irrigation

iii). Selection of cocoa varieties that perform better under water stress conditions.

The organic mulches can reduce evaporative water loss from the soil and has potential applications in regions that have a distinct dry season or more intermittent rainfall. It appears that uptake of the practice is limited in West Africa. Amoah et al. (2005) highlight the high cost and labour involved in transporting large volumes of mulch material as an impediment to adoption by farmers. Nevertheless, in a trial in Afosu, Ghana (an area that has a distinct dry season) the same researchers showed that the use of organic mulches (cocoa bean shells and coffee bean husks) reduced seedling mortality and increased early yields (probably due to increased early assimilation and hence faster canopy development)[see also section 2.3]. In the same region of Ghana, trials by Frimpong et al. (1994) using plantain pseudostems indicated a significant increase in survivorship of young cocoa (31.7% greater than the control).

The use of overhead shade may be either beneficial or detrimental to water conservation. Overhead shade reduces evaporative water loss from the soil by producing a microclimate that has a lower temperature and a higher humidity. On the other hand, the shade species may compete with the cocoa for water. Ultimately, whether overhead shade trees are a net benefit to the cocoa in ameliorating water loss or whether they are a net competitor depends on a number of factors. These include, the age of the shade species, its planting density, the intensity of the drought event and, critically, the shade species used. Examples of shade species that are competitive and non competitive are given in Table 3.

Irrigation systems are not widely used in cocoa cultivation, although drainage ditches are sometimes used to store water (Lass, 1985). An exemption is found in India where research at the Central Plantations Research Institute in Kerala, have identified irrigation thresholds and optimum irrigation levels. Stress symptoms in the cocoa were observed at drip irrigation levels of 10 litres per day, whilst optimal responses and yields were achieved at 20 litres per day (Balasimha and Apshara, 2007). Such a study could potentially be applied to other growing regions to determine regional specific optimal irrigation schedules.
There is a fair body of evidence for variation in the capacity of different cocoa varieties to conserve water through more rapid closure of stomatal pores in response to soil water deficit (Balasimha and Daniel, 1988; Balasimha et al., 1988; Balasimha et al., 1999; de Almeida, 2003). Furthermore, it has been shown that cocoa varieties vary in their water use efficiency (Daymond et al. 2010), that is the rate of photosynthetic carbon assimilation per unit of water lost through transpiration. Little is known about variation in the capacity of different varieties to extract water through their root systems. Breeding programmes in India are including drought tolerant accessions as parents (Balasimha and Apshara, 2007). With increasing concern about water stress as a result of global climate change and localised deforestation, it is highly likely that tolerance to water stress will become incorporated into breeding programmes in West Africa.

1.2.3. Summary of Implementable Strategies
The following environmental best practices are recommended in terms of water management:
(1) Use of organic mulches during the dry season particularly at the established stage; (2) Education of farmers as to which shade species are least competitive for water; and (3) Use of scheduled irrigation in areas where the dry season is more marked.

1.3. Soil Management

Key environmental issues related to soils on and around cocoa farms are: 1) soil erosion; 2) soil degradation; and 3) nutrient run-off.

1.3.1. Soil Erosion
Soil erosion may be a problem for cocoa farms that are in particularly exposed locations. The planting of trees as wind-breaks is often recommended to reduce such erosion. Erosion is greater during the establishment stage; the use of organic mulches and live mulching, such as Flemingia macrophylla can help to protect the soil against erosion (Oppong et al, 1998).

1.3.2. Maintenance of Soil Quality
Soil degradation is a serious issue affecting the sustainability of cocoa production in large parts of West Africa. In Côte d’Ivoire where cocoa is increasingly being cultivated with little or no shade, farmers will often move on from a particular area once the soil has become depleted. Furthermore, in Ghana, there has been a large shift in cocoa cultivation from the Eastern to the Western region, largely due to soil degradation. Such a shifting agricultural pattern puts increasing pressure on remaining forested land. Therefore, whilst excessive or inappropriate applications of fertiliser have well documented environmental side effects (leaching, water pollution etc.), neglect of soil maintenance also has serious environmental consequences in leading to shifting cultivation. Thus strategies to maintain soil fertility/quality in cocoa farms are an integral part of sustainable production.

It has long been established that there is an interaction between the nutrient requirements of cocoa and shade levels. The use of shade can help with maintaining soil organic matter content, although species that compete heavily for water and nutrients, such as debema and kola trees should be avoided (Petithuguenin et al., 2004). Long term field trials at the Cocoa Research Institute of Ghana (CRIG) revealed that under no shade conditions, yields were higher although could only be maintained over time with fertiliser input. In contrast, shaded plots were lower yielding but maintained their yields over longer periods (Ahenkorah et al, 1987). The study, however, also showed depletion of soil phosphorus in all shade regimes over time, suggesting that shade usage alone is not a complete substitute for fertiliser applications. The importance of soil type in determining the shade requirement for cocoa is highlighted by Petithuguenin et al. (2004) using Cameroon as an example. In the S. Central region, the soils are low in chemical nutrients and organic matter content. Here cocoa is grown under the shade of residual forest canopy. In
the south-west of the country the soils are volcanic and rich in minerals with a high porosity. In this region, cocoa is grown largely without shade or with little shade.

Studies on fertiliser inputs on cocoa farms generally show that nitrogen inputs make little or no difference to yields, whereas phosphorus and potassium inputs can result in a marked improvement in yield. The process of harvesting and removing pods from a cocoa farm represents a gradual removal of nutrients. Farmers will sometimes scatter the pods husks within the cocoa farm which act as decomposable mulch, thereby returning some of these nutrients to the soil, particularly potassium. However, poor practices are common, whereby pod husks are simply piled up in a corner of the farm. In areas where Phytophthora is prevalent, there is a danger that the pod husks can act as a source of inoculum. A solution to this is to ash the pod husks before application to the soil (Ahenkorah et al., 1981) thereby killing any Phytophthora spores. Such ash contains around 38% potassium and 1.5% phosphorus. Currently, the alternative products division of CRIG produces cocoa pod ash fertiliser on a small scale only. However, ashing kilns could potentially be set up on a village wide basis, reducing the set up cost of this procedure. Alternatively, or in addition to this, pods could be shredded using a shredding machine, such as has been used recently in a project in Nigeria (WCF, 2010).

The role of decomposing cocoa leaves in the phosphorus dynamics of cocoa soils in Ghana was investigated by Ofori-Frimpong and Rowell (1999). The authors point out that phosphorus in the decomposing litter may become immobilised at least for part of the year by soil microbial biomass. Their experiments demonstrated that addition of inorganic phosphorus to the leaf litter stimulated mineralization and therefore ground fertilization in the field might increase the rate of phosphorus released by the litter.

Any applications of fertiliser to cocoa farms should ideally be preceded by a soil analysis. This allows the fertiliser regimes to be targeted to the needs of individual farms or to local landscapes. This increases the benefit to cost ratio and limits excessive nutrient application and consequent problems of run-off. In practice, most cocoa farmers currently do not have access to reliable and affordable bodies that conduct soil analyses.

Organic composts have the advantage of improving soil organic matter as well as generally releasing nutrients more slowly (although, as with inorganic fertilizers, care needs to be taken not to over-fertilise in order to minimize run-off). Reports on the use of organic manures in cocoa are relatively sparse. A study by Afrifra et al. (2002) working in Ghana demonstrated a modest increase in yield in response to additions of chicken manure along with the aforementioned cocoa husk potash.

The use of rock phosphate to enrich organic fertilisers is practiced on a large, high yielding farm in Costa Rica (Hermelink, 2005). The effectiveness of this practice should be researched in West Africa.

1.3.3. Restoration of Fallow Land

Since cocoa farming has the potential to encroach further on primary and secondary forests, employment of strategies are needed to restore fallow land that has previously been used for other crops. Examples of successful conversions of crops usage include conversion of coffee plantations to cocoa in Côte d’Ivoire (Freud et al., 2000) and conversion of clove plantations in Indonesia (Petithuguenin et al., 2004). A project to re-plant cocoa on fallow lands using agroforestry techniques was conducted in Côte d’Ivoire between 1993 and 1999 in the Oumé region within the “Fallow Project”. The project involved the testing of leguminous shade species on fallow land in order to re-created a forest micro-climate and improve soil fertility. Among the species tested, the most promising species were Aractia auriculiformis, A. mangium, Albizia lebbeck, A. guachaepele and Gliricidia sepium. In Costa Rica, Beer et al. (1990) in converting an area of sugarcane to cocoa agroforestry found an increase in soil organic matter of 21% over ten years under pruned Erythrina poeppigiana and 9% under unpruned Cordia alliodora.
1.3.4. Summary of Implementable Strategies
The following environmental best practices are recommended in terms of soil management:

1. Planting of wind breaks on farms that have exposed areas;
2. Use of mulching particularly during the establishment phase;
3. Use of cocoa pod husk either shredded or ashed locally as a fertiliser (principally for potassium);
4. Controlled use of inorganic fertilizers; and
5. Planting of shade species on farms with a low soil organic matter content.

1.4. Climate Change and Cocoa

1.4.1. Overview
381. Climate change, as a result of increased atmospheric concentrations of greenhouse gases and localised deforestation, will impact on cocoa productivity across the tropics. The environmental parameters that will effect cocoa growth and productivity include the following:

1.4.1.1. Carbon dioxide concentration
The atmospheric concentration of carbon dioxide has risen from 270 µmol mol\(^{-1}\) in pre-industrial times to a current concentration of 380 µmol mol\(^{-1}\). The current rate of increase is 1.9 µmol mol\(^{-1}\) year\(^{-1}\) (IPCC, 2007). It is well documented that increases in CO\(_2\) concentration have a fertilising effect on plants, bringing about increases in photosynthetic rates, growth and yields. However, realistic, large-scale research has shown that the well-known fertilising effect of elevated CO\(_2\) is far less than had previously been thought (Long et al., 2006) and is highly dependent on the addition of nutrients and irrigation. Published reports on the effects of increased CO\(_2\) concentration on cocoa are very limited. However, research is being conducted on the effects of CO\(_2\) (and other climate change parameters) at CPCRI, India and is also getting underway at the University of Reading, UK.

1.4.1.2. Water availability
Global climate change is likely to bring about more erratic rainfall patterns in some cocoa-growing regions, particularly in West Africa where more intense dry periods are predicted [see also 2.2]. Furthermore, localised deforestation can impact on rainfall patterns and relative humidity levels. To some extent the effects of water stress and on photosynthetic assimilation and growth will be offset by higher atmospheric CO\(_2\) concentrations resulting in greater water use efficiency (i.e. the ratio of photosynthetic rate to water lost through photosynthesis). However, this might not compensate for reduced assimilation that will occur during prolonged dry seasons when partial or complete stomatal closure is likely to occur (in response to lower relative humidity if limited soil water content). Furthermore young cocoa seedlings will become more vulnerable to mortality if dry periods are prolonged. Hence strategies to conserve water [see section 2.2] are likely to become more important with changing climate; particularly in regions that already have a marked dry season (i.e. West Africa, the Caribbean and parts of South America).

Associated with more intense dry periods, it is likely that cloud cover will be reduced, meaning cocoa plants will be more exposed to high light intensities. The use of shade may therefore be of greater importance in some regions.

1.4.1.3. Temperature
Since the optimum growing temperature for cocoa is between 30 and 32°C, predicted increases in temperature can be expected to have most impact in regions where temperatures are already challenging (e.g.
Kerala, India) or more marginal regions. Supra-optimal temperatures are associated with higher vapour pressure deficits, this being the difference between the amount of moisture in the air and the maximum amount of water vapour that the air can hold; a high vapour pressure deficit indicating dryer air. Such conditions bring about reduced assimilation, which may impact yields. Higher temperatures also bring about faster rates of soil evaporation.

There is evidence that an increase in temperature can result in reduced bean size, although some varieties are more sensitive to temperature in this respect (Daymond and Hadley, 2008).

1.4.2. Climate Change and Ghana
The effects of climate change in Ghana have been examined by Anim-Kwapong and Frimpong (2005). The authors cite the output of General Circulation Models used in conjunction with Simple Climate Models that have been used to predict changes in rainfall and temperature patterns. Predicted changes in rainfall in the semi-deciduous forest zone of Ghana demonstrate declines of 2.9, 10.9 and 18.6% for the years 2020, 2050 and 2080 respectively. Corresponding figures for the evergreen rainforest zone show declines of 3.1, 12.1 and 20.2% respectively. Mean annual temperatures are predicted to rise by 0.8, 2.5 and 5.4 °C in 2020, 2050 and 2080, respectively in the semi-deciduous forest zone. The evergreen zone for the corresponding figures is 0.6, 2.0 and 3.9 °C respectively. Anin-Kwapong and Frimpong conclude that cocoa yields are likely to decline due to reduced rainfall which would be exacerbated by longer dry spells and higher temperatures/ high vapour pressure deficits unless adaptive strategies are applied.

1.4.3. Adaptation to Climate Change
Potential adaptive strategies to climate change include the following:-
(1) Avoiding growing cocoa in marginal areas;
(2) Managing the crop to ameliorate stressful conditions, for example by adding irrigation systems and use of shade to reduce soil evaporation, lower temperatures and raise humidity; and
(3) Growing varieties of cocoa that are more tolerant of environmental stresses, e.g. water and high temperature stresses.

1.5. Pests and Diseases of Cocoa
Losses from pests and diseases of cocoa are considerable; Flood et al. (2004) estimate that over 40% of global cocoa production is lost each year to just five diseases. The principle diseases and pests of cocoa, along with their distribution are summarised in Table 7.

**Table 7. Principal diseases and pests of cocoa and their distribution (End et al., 2010)**

<table>
<thead>
<tr>
<th>Disease/Pest</th>
<th>Geographical range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cocoa swollen shoot virus</td>
<td>Benin, Côte d’Ivoire, Ghana, Liberia, Nigeria, Sierra Leone, Togo</td>
</tr>
<tr>
<td></td>
<td>Reports also in Sri Lanka</td>
</tr>
<tr>
<td>Witches’ broom disease</td>
<td>Brazil- Bahia, Amazon región, Bolivia, Colombia, Ecuador, F. Guiana, Grenada, Guyana, Panama, Peru, St. Vincent, Suriname, Trinidad and Tobago, Venezuela.</td>
</tr>
<tr>
<td><em>Moniliophthora</em> pod rot</td>
<td>Colombia and Ecuador on both sides of the Andes, eastern Venezuela, Peru, Panama, Costa Rica, Nicaragua, Honduras, Guatemala, Belize and Mexico (Phillips-Mora et al. 2007)</td>
</tr>
<tr>
<td>(<em>Frosty pod rot or moniliasis disease</em>)</td>
<td></td>
</tr>
<tr>
<td><em>Phytophthora palmivora</em></td>
<td>Worldwide</td>
</tr>
<tr>
<td><em>P. megakarya</em></td>
<td>Cameroon, Côte d’Ivoire Fernando Po, Gabon, Ghana, Nigeria, São Tomé and Príncipe, Togo</td>
</tr>
<tr>
<td><strong>P. capsici</strong></td>
<td>Brazil, El Salvador, F. Guiana, Guatemala, India, Jamaica, Mexico, Trinidad, Venezuela, Cameroon</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td><strong>P. arecae</strong></td>
<td>Philippines and Vanuatu</td>
</tr>
<tr>
<td><strong>P. citrophthora</strong></td>
<td>Brazil, India, Mexico, Indonesia</td>
</tr>
<tr>
<td><strong>P. hevea:</strong></td>
<td>Malaysia</td>
</tr>
<tr>
<td><strong>P. megasperma</strong></td>
<td>Venezuela</td>
</tr>
<tr>
<td><strong>P. nicotianae var. parasitica</strong></td>
<td>Cuba</td>
</tr>
<tr>
<td><strong>Vascular streak die-back</strong></td>
<td>Most cocoa-growing areas in South and South East Asia: PNG, (islands of New Guinea, New Britain, New Ireland), Hainan Island (China), Kerala State (India), West Malaysia and Sabah, Indonesia, Thailand, Myanmar, Vietnam and the southern Philippines.</td>
</tr>
<tr>
<td><strong>Ceratocystis wilt</strong></td>
<td>Brazil, Columbia, Costa Rica, Ecuador, F. Guiana</td>
</tr>
<tr>
<td><strong>Cocoa pod borer</strong></td>
<td>Southeast Asia including Malaysia, Indonesia, the Philippines and Papua New Guinea.</td>
</tr>
<tr>
<td><strong>Mirids</strong></td>
<td>Worldwide</td>
</tr>
</tbody>
</table>

Environmentally sensitive strategies for dealing with pest and disease problems of cocoa may be summarised as follows:

- **Targeted pesticide use**: for example, optimising the timing of pesticide applications and using spraying technologies to maximise impact thus limiting pesticide usage.
- **Cultural techniques**: e.g., frequent harvesting or planting barrier crops. Biological control can also help.

**Selection and breeding of improved material**: Cocoa varieties that have a degree of resistance to local pest and/or diseases will not require as much (if any) pesticide application. Further, if cocoa varieties are selected for high yield, the farmer may be able to afford losing a portion of the crop to a pest or disease.

1.5.1. **Control of Pest and Diseases in West Africa**

1.5.1.1. **Cocoa Swollen Shoot Virus**

Cocoa swollen shoot virus (CSSV) is a major cause of crop loss in Ghana, Côte d’Ivoire and Nigeria. The disease causes loss of yield and, over time, the most virulent strains of the CSSV will ultimately kill the tree. Plants that are infected cannot be treated but instead may be cut out by the farmer. Thus the environmental impact of CSSV is not usually through the use of pesticides but rather the reduced yields caused by this disease means that a greater area of land is needed for the production of cocoa than would otherwise be the case.

Breeding for resistance to cocoa swollen shoot virus has been an integral part of the breeding programme at the Cocoa Research Institute of Ghana (CRIG) (Thresh and Owusa, 1986; Thresh et al., 1988). The potential for the use of barrier crops has been investigated at CRIG. As a result of these studies various trees crops, including oil palm and citrus, are recommended as a barrier to the various species of mealybug that are vectors for CSSV (Ollenu et al., 2005).

A number of trees act as alternate hosts for CSSV and should be removed from farms, including *Cola chlamydantha*, *Sterculia tragacantha*, *Adansonia digitata* and *Ceiba pentandra* (Dzahini-Obiatey 2010).

1.5.1.2. **Phytophthora Pod Rot**
*Phytophthora* pod rot or black pod is widespread throughout West Africa. The two most important species of *Phytophthora* in terms of losses of cocoa are *P. palmivora* and *P. megakarya*. The former is found throughout West Africa, whilst the latter is a relatively new encounter disease that has been spreading through Cameroon, Côte d’Ivoire, Fernando Po, Gabon, Ghana, Nigeria, São Tomé and Príncipe, Togo West Africa. *P. Megakarya* is the most aggressive of the *Phytophthora* pathogens and can result in complete pod loss (Opuku et al., 2000).

Environmentally sensitive methods of *Phytophthora* control include more targeted fungicide applications, botanical pesticides, various cultural practices and breeding for disease resistance. A number of techniques exist for more effective fungicide applications. Bateman et al. (2004) highlight the importance of low volume sprayer nozzles in improving pesticide coverage (and thus reducing the quantity of pesticide required); (see also [www.dropdata.net](http://www.dropdata.net)). Some success has also been achieved with injecting systemic pesticides into the tree trunk. In Ghana under experimental conditions, a trunk injection with potassium phosphonate has provided a moderate level of protection, comparable to spraying with mixtures of copper oxide and metalaxyl (a systemic fungicide) (Opuku et al., 2004). The potential use of botanic pesticides has been investigated at IRAD, Cameroon. Trials suggest that treatment of pods with hemp extracts can bring about reductions in infection rates (Nyassé et al, 2002).

There are various cultural practices that may be employed to restrict the movement of fungal spores from the soil to the cocoa canopy. These include using appropriate pruning and spacing of both cocoa and shade to increase air movement and thus reducing surface wetness (and hence sporulation). Other husbandry measures include frequent and complete harvesting, sanitary pruning and appropriate disposal of infected pods/ pod husks (Flood et al., 2004). In Ghana, cultural control alone can be effective in areas where only *P. palmivora* is present but not in areas where *P. megakarya* is the dominant pathogen (Opuku et al., 2000). In Papua New Guiana, Konam and Guest (2002) demonstrated that leaf litter mulch can reduce the survival of *P. palmivora* by accelerating the decomposition of the substrates which acts as hosts for the pathogen. The mulches also stimulate the activity of microbes which are antagonistic to *Phytophthora*. The authors suggest that the use of mulches may reduce disease levels when used as part of an integrated disease management programme. Similar studies are needed in West Africa particularly in areas where *P. megakarya* is present.

Whilst biological control against *Phytophthora* has not been widely adopted on cocoa farms, research in Côte d’Ivoire has identified various species and isolates of the fungus *Trichoderma* that are antagonistic to *Phytophthora palmivora* under *in vitro* laboratory conditions. These isolates are now being investigated under field conditions (Mpika et al., 2009) and represent part of a longer-term strategy to control the disease.

Selection and breeding activities for resistance to *Phytophthora* pod rot are being conducted in all the major cocoa research institutes in West Africa and offer the most sustainable means of disease control in the long term. Genotypic variation has been found in susceptibility and resistance to *Phytophthora* spp. under both experimental and on-farm conditions (e.g. Pokou et al, 2008). The process of identifying and screening different cocoa genotypes for with levels of resistance to *Phytophthora* and other pests and diseases of cocoa has been, in part, driven by two consecutive projects funded by CFC/ICCO/Bioversity International (Eskes et al. 2006, 2010).

A large scale project in Mambang, Ghana, managed by CRIG, is currently in progress with the aim of identifying parental clones with resistance to *Phytophthora megakarya* (in combination with other agronomically desirable traits) (Lockwood, 2006).

### 1.5.1.3. Mirids

The mirid group of sap-sucking insects cause damage to cocoa worldwide by attacking both the canopy and pods. In West Africa, the most common species are *Distantiella theobroma* and *Sahlbergella singu-
laris; the species *Helopeltis lalendei* (cocoa mosquito) and *Bryocoropis laticollis* feed on the pods only. Environmental best practice in cocoa includes appropriate shade management (mirid infestations tend to be greater under no shade conditions, Babin et al., 2010) and effective use of pesticides, for example, mist-blower applicators are often used in Ghana, which give better crop coverage. The aforementioned CFC/ICCO/Bioversity International projects have identified a number of genotypes in Ghana, Cameroon and Côte d’Ivoire that are more resistant to mirid attacks.

1.5.2. Integrated Pest Management Strategies
Research at CRIG, Ghana is moving towards an integrated pest management (IPM) strategy for mirids. Such strategies aim to combine targeted spraying with cultural best practice and more resistant varieties. A critical component of this work has been the development of pheromones, which have been designed at the Natural Resources Institute, UK. When these are used in conjunction with trapping devices (e.g. sticky traps), the population of mirids may be monitored throughout the course of the year, thus enabling pesticides applications to be timed to have maximal impact. Furthermore, mass trapping may have the potential to disrupt the mating cycle thus reducing further the need for pesticide usage (Sarfo, 2008). This work is still at the experimental stage but has the potential to be applied in the field in the future.

Another potential future route to an IPM strategy is to use models to predict peaks of flushing and fruiting, thereby determining when the cocoa trees will be more susceptible to insect and/or disease attack and hence when pesticide applications would be most effective.

1.5.3. Summary of Implementable Strategies
The following environmental best practices are recommended for pest and disease management:
(1) Planting of CSSV barrier crops;
(2) Targeted spray applications;
(3) Encouraging farmers to use recommended planting material (e.g. in the case of Ghana, CRIG-selected hybrids) and not farmer-selected hybrid seed;
(4) Phytosanitary removal of diseased pods on a regular basis; and
(5) Appropriate shade management.

1.6. Post Harvest Environmental Best Practice

1.6.1. Drying
After fermentation, cocoa beans must be dried to reduce moisture levels for safe storage and shipment (usually less than 6% water content). The drying process and method of drying will also impact on bean quality (McDonald *et al*., 1981; Wood, 1985b). In regions where the main harvest is in the dry season (such as West Africa) the beans are usually dried in the sun. In most West African cocoa growing regions the beans are commonly dried on mats raised above the ground. In Bahia, Brazil and Venezuela where dry spells are intermittent with rains, beans are usually dried on wooden or concrete floors that have corrugated iron roofs which may be moved over the beans during rainy spells.

Artificial drying is sometimes conducted in particular regions or at times of the year when sun drying is difficult to achieve. Farmers may also opt for artificial drying in order to reduce the amount of labour associated with the drying process. There are various methods of artificial drying (summarised in Wood 1985b). Cocoa dryers are typically wood-burning, thus having an environment impact since the wood will often come from an unsustainable source. Use of such dryers also increases the carbon footprint associated with cocoa production. Artificial dryers can also impact on the bean quality, in some cases bringing about “off-type” flavours (Wood, 1985c).
Solar drying technologies are being applied to cocoa in various forms, particularly in the Caribbean and parts of South America, although are not widespread in West Africa. They offer a more environmentally sensitive alternative to artificial drying at times when sun drying is difficult. Simple technologies include the erection of greenhouse or polytunnel type structures over the cocoa drying area. Air ventilation is achieved by having open ends and sometimes also open sides of the structure. In Papua New Guinea, solar dryers are sometimes used that consist of rock-bed collectors and polycarbonate roofs (Sukha, 2009). Hii et al. (2006) describe a similar dryer designed in Malaysia that consists of a drying platform and a “roof-like” enclosure made with ultra-violet stabilised film. Ventilation gaps enable a certain amount of air movement. Indirect dryers have a separate solar collector and drying area (e.g. Bonaparte et al., 1998; Fagunwa et al., 2009). A study by Bonaparte et al. (1998) in St Lucia demonstrated little difference in bean quality between sun-dried beans and those dried with a solar dryer; although a marginal improvement in bean quality was found when using indirect dryers compared with direct dryers.

1.6.2. Storage
During storage, there is a potential danger of dried beans becoming infested with pests such as the tropical warehouse moth (Ephestia cautella), the tobacco beetle (Lasioderma serricorne) and the coffee weevil (Araecerus fasciculatus) (Wood, 1985b). Since such infestations are usually treated with pesticides. Store construction that minimise the chance of pest outbreaks should be employed as an environmental best practice. The store should have a cement floors and walls from bricks or concrete (not wood which can harbour larvae). Stacking sacks away from walls, inspecting the bags regularly and rotating the stock also help to minimise infestations.

1.6.3. Summary of Implementable Strategies
The following environmental best practices are recommended in terms of post-harvest practices:-
(1) Use of simple solar technologies in regions where sun-drying is difficult; and
(2) Storage of beans in well-designed stores employing stock rotation, regular inspections etc.

1.7. Biodiversity Habitat Management

1.7.1. Biodiversity on Cocoa Farms
Shaded cocoa often supports higher levels of biodiversity than other tropical crops (Rice and Greenburg, 2000). However, species diversity will vary considerably according to management practices and geographical location. An attempt was made to define levels of biodiversity associated with different agroforestry regimes in Sulawesi in project conducted through the University of Bayreuth, Germany (Steffan-Dwenter et al, 2007). The study demonstrated that conversion of rainforest to extensive cocoa farms with a high density of shade reduced the species richness of forest-dwelling species by 60%. However, as shade was reduced further to 40-50%, the consequent reduction in biodiversity was relatively small.

The main cocoa-growing region of Brazil, S.E of the state of Bahia is located within the remnants of the Atlantic Rainforest (Mata Atlantica) and is a region known for its biological diversity. A study by Faria et al. (2007) compared biological diversity of cocoa agroforests (locally termed cabrucas) in two types of landscape; one where forest was dominant, interspersed with cocoa agroforests, the other landscape where cocoa agroforests were dominant interspersed with forest fragments. Whilst a high diversity of forest fauna and flora were found throughout the cocoa agroforests, those surrounded by higher density forest, perhaps not surprisingly, had higher species richness.

In Cameroon, Sonwa et al. (2007) studied plant diversity in cocoa agroforests along a gradient of market access, population intensity and resource use intensity. In sampling 60 agroforests, the authors encountered 206 tree species (mean of 21 per agroforest) a number of which provided supplementary farmer income. With increasing market access, famers were replacing native tree species with exotic tree crops.
The authors conclude that farmers need better financial rewards for their conservation efforts such as access to markets for native tree species.

1.7.2. Shade Species of Conservation value
A few publications have specified shade species that have particular conservation value to fauna and flora. Cassano et al. (2009), list 19 tree species in cocoa agroforestry systems in Bahia, Brazil which form an important part of the diet of two endangered species, the golden headed lion tamarins and maned three-toed sloths. In Cameroon, Laird et al. (2007) highlight shade trees with particular conservation value in the Mount Cameroon region. These include Cola lepidota, Cordia aurantiaca, Mansonia altissima and Milicia excels.

1.7.3. Management Practices and Government Interventions to Enhance Biodiversity
In reviewing the biodiversity associated with cocoa agroforestry in Bahia, Brazil, Cassano et al. (2009) highlight the importance of shaded cocoa in linking forest fragments. The authors state that under Brazilian law current legislation requires farm owners to set aside 20% of their land as reserves. Furthermore, Brazilian law offers tax rebates for the creation of private reserves and the conversion of mature forest to agriculture in the Atlantic rainforest region is illegal. A recent announcement by the Brazilian government of a tree planting initiative within the Atlantic rainforest region may provide an opportunity for the linking of forest fragments with cocoa agroforestry an integral component.

In Côte d’Ivoire the PRODUCAO (Production Durable et Amelioration de la Qualité de Cocoa) project is introducing agroforestry techniques for sustainable cocoa production which will take the pressure off forest areas around the Taï National Park. A part of this project involves rehabilitation of moribund cocoa farms as an alternative to expansion into virgin forested areas (Gilmour, 2004). Excessive and/ or inappropriate pesticide usage will impact on the biological diversity associated with a cocoa farm and the surrounding environment. Thus the use of integrated pest management strategies that have minimal environmental impact are an important part of biodiversity conservation practices [See section 2.4].

1.8. Carbon Management and Payment for Ecosystem Services
Payments for ecological services (PES), the practice of offering farmers financial incentives in exchange for managing their land for some kind of ecological service, has potential application to cocoa agroforestry systems. For example, Sonwa et al. (2006) identify the Yaoundé fringe (Cameroon) as a cocoa-growing area that provides good opportunities for PES. The authors suggest that the environmental services provided by these agroforestry systems could include: (1) biodiversity conservation and restoration of landscape, (2) carbon sequestration through reforestation with cocoa agroforests, (3) ecotourism and (4) maintenance of the watershed of the river Mefou. Payments for Environmental Services for cocoa cultivation effectively are in operation for organic certified cocoa where farmers are usually paid a premium of between US$ 100 and US$ 300 per tonne (ICCO, 2010b). Currently this market represents only a small proportion of the total (around 0.5%) (ICCO, 2010b).

Reducing Emissions from Deforestation and forest Degradation (REDD) is a specific type of PES, where payments are made to preserve carbon stocks (e.g. large forest trees) or for carbon sequestration activities (re-forestation). While cocoa itself sequesters little carbon, having a relatively low growth rate, cocoa agroforestry systems with native forest or timber species provide potential opportunities for REDD initiatives; for example, Isaac et al. (2005) calculated carbon sequestration rates in 25-year old multilevel cocoa farms in the Western Region of Ghana to be 3 t/ha/year. In terms of carbon storage, estimates of unshaded cocoa in Cameroon are 60 t/ha of carbon, compared with 243 t/ha for shaded cocoa agroforests (Sonwa and Weiss, 2008). In Ghana, an initial project found that forests in the Eastern region stored 155 tonnes of carbon ha\(^{-1}\), compared with 131 tonnes ha\(^{-1}\) for traditional (shaded) cocoa and 39 tonnes ha\(^{-1}\) for intensive cocoa (Wade et al., 2010).
Whilst REDD payments are not currently widely employed for cocoa agroforestry systems, the potential exists for them to be adopted, particularly as the UNFCC clean development mechanism (CDM) can be applied to agroforestry, forestation or reforestation. A study by Seeburg-Elverfeidt (2009) of the potential for carbon finance options for cocoa agroforestry in Indonesia used a modelling approach to calculate the carbon payments needed to reduce emissions from deforestation. The study indicated that the deforestation activities of the majority of households could be stopped with current carbon prices. The author concluded that for carbon payments to be effective, such payments should not be paid in a general manner to all agroforestry systems within a region but should be biased towards those that provide greater ecosystem services. Furthermore, the study illustrated that poorer households would benefit proportionally greater from such payments.

Currently the clean development mechanisms cannot be used with plantation systems e.g. when two crops are intercropped. However, in studying carbon sequestration in areca-cocoa mixed crop systems, Balasimha and Kumar (2009) found that CO₂ sequestration ranged from 1.38 – 2.66 t ha⁻¹ for cocoa and 5.14 – 10.94 t ha⁻¹ for areca. The authors argue that based on these data CDM should also be considered for plantation systems.

2. Economic Analysis of Good Environmental Practice

In this section, a number of examples are given of the comparative cost of environmental best practice compared with other practices.

2.1. Disease Management

Whether or not phytosanitary procedures are cost effective will vary from region to region and will depend on level of disease prevalence, labour costs and farm-gate prices. An economic analysis of the benefits phytosanitary pod removal has been reported for Peru, where three major pathogens of cocoa are present (witches broom disease, frosty pod rot and black pod) (Soberanis et al., 1999). Using 1995 farm-gate prices of US$ 1.43 kg⁻¹, the analysis revealed a benefit: cost ratio of 3.1 when employing the practice of complete removal of diseased pods (see Table 8). Although labour costs would have risen since this analysis was conducted, the world cocoa price is currently over two and a half times more than it was in 1995, therefore it is reasonable to assume that the benefit to cost ratio of conducting phytosanitary pod removal remains attractive.

Since disease pressures and labour costs are different in Ghana, a similar type of study is needed to guide farmers as to the economic benefits of phytosanitary pod removal. Such a study could be conducted across different regions where disease pressures vary.

Table 8. Economic benefits of employing phytosanitary pod removal, at a farmgate price of US$ 1.43 kg⁻¹ (after Soberanis et al., 1999)

<table>
<thead>
<tr>
<th>Cultural regime (removal of diseased pods)</th>
<th>Production cost (US $ ha⁻¹ year⁻¹)</th>
<th>Gross return (US$ ha⁻¹ year⁻¹)</th>
<th>Net returns (US$ ha⁻¹ year⁻¹)</th>
<th>Benefit: cost ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pod removal</td>
<td>123</td>
<td>208</td>
<td>83</td>
<td>1.7</td>
</tr>
<tr>
<td>Fortnightly removal</td>
<td>229</td>
<td>721</td>
<td>492</td>
<td>3.1</td>
</tr>
<tr>
<td>Weekly removal</td>
<td>293</td>
<td>943</td>
<td>650</td>
<td>3.2</td>
</tr>
</tbody>
</table>

2.2. Comparison of Shaded Versus Unshaded or Partially Shaded Cocoa
In Sulawesi, Steffan-Dewenter et al. (2007) estimated a 40% lower household income for low shaded agroforestry compared with unshaded cocoa (no return from the shade trees was considered here). The authors suggest that compensation might need to be paid to farmers conducting agroforestry to encourage such systems.

A financial analysis of shaded hybrid cocoa versus unshaded hybrid cocoa and “traditional” cocoa (shaded Amelonado) was conducted by Obrid et al. (2007) in the Ashanti region of Ghana. Critically, unlike the previous study, this analysis factored in an assumed return to the farmer of the timber shade species. The results revealed a marginal advantage of unshaded hybrids of shaded hybrids. Both systems using hybrid cocoa were more profitable than the traditional system (Table 9). Therefore if farmers are to be encouraged to maintain shade on their farms, they need additional revenue from the shade either in the form of a return from the shade itself (timber, sales of fruits) or through PES.

Table 9. Summary of discounted cash flow cocoa with and without planted shade trees (after Obrid et al. 2007)

<table>
<thead>
<tr>
<th>Economic indicator</th>
<th>Traditional</th>
<th>Hybrid</th>
<th>Shaded hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/C Ratio</td>
<td>1.57</td>
<td>1.74</td>
<td>1.71</td>
</tr>
<tr>
<td>Optimum rotation age</td>
<td>44</td>
<td>18</td>
<td>29</td>
</tr>
</tbody>
</table>

2.3. Comparison of Organic Versus Inorganic Fertiliser use
The cost of the inorganic fertiliser that is recommended by CRIG in Ghana is 43 cedis per 50 kg. During the current season, farmers are buying at a subsidy of 57% thereby making it more affordable than it would otherwise be. CRIG does not currently recommend organic fertilisers on a commercial scale. When farmers obtain chicken manure from local farms they usually obtain it free of charge (K. Ofori-Frimpong, personal communication).

2.4. Cost Analysis of Solar Drying Technologies
Whilst precise costs of solar drying technology are not available in published formats, the cost involved will much depend on the size and sophistication of the system employed. In the case of simple solar dryers such as those with a low roof or walk-in greenhouse like structures, the main cost would be that of the polythene or polycarbonate covering materials. The materials for the frames could be sourced locally. A larger walk-in type structure would involve a greater initial outlay, although the use and therefore the costs of such a system could potentially be shared between several farmers.

The cost associated with an indirect drying system would be expected to be greater in that additional materials are needed for the solar collector area. Materials for the solar collector might typically include wood for the frame and glass panels.

3. Effectiveness of Additional Tools to Promote Sustainable Cocoa Production

3.1 Certification
Until recently, certified cocoa products (such as chocolate bars with organic cocoa) occupied only a niche market. However, more recently some of the multinational companies have certified particular product lines as being from environmentally and/or socially responsible sources. Examples include organic certification applied to Green and Black’s chocolate (part of Cadbury/Kraft), Rainforest Alliance certification which is now applied to some Mars products in particular locations and Fairtrade certification applied to particular Cadbury/Kraft products and also now to some Nestlé products. The Rainforest Alliance Certi-
fied farms have met a series of standards set out by the Sustainable Agriculture Network. These include aspects of ecosystem conservation, such as wildlife protection, water and soil conservation and reduction in the use of agrochemicals (pesticides and chemical fertilisers). The standards also cover aspects of workers’ rights and safety including legal wages and contracts and decent housing conditions (Rainforest Alliance, 2009). The Fairtrade mark is usually associated with social schemes and paying farmers premiums. However, Fairtrade certification also includes adherence to particular environmental standards (Fairtrade, 2010).

3.1.1. Benefits of Certification
The process of certification and monitoring ensures that certified farms adhere to particular environment standards. The farmer of a certified farm benefits from direct premium payments for produce, or provision of benefits to the local community, or some combination of both. The consumer benefits from being able to choose products that adhere to standards that may be of particular concern.

3.1.2. Potential Limitations of Certification
Whilst providing particular benefits, certification is not in itself a panacea for bringing about environmental improvements to cocoa farming. Whilst certification incentivizes farmers to follow a set of environmental standards, these are of an arbitrary nature and the farmer is not necessarily encouraged to go beyond the basic conditions laid out. Therefore as certified farms become more commonplace, it may be necessary for certifying agencies to find means of raising the bar for environmental standards.

Particular farms that apply high environmental and/or ethical standards may find themselves exempt from certification status due to the application of arbitrary rules. For example, some Fairtrade schemes only apply to small farmers.

Certification does not necessarily guarantee a market. As more products appear with certification logos on them, consumer skepticism may arise regarding their value which in turn can reduce demand for a specific type of certified product. Certification, unless carefully structured, may not necessarily produce the desired national outcome of biodiversity conservation. Furthermore, it can be beyond the financial resources for farmers to become and remain certified.

Table 10. Comparison of large international certification schemes

<table>
<thead>
<tr>
<th>Biodiversity Focus</th>
<th>SAN-RA</th>
<th>FLO</th>
<th>Bird Friendly (SMBC)</th>
<th>IFOAM</th>
<th>Utz</th>
<th>Forest Stewardship Council</th>
<th>USDA Organic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banning forest clearance</td>
<td>Yes, Primary / Secondary forest</td>
<td>Yes, Primary only</td>
<td>Yes – verify production areas free of any legal protection status</td>
<td>Yes, but not Specified</td>
<td>Yes, Primary forest</td>
<td>Yes, forest conversion controlled with exceptions</td>
<td>No standard</td>
</tr>
<tr>
<td>Wildlife protection</td>
<td>Yes</td>
<td>No standard</td>
<td>Yes, specifically birds, tree diversity and secondary plant diversity</td>
<td>Not prohibited</td>
<td>Yes</td>
<td>Yes, conserves genetic diversity, high value areas, &amp; safe guards critical species</td>
<td>Yes, indirectly by strict control of synthetic chemicals</td>
</tr>
<tr>
<td>Creation of corridors between farms and forested areas</td>
<td>Yes, to some extent: unsuitable farm area reforested &amp; disturbed riparian strip recovered</td>
<td>No standard</td>
<td>Yes to some extent - strict shade tree and canopy layer requirements</td>
<td>No standard</td>
<td>Yes but less specific then SAN standards</td>
<td>Yes to some extent through rules for maintaining forest ecological function</td>
<td>No standard</td>
</tr>
<tr>
<td>Cropping / practices that simulate natural forest ecosystems</td>
<td>Yes, but no recommendations on tree habit. Farms can be certified even if they do not meet standards but show plans and are working to meet them</td>
<td>No standard</td>
<td>Yes, minimum 40% shade with recommendations for the diversity and size of trees that make up the forest canopy.</td>
<td>No standard</td>
<td>Yes, on several counts i.e. forest regeneration, ecological function,</td>
<td>Yes, to some extent through maintaining ecological function</td>
<td>No standard</td>
</tr>
<tr>
<td>Protecting waterways by vegetative buffers</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes, 5m from sides of streams; 10m along rivers</td>
<td>No standard</td>
<td>Yes, but not specific for coffee</td>
<td>Yes, specifies water resource protection; no detail</td>
<td>No standard</td>
</tr>
<tr>
<td>Fuel wood usage and renewable energy</td>
<td>Yes – but detail not given</td>
<td>Yes</td>
<td>Not specified</td>
<td>No standard</td>
<td>Yes</td>
<td>No standard</td>
<td>No standard</td>
</tr>
<tr>
<td>Use of genetically modified crops</td>
<td>Prohibited</td>
<td>Prohibited</td>
<td>Prohibited</td>
<td>Prohibited</td>
<td>Prohibited</td>
<td>Prohibited</td>
<td>Prohibited</td>
</tr>
<tr>
<td>Reduced synthetic chemicals</td>
<td>Yes, prohibits use of class I &amp; II WHO chemicals and standards for reduced pesticide applications</td>
<td>Yes, class I &amp; II WHO chemicals prohibited; pesticides &amp; herbicides reduced; country specific</td>
<td>Yes, prohibits use of most synthetic chemicals through USDA organic certification</td>
<td>Yes, all synthetic chemicals</td>
<td>Yes, 3 years to phase out SAN prohibited list</td>
<td>Yes, avoids use of WHO class I &amp; II chemicals</td>
<td>Yes, prohibits use of most synthetic chemicals</td>
</tr>
</tbody>
</table>

3.2. Improved Capacity Building and Extension Strategies

3.3.1. National Cocoa Boards
A number of cocoa growing countries have national cocoa boards, which have an over-arching role in dealing with trade, research and extension. A notable example of this is the Cocoa Board (COCOBOD) in Ghana which has responsibility for funding and undertaking research, development and extension activi-
ties in cocoa (also coffee and sheanut), regulating the internal cocoa market and purchasing, marketing and exporting cocoa/cocoa products. Given the wide remit of this body, it could potentially play a key role in delivering a PES system. Such a system would need to ensure that carbon payments are sufficiency high in relation to the cocoa price (which is also controlled by the cocoa board) to incentivize the farmer to retain shade species; it is important that such a system does not rely on low cocoa prices. Furthermore, it is important that PES schemes are not stand alone schemes but are integrated with measures to improve cocoa yields under shade (e.g. as outlined in section 2.1).

3.3.2. Public Private Partnerships
Two notable public-private partnerships that have an extension role in delivering improved cocoa sustainability are the Sustainable Tree Crops Programme (STCP) in West Africa and the SUCCESS Alliance in South-East Asia. The STCP [http://www.treecrops.org/ ] is collaboration between the confectionary industry and traders, producers, government agencies, public sector bodies and conservation organisations. Its remit includes the creation of systems that are environmentally sensitive, socially responsible and economically sustainable and it is active in the cocoa-growing countries of West Africa. The SUCCESS alliance (Sustainable Cocoa Extension Services for Smallholders) [ http://www.thesuccessalliance.org/index.html ] is active in a number of projects in Ecuador, Indonesia, Liberia, the Philippines and Vietnam. The donors include USDA, USAID and the confectionary industry. The implementing partner is ACDI/VOCA - a nonprofit making NGO. Projects which they run include farmer field schools for integrated pest management.

3.3.3. Logistical Barriers
The fact that many cocoa farms in West Africa are in remote areas means that there may be logistical and cost issues surrounding transportation of materials needed for more sustainable production (e.g. mulches and organic fertilisers). Furthermore, long distance transportation of materials clearly has a negative environmental impact. Possible solutions could include more localised production and distribution centres for organic mulches and fertilisers combined with particular on-farm composting activities (e.g. composting or ashing of pod husks).

3.3.4. Barriers to the Adoption of PES
Potential barriers to the adoption of PES include a lack of existing models to build upon in many cocoa-growing countries, and issues to do with land rights and tree ownership rights. The latter is an issue in Ghana, where farmers do not have tree tenure and so currently do not have incentives to maintain shade trees on their farms. However, the situation is gradually changing in this respect. Farmers have rights over trees if they can prove that they planted them. In order to aid farmers in providing such proof, the IUCN has a tree passport programme, which is encouraging farmers to register new planting with the forestry commission.

3.4. Sample Policies, Legislation and Norms that Provide Incentives for Improved Environmental Performance of Cocoa Landscapes

3.4.1. South America
In Brazil, legislation exists that prohibits felling of primary forest in the Atlantic rainforest and Amazon regions; although enforcement of such legislation is often patchy. Tax incentives exist for setting aside land as private reserves.

3.4.2. Central America
In the Central American region there are a number of organisations across the regions that have the potential to impact on the environmental performance of cocoa farms. Somarriba et al. (2008) list the Central
American Forestry Action Plan (PAFT-CA), the Central American Alliance for Sustainable Development (ALIDES), and the Central American Regional Environmental Plan (PARCA).

3.4.3. West Africa
In Ghana, the Cocoa Board (Cocobod) reviews the safety (environmental and human health) of all new pesticides before they are released, thus acting as a filter to the most polluting pesticides. Attention to post-harvest procedures, i.e. fermentation and adequate drying, is a cultural norm embedded in the psyche of Ghanaian farmers. It is possible that the piloting of solar drying technologies in Ghana may tap into a culture of pride in cocoa bean quality.

3.4.4. South-East Asia
The Indonesian government has banned the use of certain pesticides on commodity crops. Furthermore the Indonesian Department of Agriculture imposes minimum pesticide residue levels for cocoa beans.

3.4.5. Potential Policies for Environmentally and Biodiversity Sensitive Cocoa Landscapes in Ghana
The following policy changes may need to occur to promote more environmental sensitive cocoa farming in Ghana:

i). Identification of biodiversity-rich forest fragments and the setting aside of reserves;
ii). Identification of forest corridors between cocoa farms and financial incentives for farmers to set aside such land;
iii). Extension of the tree passport scheme;
iv). Better enforcement of pesticide legislation; and
v). Better education of farmers on key environmental best practices, for example, rational pesticide use and farm sanitation practices.

4. Summary tables

Table 11. Summary of best environmental practices being employed and under development

<table>
<thead>
<tr>
<th>Environmental issue</th>
<th>Poor or unsustainable practice</th>
<th>Alternative environmental best practice</th>
<th>Potential Future Developments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spraying of pesticides</td>
<td>Regular spraying in a relatively non systematic manner Inappropriate / non recommended chemical use</td>
<td>Targeted spraying with improved applicators Cultural practices including diseased pod removal, pruning, shade management Use of more disease resistant planting material Maintaining shade, particularly during establishment to reduce mirid attacks</td>
<td>Development of varieties resistant to pests and diseases, via breeding Use of pheromones for mass trapping / temporal targeting of pesticides Biological control against pests and diseases</td>
</tr>
<tr>
<td>Drought</td>
<td>Often few interventions are employed</td>
<td>Use of optimal irrigation scheduling Optimal shade management Mulching during establishment Use of varieties more resistant to water stress</td>
<td>Utilisation of varieties that are more resistant to water stress resulting from breeding programmes</td>
</tr>
</tbody>
</table>
| Soil degradation/erosion | Shifting cultivation, whereby the farmer moves to new land when yields decline as a result of soil degradation | Planting of wind breaks
Use of organic mulches
Use of organic fertilisers such as pod ash/compost
Controlled use of inorganic fertilisers
Planting shade trees on farms liable to erosion or with nutrient poor soils | Payments for environmental services
Utilisation of higher yielding/more disease resistant varieties resulting from breeding programmes |
|-------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| Pressure on remaining virgin land due to low economic yields | Planting of unselected (farmer selections) cocoa hybrid seedlings | Use of improved cocoa varieties
Use of economic shade species or complementary crops to diversify income
Optimal management of cocoa and shade to maximise yields
Farmer education on best practices and access to required ongoing training
Cheaper crop inputs | Payments for environmental services
Utilisation of higher yielding/more disease resistant varieties resulting from breeding programmes |
| Habitat fragmentation | Felling of shade trees on farms that link forest fragments | Maintaining shade species to act as “corridors” between forest fragments | Payments for environmental services |
| Post harvest issues | Use of wood-burning drying ovens | Use of various solar drying systems (at times when sun drying is difficult) | Development of more high-tech driers |

Table 12: Summary Benefits to Cocoa and Environmental Services Provided by Shade Trees in Cocoa Agroforestry Systems

<table>
<thead>
<tr>
<th>Service provided</th>
<th>Factors to be considered for optimal cocoa performance</th>
</tr>
</thead>
</table>
| Ameliorating the micro-environment of the cocoa crop | Small leaved shade species give more even light distribution
Avoid over shading cocoa canopy
Where fungal diseases are present a balance is needed between raising humidity to promote cocoa growth and not having such a high humidity that sporulation of disease causing fungi is promoted
Shade species that compete with cocoa should be avoided |
| Reducing high light stress—important for young cocoa | Reduced soil evaporation
Reduced plant stress
Humidity levels are raised |
| Reduction in temperature peaks | Protection against soil degradation
Shade trees can act as wind breaks protecting against soil erosion
Improved soil organic matter |
| Humidity levels are raised | Biodiversity Conservation
Provides habitats for particular fauna and flora
Provides “wildlife corridors” between forest |
| Reduced soil evaporation | Avoid monoculture plantings—a diverse selection of trees should be planted to improve suitable species habitats
Need agreements between smallholder farmers to make |
fragments | corridors realistic
---|---
Provides opportunities for additional income from PES schemes i.e. attached to carbon standards | Need significant government support and institutional strengthening

**Pest Control**

Suppression of mirid populations | Shade species that act as alternate hosts to particular pests and diseases should be avoided

**Carbon Management**

Carbon sequestration
Carbon storage
Improved long term yield sustainability
Additional income generating opportunities

---

### Cocoa Research Institutes Conducting Research to Improve the Environmental Performance of Cocoa

<table>
<thead>
<tr>
<th>Institute</th>
<th>Key Environmental Research Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>West Africa</strong></td>
<td></td>
</tr>
<tr>
<td>Cocoa Research Institute of Ghana (CRIG), P.O. Box 8, Tafo-Akim, Ghana</td>
<td>Use of mulching for establishment, Intercropping with shade species, Development of IPM strategies, Breeding for improved disease resistance</td>
</tr>
<tr>
<td>Forestry Research Institute of Ghana (FORIG), P.O. Box 63, Knust, Kumasi, Ghana</td>
<td>Intercropping cocoa with timber species</td>
</tr>
<tr>
<td>Plant Genetic Resources Institute P.O. Box 7, Bunso, Eastern Region, Ghana</td>
<td>Use of indigenous fruit tree species as shade for cocoa</td>
</tr>
<tr>
<td>Centre National de Recherche Agronomique (CNRA), 01 B.P. 1740, Abidjan 01, Côte d’Ivoire</td>
<td>Potential use of biological control against black pod, Breeding of varieties with improved disease resistance</td>
</tr>
<tr>
<td>Institut de Recherche Agricole pour le Développement (IRAD), BP 2076, Yaoundé, Cameroon</td>
<td>Breeding for resistance to black pod and mirids, Research into biological control of <em>P. megakarya</em>, Development of botanical pesticides, Cultural control of mirids, Farmer knowledge of cocoa agroforestry systems</td>
</tr>
<tr>
<td>Cocoa Research Institute of Nigeria (CRIN), P.M.B. 5244, Ibadan, Nigeria.</td>
<td>Rehabilitation techniques on cocoa farms, Rootstock scions interactions in relation to water stress</td>
</tr>
<tr>
<td><strong>Americas</strong></td>
<td></td>
</tr>
<tr>
<td>CEPEC/CEPLAC, CX Postal 7, CEP 45.600-000, Itabuna, Bahia, Brazil</td>
<td>Selection and breeding for witches’ broom disease resistance</td>
</tr>
<tr>
<td>Department of Agriculture and Agroforestry, CATIE, Turrialba, Costa Rica</td>
<td>Cocoa agroforestry</td>
</tr>
<tr>
<td>INIAP, Pichinglingie, Quevedo, Ecuador</td>
<td>Selection and breeding for witches’ broom disease and frosty pod rot resistance</td>
</tr>
<tr>
<td>USDA, Agricultural Research Service Subtropical Horticulture Research Station 13601 Old Cutler Rd, Miami, FL 33158, USA</td>
<td>Collaborate with various institutes in cocoa growing countries</td>
</tr>
<tr>
<td><strong>Asia</strong></td>
<td></td>
</tr>
<tr>
<td>Institution</td>
<td>Focus Area</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Central Plantation Crops Research Institute, Regional Station, Vittal – 574243, Karnataka, India</td>
<td>Optimisation of irrigation schedules Breeding for drought tolerance</td>
</tr>
<tr>
<td>Malaysian Cocoa Board, Locked Bag 211, 88999 Kota Kinabalu, Sabah, Malaysia</td>
<td>Cultural control against cocoa pod borer</td>
</tr>
<tr>
<td>Indonesian Coffee and Cocoa Research Institute, J.I. P.B. Sudiman, No. 90, Jember 68118, Indonesia</td>
<td>Cultural control against cocoa pod borer</td>
</tr>
<tr>
<td><strong>Europe</strong></td>
<td></td>
</tr>
<tr>
<td>The University of Reading, School of Biological Sciences, Whiteknights, Reading, RG6 6AS, United Kingdom</td>
<td>Collaborate with institutes in Ghana, Nigeria and Malaysia on cocoa establishment, shade utilisation, water stress, cocoa pod borer resistance</td>
</tr>
<tr>
<td>Natural Resources Institute, University of Greenwich, Central Avenue, Chatham Maritime Kent, ME4 4TB, United Kingdom</td>
<td>Development of pheromones for use in IPM strategies</td>
</tr>
<tr>
<td>CABI Biosciences, Head Office Nosworthy Way, Wallingford, Oxfordshire OX10 8DE, United Kingdom</td>
<td>Collaborate with various institutes in cocoa growing countries particularly on IPM strategies</td>
</tr>
<tr>
<td>CIRAD Adei Avenue Agropolis, 34398 Montpellier Cedex 5, France</td>
<td>Collaborate with institutes in Côte d'Ivoire, Cameroon and F. Guiana, particularly on disease control and breeding</td>
</tr>
</tbody>
</table>
Appendix 8: Past and current Projects

Over the past decades, there have been a number of technical assistance projects carried out in the cocoa sector. The emphasis of these past projects was on rehabilitation of old cocoa farms which had been devastated by the cocoa swollen shoot viral disease. Most of the cocoa rehabilitation activities by the COCOBOD were supported by funds from the World Bank and the European Union.

Current projects have focused on the poor cocoa farming techniques which are wreaking havoc on both the soil and the surrounding forests. Efforts are also been made to promote sustainable cocoa farming by tapping into the global carbon markets. These current on-going projects and research efforts are been spearheaded by many international NGOs and some local stakeholders. The involvement of farmer based organizations (FBOs), community based organizations (CBOs), and district assemblies in the implementation of these projects has been significant. Past and current projects which have been captured by the baseline study are listed in the table below.

<table>
<thead>
<tr>
<th>Project title</th>
<th>Objective/results. Current (C) or Past (P) project</th>
<th>Stakeholders involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building a Carbon Map of Ghana: Existing Carbon Stock Data</td>
<td>(C) Objective: Create a carbon map for Ghana by the end of 2010. Carbon information will be collected from existing mapping data—land cover, forests, plantations, farmlands, soils—and other sources.</td>
<td>NCRC, Katoomba group, Moore Foundation, Oxford University and Forest Trends</td>
</tr>
<tr>
<td>Ghana Cocoa Carbon Initiative (GCCI)</td>
<td>(C) Objective: Mitigation of climate change by reducing carbon emissions from deforestation and land degradation through enhancement of land-based carbon stocks (carbon sequestration via planted trees or natural regeneration (on-going)</td>
<td>NCRC, Katoomba group, Forest Trends, Local Communities</td>
</tr>
<tr>
<td>Identification and development of the Carbon finance potential</td>
<td>(C) Objective: Develop economic models which would help assess the attractiveness of cocoa through enhancements of land–based carbon payments to farmers and investors (on-going)</td>
<td>NCRC, Katoomba group, Forest Trends, Local Communities</td>
</tr>
<tr>
<td>An African Agricultural Carbon Facility; Feasibility Assessment and Design Recommendations (2010)</td>
<td>(C) Objective: Developing new scalable carbon finance transaction models that will offer African smallholder farmers a ‘bridge’ to mitigate climate change while transitioning to more sustainable farming with greater adaptive capacity</td>
<td>Forest Trends, Katoomba group, Ecoagriculture, Climate Focus, The Rockefeller Foundation, UNDP, FAO, NCRC</td>
</tr>
<tr>
<td>Exploring the Potential for cocoa carbon in Ghana</td>
<td>(C) Objective: Improving productivity in cocoa farming systems of high biodiversity and ecosystem service value through integrated agricultural and environmental research</td>
<td>University of Reading, Cocobod, Farmers Associations, NCRC, Katoomba group</td>
</tr>
<tr>
<td>The Ghana Environmental Resources Management</td>
<td>(C) Objective: Identifying land use and management practices, socio-economic strategies</td>
<td>EPA, World Bank, CERGIS, Forest Commission</td>
</tr>
<tr>
<td>Management Project (GERMP)</td>
<td>and institutional arrangements that enhance carbon uptake and storage (mitigation) and contribute to more resilient livelihoods and ecosystems (adaptation)</td>
<td>WB; Rainforest Alliance, MLFM, MOFA, Forest Commission, Forest Carbon Partnership Facility (FCPF), MEST; EPA; Timber Associations, Traditional Authorities, District Assemblies;</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Readiness-Preparation Proposal (R-PP)</td>
<td>(C) <strong>Objective:</strong> To assist Ghana to prepare itself for reducing emission from deforestation and forest degradation and for implementation of an international mechanism for REDD (2010). Forest management policies to help Ghana achieve REDD and the list of players working to forge Ghana’s payments for ecosystem services regime will become available</td>
<td>NCRC, The Katoomba group, Forest Trends, FORIG</td>
</tr>
<tr>
<td>Nyankamba Community Resource Management Area REDD Project</td>
<td>(C) <strong>Objective:</strong> To avoid deforestation and forest degradation plus promoting carbon stocks conservation and enhancement (REDD+) through the creation and implementation of a Community Resource Management Area (CREMA) of about 240,000 ha in the Nyankamba escarpment of Northern Ghana</td>
<td>NCRC, Cadbury plc., Earthwatch Institute, University of Reading, University of Ghana, Ghana Cocoa Research Institute</td>
</tr>
<tr>
<td>Management strategies for maximizing carbon storage and tree species density in cocoa growing landscape</td>
<td>(P) <strong>Objective:</strong> To identify the best options to attain high carbon storage and tree species richness in tropical cocoa-growing landscape. <strong>Results:</strong> The optimal strategy for carbon storage depends on the cocoa yield. At low yields wildlife friendly farming is the best option, whereas at higher yields land sparing is the best.</td>
<td>NCRC, The Katoomba group, Forest Trends, FORIG</td>
</tr>
<tr>
<td><strong>Crop insurance</strong></td>
<td><strong>Objective:</strong> Detailed risk assessment of the key climatic hazards and their impact on food crop and cash crop production in Ghana ii. Review the quality and availability of time series data for risk assessment and rating. iii. Assess the demand for and current supply of agricultural insurance in Ghana</td>
<td>GTZ, Ghana National Insurance Commission (NIC), German Federal Ministry for the Environmental, Nature Conservation and Nuclear Safety</td>
</tr>
<tr>
<td><strong>Cocoa Certification and traceability</strong></td>
<td><strong>Objective:</strong> To implement a mainstream certification programme to ensure a sustainable and ethical cocoa supply chain (2009). <strong>Results:</strong> Code of conduct developed; cocoa buyers committed to purchasing sustainable UTZ CERTIFIED cocoa, producers trained on sustainable and professional production practices</td>
<td>Mars, Solidaridad,Cargill, Heinz, Nestle, IKEA</td>
</tr>
<tr>
<td>The Good Inside cocoa program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allanblakia and biodiversity conservation</td>
<td>(C) <strong>Objective:</strong> Allanblakia: standard setting and sustainable supply chain management</td>
<td>IUCN, Technoserve, Institute of Cultural Affairs</td>
</tr>
<tr>
<td>UTZ certification</td>
<td>(C) <strong>Objective:</strong> Developing and implementing a mainstream certification and traceability system for sustainable cocoa</td>
<td>UTZ; Solidaridad; WWF, Cocoa Abrabopa</td>
</tr>
<tr>
<td>Project Description</td>
<td>Objective</td>
<td>Partnering Organizations</td>
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<tr>
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</tr>
<tr>
<td><strong>Rainforest Alliance Certification</strong></td>
<td>(C) Objective: Encourage sustainable cocoa farming practices by maintaining a healthy environment and decent working conditions</td>
<td>GTZ; STCP; Armajaro Trading; Kraft foods; Rainforest Alliance; WWF, Cocoa Abrabopa</td>
</tr>
<tr>
<td><strong>Certification Capacity enhancement, (CCE)</strong></td>
<td>(C) Objective: Common training materials for Fairtrade, Rainforest Alliance and UTZ certified</td>
<td>Mars, Armajaro, ADM, RA, UTZ, Flo, GTZ, Solidaridad, IDH, Barry Callebant, Cocoa Abrabopa</td>
</tr>
<tr>
<td><strong>Sustainable Forest Management</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Agriculture Sustainable Land Management Strategy and Action Plan (2009-2015)</strong></td>
<td>(C) Objectives: Contribute to improved agricultural productivity, food security, enhanced livelihoods, ecosystem integrity, growth and development in an environmentally sustainable manner</td>
<td>MOFA; TerrAfrica; World Bank; FAO; NEPAD, EPA, FC</td>
</tr>
<tr>
<td><strong>Integrated Community based Land Management and Soil Fertility Improvement</strong></td>
<td>(C) Objective: Introducing land use planning into rural communities as basis for promoting improved soil fertility management. Farmer field School approach will be used for the training of the SLM technologies</td>
<td>MoFA; FAO, Community Based Organizations, District Assemblies, MLFM</td>
</tr>
<tr>
<td><strong>National Forest Resources Management: National Agroforestry Project (1989-1998)</strong></td>
<td>(P) Objective: To promote agroforestry systems to reduce pressure on natural forest resources for fuel, farm, and domestic wood requirement. Results: AF was adopted across the country</td>
<td>MOFA, MLFM; EPA; District Assemblies, FC, CBOs, FBOs</td>
</tr>
<tr>
<td><strong>Land and Water Management Project (1994-2003)</strong></td>
<td>(P) Objective: Building the capacity of MoFA to be able to promote community-based land and water management practices. Results: Over 500 MoFA staff was trained on procedures for facilitating planning of community based land improvement activities</td>
<td>FAO, MoFA; MLFM; EPA, CBOs, FBOs</td>
</tr>
<tr>
<td><strong>Agroforestry and sustainable forestry techniques in cocoa system in three Ghana districts (ongoing)</strong></td>
<td>(C) Objective: Introduction of economic trees into cocoa systems to conserve biodiversity and thus mitigate climate change</td>
<td>Pro-Natura International (Ghana); University of Ghana; Leventis Group; Farmer communities in Kade,</td>
</tr>
<tr>
<td><strong>Forest Protection and Resource Use (FORUM) Project</strong></td>
<td>(P) Objective: To slow the degradation of forest resources in the Volta region through protection of the natural forest reserves and intensification of private woodlot establishment. Results: Establishment and maintenance of plantations through enrichment in Ho and Jasikan areas during the period covered 6,364 ha. Development of community woodlots in off-reserves totalled 3,050 ha in Denu and Sogakope districts</td>
<td>GTZ; German Bank for Reconstruction and Development (Kfw), FC; CBOs, Community Forest Committees; Community Biodiversity Advisory Committees (CBACs)</td>
</tr>
<tr>
<td><strong>Voluntary Partnership Agreement with EU</strong></td>
<td>(C) Objective: To ensure that the supply of timber is from well managed forest and that it conforms with the EU Forest law enforcement and governance and trade principles</td>
<td>FC, EU, DFID, Civil Society, Local Communities, Timber Companies, Timber industries.</td>
</tr>
<tr>
<td>Project</td>
<td>Objective/Description</td>
<td>Collaborators</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
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<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Clean Development Mechanism project (CDM)</strong></td>
<td>(C) Objective: Restoration of Pamobrekum degraded forest reserve using the CDM mechanism</td>
<td>FC, FORIG, Traditional Authorities, Local Authorities, District Assemblies</td>
</tr>
<tr>
<td><strong>GOG HIPIC Plantation Programme</strong></td>
<td>(P) Objective: To rehabilitate 30,000 ha of degraded forest by the year 2004. Result: 8,250 ha was achieved: Urban Forestry (1,250 ha), Degraded Forests (5,100 ha) and offshore Community Afforestation (1,900 ha).</td>
<td>MLF, FC, District Assemblies,</td>
</tr>
<tr>
<td><strong>Biodiversity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Kakum Project: Cocoa Agroforestry</strong></td>
<td>(P) Objective: To improve the livelihood of cocoa farmers at Kakum (2002-2004). Result: 30% increase in productivity of cocoa at the project site, gave birth to STCP in Ghana and increased biodiversity</td>
<td>Conservation International (CI); GCRI, MoFA Extension Unit, FAO Integrated Pest Management Unit (ICPM), Akuapa kookoo, University of Ghana; Wildlife Division; Forest Commission</td>
</tr>
<tr>
<td><strong>Conservation of globally significant biodiversity in cocoa production landscape in Ghana,</strong></td>
<td>(C) Objective: Addressing root causes of biodiversity loss at local, national and global scale. The project will reduce encroachment, decrease unprotected forest conservation rate and increase tree cover</td>
<td>UNDP, GEF; IUCN; Cocobod</td>
</tr>
<tr>
<td><strong>Population, Land Management, and Environmental Change (PLEC)</strong></td>
<td>(P) Objective: Intended to strengthen national abilities to manage biodiversity and environmental degradation, and also to enhance the sustainability of natural resources and ecosystem use. (1998-2002) Result: i. Provided an adequate information on how farmers traditionally cultivate and conserve biodiversity while also using the land for food production ii. Provided intervention for sustaining agro-biodiversity for rural livelihoods and lesson for teaching, policy and development planning</td>
<td>UNDP, UNU-INRA, FAO, IPGRI, UNU-Tokyo, University of Ghana, KNUST, UDS, CSIR-SRI, MOFA, EPA, Friends of the Earth, PLEC Farmer Association, MEST</td>
</tr>
<tr>
<td><strong>Afforestation and Agroforestry to Reduce the Depletion of Forest Harbouring Monkey</strong></td>
<td>(P) Objective: The Busunya Forest is part of an ecosystem that harbours large numbers of threatened Mona Monkeys, <em>Cercopithecus mona</em> and Black and White Colobus Monkeys, <em>Colo-</em>**</td>
<td>GEF small Grant Scheme, Busunya SDA Afforestation group, Comp., Community groups</td>
</tr>
</tbody>
</table>
Sanctuary Afforestation and Agroforestry to Reduce the Depletion of Forest Harbouring Monkey Sanctuary

*bus polykomos.* The major threat is deforestation by logging, firewood extraction and shifting cultivation (1993-1995).

**Results:**

i. Two groups were formed and equipped to operate as CBOs in Busunya.

ii. The groups developed community nurseries and produced about 120,000 seedlings of exotic and indigenous species.

iii. The groups established 12 ha woodlots and 20 ha natural forests. About 50 farmers were assisted to establish agroforestry farms.

|---|
| **(P) Objective:** to establish effective systems for the protection of globally significant biodiversity areas in order to increase their ecological security in the tropical high forest biomes of Ghana. 
**Main Result:** The survey, demarcation and pil-laring of twenty four (24) Globally Significant Biodiversity Areas have been completed |

### Policy and Research

<table>
<thead>
<tr>
<th>The Eastern Region Cocoa Project and the Ashanti Region Cocoa Project 1972-1982</th>
</tr>
</thead>
</table>
| **(P) Objective:** Designed to replant about 50,000 ha of cocoa and control CSSD. 
**Results:** Of the proposed 17,330 ha of CSSV cocoa programmed for removal and re-planting, 13,050 ha were cut but only 3,810 ha planted |

<table>
<thead>
<tr>
<th>Cocoa Rehabilitation project 1989-1996 (Re-construction Import Credit, Export Rehabilitation and Export Rehabilitation Technical Assistance)</th>
</tr>
</thead>
</table>
| **(P) Objective:** policy reforms in the cocoa sector and rehabilitation of existing farms via improved practices and massive new planting totalling 300,000 ha 
**Results:** i. GCCSFA was set up 
ii. Improved technical services to cocoa production and enhanced efficiency and effectiveness of extension services |

<table>
<thead>
<tr>
<th>Strategic Environmental Assessment of FASDEP II</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(C) Objective:</strong> build and provide a vehicle to mainstream environmental issues within agricultural sector policies, plans and programmes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Roundtable for sustainable cocoa economy(RSCE)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(C) Objective:</strong> Establishing a participatory and transparent dialogue process towards economic, environmental and social sustainability in the global cocoa economy (2007, on-going).</td>
</tr>
</tbody>
</table>

|---|
| **(P) Objective:** Achieving Biodiversity conservation by using conservation concessions to complement agroforestry. 
**Results:** Some most promising trees suitable for cocoa farms identified. |

<table>
<thead>
<tr>
<th>GRF; FC; Regional and District Forest Service Divisions; World Bank; Local Communities</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Eastern Region Cocoa Project and the Ashanti Region Cocoa Project 1972-1982</td>
</tr>
</tbody>
</table>

| WB, IDA, EU, COCOBOD, CVSSVD |

| EU, IDA, COCOBOD, CVSSVD |

| MOFA, EPA, Water Commission, District Assemblies |

| International Cocoa organization (ICCO), Cocobod |

<p>| CIRAD/UMR Innovations, CIRAD, UMR Systemes, University of Ghana |</p>
<table>
<thead>
<tr>
<th>Project</th>
<th>Description</th>
<th>Objective</th>
<th>Results</th>
<th>Collaborators</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Participatory Approach for Tree Diversification in Cocoa Farm: Ghanaian Farmers’ Experience (2008)</td>
<td>Testing and implementation of a tree diversification framework with 36 farmers in six farmer groups. The value was to provide farmers with a flexible decision support tool for evaluating and integrating desirable trees into tree crop systems for increased diversity.</td>
<td>A decision support tool helped farmers select desirable shade trees compatible with cocoa and then provided a structure for planning their integration into their farms through the use of farm maps and planting arrangements.</td>
<td>STCP, Forest and Landscapes Denmark, IITA, Yale University, School of Forestry &amp; Environmental Studies</td>
<td></td>
</tr>
<tr>
<td><strong>Socio-Economics</strong></td>
<td></td>
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</tr>
<tr>
<td>MASDAR Socio-economic study</td>
<td>Effect on farming productivity of socio-economic factors and their interaction with institutional and agronomic factors (1998).</td>
<td>Social or socio-economic factors do not necessarily encourage higher productivity. Increased cocoa production can be met by increased productivity per unit area.</td>
<td>MASDAR (U.K), GCRI, Cocobod</td>
<td></td>
</tr>
<tr>
<td>Community Forest Management Project (CFMP) (on-going)</td>
<td>To help communities plant an area of 6,000 ha and have alternative livelihoods scheme to reduce poverty in the Eastern, Ashanti, Western and Central regions</td>
<td></td>
<td>ADB; FC; MLFM, Local Communities</td>
<td></td>
</tr>
<tr>
<td>Cocoa Livelihood programme</td>
<td>Enhancing farmers’ knowledge and competitiveness, improving productivity and quality, promoting crop diversification and improving supply chain efficiency (on-going).</td>
<td>Trained farmers realized yields 15-40% greater than non-trained farmers while using 10-20% less pesticides. Income is 23-55% higher</td>
<td>World Cocoa Foundation; COCOBOB, GTZ; IITA/STCP; TechnoServe; Agribusiness International</td>
<td></td>
</tr>
<tr>
<td>Capacity building of CSSVD staff in the use of GIS and Remote Sensing</td>
<td>Building of capacity of CSSVD Unit to convert analogue maps into digital for effective management of CSSVD (2006).</td>
<td>Capacity building Digital in technology conversion has largely succeeded. GIS equipment procurement and installation of the database, and re-training of the CSSVD staff have been completed</td>
<td>CERGIS, CSSVDU, COCOBOD</td>
<td></td>
</tr>
<tr>
<td>Empowering Cocoa Households with Opportunities and Education Solutions (ECH-OES) Alliance</td>
<td>Building on World Cocoa Foundation member-supported pilot education programs, ECHOES expands opportunities for youth living in cocoa-growing communities. The programme targets 160,000 youth and young adults</td>
<td></td>
<td>World Cocoa Foundation (WCF), Cocobod</td>
<td></td>
</tr>
<tr>
<td>Efficiency of Cocoa production and Marketing to Improve the</td>
<td>Training farmers to improve marketing efficiency, cocoa production efficiency, and quality at the farm level; and improving</td>
<td></td>
<td>World Cocoa Foundation (WCF), Gate Foundation</td>
<td></td>
</tr>
<tr>
<td>Livelihoods of cocoa farmers Program</td>
<td>Objective: Improving the livelihoods of diversified cocoa farms (on-going). The target is to train 200,000 smallholder farmers</td>
<td>GTZ, Mars, RA, STCP, Africare, PDA</td>
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<tr>
<td><strong>GTZ-Mars-IMPACT</strong></td>
<td>(C ) <strong>Objective:</strong> Improving the livelihoods of cocoa communities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Climate change</strong></td>
<td></td>
<td><strong>WB, DFID, Dutch Ministry of Foreign Affairs, Swiss Agency for Development and Co-operation, EPA, Ministry of Finance and Economic Planning</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ghana: Economics of Adaptation to Climate Change Study (2010-2015)</td>
<td>(C) <strong>Objective:</strong> Providing new and additional resources by international communities to developing countries through a better understanding of the costs of adapting to climate change</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Promoting Sustainable use of Natural Resources and Good Environmental Management in Ghana (On-going)</td>
<td>(C) <strong>Objectives:</strong> i. Support the coordination role of the Ministry of Local Government, Rural Development and Environment with respect to environmental policies and programmes by promoting inter agency linkage and networking with environmental practitioners ii. Review and update legislation of relevant international conventions in the light of the obligations they impose on the parties. At the end of the programme three selected communities will be provided with small scale income generating activities and skills training to enhance effective management of natural resources in the communities</td>
<td><strong>UNDP, Min of Local Government, Rural Development; Ministry of Environment Science and Technology; EPA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAN Climate Module: Criteria for Adaptation and Mitigation to Climate Change</td>
<td>(C) <strong>Objective:</strong> Collecting comments and technical suggestions regarding the SAN Climate Module and implementation of climate-friendly practices in Rainforest Alliance certified (RAC) farms</td>
<td><strong>GTZ, Amajaro, WA Fairtrade, Rainforest Alliance, The Katoomba group, AgroEco, Pro Natura, UTZ, Forest Commission, NCRC, STCP, Univ. of Ghana, UCC</strong></td>
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</tbody>
</table>
Appendix 9: Stakeholder Analysis

The baseline survey identified some stakeholders with which partnership in the CCP project is possible or that partnership in the project has already been agreed upon. These institutions were approached by the Consultants because they play an important role in the national or international cocoa sector, or in sectors that will be directly or indirectly impacted by the project activities. We made an effort to include Ministry of Lands and Forestry and a timber company since their activities impact on the sustainable cocoa production in the country. The analysis of the stakeholders has been grouped into the following:

(1) Government Ministries and Agencies;
(2) International Non-Governmental Organisations (NGO);
(3) Local NGOs;
(4) Farmers Associations;
(5) Private Companies in the cocoa sector; and
(6) District Assemblies

The Table below gives the classification of the stakeholders, their focal area(s) and their possible partnership in the CCP project. It is to be noted that most of the LBCs have been left out since their core business is the same as those listed.

<p>| Classification of Stakeholders according to their focal area(s) and possible partnership in CCP project |</p>
<table>
<thead>
<tr>
<th>Starkholder</th>
<th>Focal area(s)</th>
<th>Possible Partnership in</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Government</strong></td>
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</tbody>
</table>
| Ghana Cocoa Board (COCOBOD) | i. Improve livelihood of cocoa farmers  
ii. External marketing and export of Ghana cocoa  
iii. Formulate policies affecting the cocoa industry e.g cocoa ‘Hi-Tech’  
iv. implement government policy of CODAPEC  
v. Address child labour issues | Governance; Operation in cocoa certification strategy; Carbon Trade; conservation of biodiversity; and livelihood of farmers; land and institutional reforms |
| Quality Control Unit  
Seed Production Unit | - Inspection, grading and sealing; ensuring quality cocoa beans for export.  
- Production of hybrid cocoa pods and cocoa seedlings for farmers and the CSSVD rehabilitated farms | Certification; education on quality  
Seed quality; Seed health |
| Cocoa Swollen Shoot Virus Disease (CSSVD) Unit | i. Constant monitoring of swollen shoot and virus diseases in cocoa farms  
ii. Rehabilitation of infected cocoa-trees  
ii. Provision of hybrid seedlings to farmers to rehabilitate old cocoa farms  
iii. Incorporation of AF trees within cocoa farms to provide shade. | Governance: biodiversity, Inspection and monitoring |
| Ministry of Forest, Lands and Mines (MLFM) | i. Implementation of government policies on conservation and sustainable development of the nation's lands, forest and wildlife resources for maintenance of environmental quality | Biodiversity; NTFP; Tree Tenure and tree registration; land reform |
| Ministry of Food and Agriculture (MOFA) | i. Formulation and Implementation of policies affecting agricultural productivity, food security, enhanced livelihoods, ecosystem integrity, growth and development in an environmentally sustainable manner  
ii. Focusing on issues of land management as a major step towards sustaining agricultural productivity | Environmental biodiversity; sustainable production; Certification; land reform; tenancy |
| Plant Protection and Regulatory Services (PPRS-MOFA) | i. Regulation of agricultural inputs for food crops  
ii. Monitoring and forecasting of pests and diseases  
iii. Storage of agro-chemicals against outbreaks of pests and diseases in the country | Certification; extension education |
| Environmental Protection Agency (EPA) | i. Registration of importers of all agro-chemicals under Act 528  
ii. Monitoring of companies for registration  
iii. Residue contamination in cocoa to ensure quality  
iv. Disposal of agrochemicals in the country  
v. Climate change and Green House Gases  
vi. Environmental impact assessment | Climate change and regulation of agrochemical inputs; EIA |
| Wildlife Division | The regulation of off-reserve wildlife utilization | Biodiversity |
| Council for Scientific and Industrial Research (CSIR) | I. Carrying out research particularly related to agriculture and industry to find solutions to problems that affect Ghana’s socio-economic development  
ii. Dissemination of S&T information for the improvement of social, economic and environmental well being of the people of Ghana | Technology transfer and dissemination of agricultural best practices |
<p>| Forestry Research Institute of Ghana (FORIG) | Focusing research that generates scientific knowledge and appropriate technologies which enhance the sustainable development, conservation and efficient utilisation of Ghana’s forest resources | Technology generation and biodiversity conservation |
| University of Ghana Centre for Remote Sensing and Geographical Information (UG- | Provision of GIS information including maps; | GIS to monitor CCP projects in the areas of crop insurance, carbon footprint and REDD |</p>
<table>
<thead>
<tr>
<th>Organization</th>
<th>Activities</th>
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</thead>
</table>
| **Forest Commission (FC)** | i. Regulation of the utilization of forest and wildlife resources as well as its conservation, restoration, management and development through planning, implementation, monitoring and evaluation  
ii. Promotion of climate change and REDD+ policy in Ghana. |
| **Ghana Cocoa Research Institute (GCRI)** | i. Conduct research into best agricultural practices of cocoa, cola and sheanut to give high economic returns under sustainable environmental conditions.  
ii. Conduct research into and develop new products (non-traditional) from cocoa, coffee kola and sheanut to diversify utilization and improve prices  
iii. Developing techniques for the value addition of cocoa, coffee, sheanut and kola for the market  
iv. Technology transfer of by-products from residues or waste parts of cocoa to give farmers more income from their crops.  
v. Establishing strong linkage with cocoa extension, farmers and CBOs for effective transfer of research findings, new technologies and best practices. |
| **International Organizations** | |
| **Conservation International (CI)** | i. Conservation and sustainable use of biodiversity  
ii. Maintenance of Ecosystem services  
iii. Creating awareness of investment in rural natural resources management to reduce poverty, improve food security and conserve biodiversity |
| **Rainforest Alliance** | i. Certification of cocoa and voluntary standards  
ii. Environmental and social best practices |
| **West Africa Fair Trade** | Training of farmers in Organic cocoa production and voluntary standards for cocoa certification |
| **Solidaridad** | Certification and standards of cocoa; environmental best practices |
| **Flo (Fair Trade)** | Provide tools e.g.cocoa certification, for conservation of biodiversity |
| **International Union of Conservation of Nature (IUCN)** | i. Education of farmers on tree planting, registration & development of tree certificate for farmers;  
ii. Promotion of NTFPs esp. Allanblakia in cocoa |
| | Tree passbook, voluntary carbon market, REDD tools  
Technology generation and transfer;  
Biodiversity conservation and enhanced ecosystem services; Livelihood  
Training in voluntary standards and carbon certification; biodiversity conservation; livelihood  
Fair trade and standards; biodiversity; livelihood  
Livelihood and certification  
Biodiversity conservation and certification  
NTFPs, livelihood and biodiversity conservation; sensitization of ecosystem services; tree registration certificate |
<table>
<thead>
<tr>
<th>German Technical Cooperation (GTZ)</th>
<th>Support German Government in achieving its development objectives by providing viable, forward-looking solutions for political, economic, ecological and social development in a globalised world to improve people’s lives on a sustainable basis.</th>
<th>Sustainability of cocoa; improved livelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest Trends</td>
<td>i. Promotion of sustainable forest management and conservation by creating and capturing market values for ecosystem services ii. Support innovative projects that are developing new environmental markets iii. Enhance the livelihoods of local communities living in and around forests.</td>
<td>Improved biodiversity and certification</td>
</tr>
<tr>
<td>CABI Bioscience</td>
<td>Researching into three areas of core competence: invasive species management, fungal biodiversity and integrated crop/pest management</td>
<td>Integrated pest management</td>
</tr>
<tr>
<td>Pro-Natura International (PNI)</td>
<td>Capacity building of NGOs in project management; environmental advocacy; AF in cocoa farms</td>
<td>Livelihood and sustainability; biodiversity</td>
</tr>
<tr>
<td>Sustainable Tree Crop Programme (STCP)</td>
<td>Identification of economic trees in cocoa system and biodiversity conservation; best environmental practices</td>
<td>Biodiversity conservation and ecosystem services; sensitization on shade in cocoa; lobbying and advocacy</td>
</tr>
<tr>
<td>World Vision</td>
<td>Strengthening of Capacity of extension staff and building of capacity of farmers</td>
<td>Environment best practices; alternative crops with economic value; awareness creation</td>
</tr>
<tr>
<td>Voluntary Services Organisation</td>
<td>Working with 100 CCP communities in 3 cocoa zones. Capacity building of farmers, alternative crops and markets</td>
<td>Education and sensitization programmes; awareness creation; lobbying</td>
</tr>
<tr>
<td>Care International</td>
<td>Capacity building of farmers; alternative crops outside cocoa and markets,</td>
<td>Extension education; advocacy</td>
</tr>
<tr>
<td>DFiD</td>
<td>Bilateral support to the cocoa industry</td>
<td>Funding; livelihood</td>
</tr>
<tr>
<td>Katoomba incubator</td>
<td>Carbon footprint in cocoa</td>
<td>Knowledge in carbon trade</td>
</tr>
<tr>
<td>Technoserve</td>
<td>Building agribusinesses to create income, opportunity and economic growth for rural people and their families, communities and countries</td>
<td>Agribusiness in NTFPs</td>
</tr>
<tr>
<td>Agro-Eco</td>
<td>Organic cocoa; environmental best practices; Rainforest Alliance certification</td>
<td>Environmental best practices; conservation of biodiversity</td>
</tr>
<tr>
<td>UTZ</td>
<td>UTZ – certification; social best practices; child labour in cocoa</td>
<td>Training of extension in standards; certification</td>
</tr>
<tr>
<td>The World Bank</td>
<td>Voluntary Carbon market</td>
<td>Carbon and Payment for Ecosystem Services</td>
</tr>
<tr>
<td><strong>Local NGOs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Friends of the Earth</td>
<td>Engaging politicians and decision makers regularly on issues of sustainability and quality of the environment for the conservation and sustainable use of the world’s natural resources.</td>
<td>Sustainable ecosystem services; lobbying and advocacy</td>
</tr>
<tr>
<td>ASNAPP</td>
<td>Medicinal plants; alternative economic forest</td>
<td>Livelihood</td>
</tr>
<tr>
<td><strong>Organisations</strong></td>
<td><strong>Engagement</strong></td>
<td><strong>Outcomes</strong></td>
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</tr>
<tr>
<td><strong>UNDP-SGS</strong></td>
<td>Education on Timber rights, and planting of NFTP in cocoa farms to fight poverty</td>
<td>Poverty reduction; biodiversity; alternative trees</td>
</tr>
<tr>
<td><strong>Africa Cocoa Coalition</strong></td>
<td>Registration of cocoa farms, trees planted by farmers in their cocoa farms and issuance of ID cards to farmers; gender issues</td>
<td>Advocacy on forest degradation and biodiversity loss. Livelihood of cocoa farmers</td>
</tr>
<tr>
<td><strong>Drama Network</strong></td>
<td>Involved in compositing</td>
<td>Environmental best practices</td>
</tr>
<tr>
<td><strong>Golden Tree</strong></td>
<td>Compliance of cocoa standards</td>
<td>Certification</td>
</tr>
<tr>
<td><strong>Nature Conservation and Research Centre (NCRC)</strong></td>
<td>Building local institutions to access payments for ecosystem services; advocate for community-level ownership and benefit sharing of revenues generated from conservation activities.</td>
<td>Conservation of biodiversity; environmental best practices; Education of farmers on best agricultural practices</td>
</tr>
<tr>
<td><strong>Ghana Community Radio Network</strong></td>
<td>Dissemination of agricultural information to the communities</td>
<td>Dissemination of information about the activities of CCP</td>
</tr>
<tr>
<td><strong>Farmer Organisations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cocoa Coffee Sheanut Farmers Association</strong></td>
<td>Lobbying and advocacy</td>
<td>Active partner</td>
</tr>
<tr>
<td><strong>Apex Farmers Organisation of Ghana (AFOG)</strong></td>
<td>Lobbying and advocacy</td>
<td>Active partner</td>
</tr>
<tr>
<td><strong>Ghana Agricultural Inputs Association; Croplife</strong></td>
<td>Importation of pesticides for the cocoa industry</td>
<td>Sustainable environment; health</td>
</tr>
<tr>
<td><strong>Private Companies</strong></td>
<td>Production of AF seedlings</td>
<td>AF seedlings</td>
</tr>
<tr>
<td><strong>Summertex</strong></td>
<td>Making fertilizer and agricultural inputs reliably, timely, and efficiently via an extensive distribution network at the most affordable prices to farmers</td>
<td>Sustainable environment</td>
</tr>
<tr>
<td><strong>Wienco</strong></td>
<td>Making fertilizer easily available to farmers</td>
<td>Sustainable environment</td>
</tr>
<tr>
<td><strong>Sidalco Ltd</strong></td>
<td>Making fertilizer easily available to farmers</td>
<td>Sustainable environment</td>
</tr>
<tr>
<td><strong>Kraft Foods</strong></td>
<td>Good social, environmental and economic programmes; forecasting</td>
<td>Certification</td>
</tr>
<tr>
<td><strong>Cargill</strong></td>
<td>Social, environmental and economic programmes; forecasting</td>
<td>Certification</td>
</tr>
<tr>
<td><strong>AkufoAdamfo; Adwumapa; Kookoo Abrabopa</strong></td>
<td>License buying companies</td>
<td>Improved livelihood</td>
</tr>
<tr>
<td><strong>Olam</strong></td>
<td>License buying company</td>
<td>Livelihoods</td>
</tr>
<tr>
<td><strong>Armajaro</strong></td>
<td>Cocoa certification and traceability</td>
<td>Traceability and biodiversity</td>
</tr>
<tr>
<td><strong>Kuapa Kookoo</strong></td>
<td>License buying company; cocoa certification compliance</td>
<td>Biodiversity, standard compliance</td>
</tr>
<tr>
<td><strong>District Assemblies</strong></td>
<td>Statutory deliberative and legislative government body responsible for the determination of broad policy objectives of the development process</td>
<td>Sustainable production and livelihood; threat of galamsey; community participation,</td>
</tr>
</tbody>
</table>
Description of specific stakeholders

Government Stakeholders

COCOBOD
As the institution with government authority to regulate the cocoa industry and export cocoa from Ghana, COCOBOD is a key project stakeholder in defining the vision of sustainability for the sector and developing strategies to support that vision through appropriate incentives for farmers and other stakeholders of the cocoa supply chain. COCOBOD will also play a key role in the implementation of all of the project’s Outcomes. A particular focus of its involvement will be in governance framework and Outcome on cocoa production systems as well as Outcome on incentive systems. COCOBOD’s role will be crucial in the development of traceability for Ghanaian cocoa and in the development of a compliance monitoring system for agreed production standards. It will also play a key role in discussions with the national and international cocoa and chocolate companies about the type of incentives and the most appropriate ways of their implementation to increase biodiversity friendliness of Ghana’s cocoa production methods. Locally, COCOBOD and other stakeholders should be involved to lobby the parliament to enact laws and legislation that will streamline land ownership in cocoa growing communities as well as encourage farmers to support government’s efforts in eradicating cocoa swollen shoot disease without fear of losing their farms.

Quality Control Division
The Division is responsible for the inspection, original grading and sealing, and check sampling of all cocoa. The quality control takes place at three stages of the marketing chain, in land sheds, takes over points, and immediately prior to export. The QCD may assist the various NGOs and LBOs operating in the country to ensure that farmers who are participating in the CCP project produce quality cocoa to earn a premium price and thereby enhancing their livelihood.

Cocoa Research Institute of Ghana (CRIG)
CRIG will play a critical role throughout the project in the development of best practices of cocoa production and the rehabilitation of cocoa farms. Through its ongoing breeding programs (in cooperation with IITA and Mars Inc.), CRIG will contribute to supplying farmers with more productive and disease-resistant cocoa germplasm. CRIG will also play a key role in researching and testing the most appropriate ways to associate cocoa with other farm trees and in monitoring the impact of new production practices on the ecological and economic sustainability of the production systems.

Ghana Cocoa, Coffee and Sheanut Association
The Ghana Cocoa, Coffee and Sheanut Association is an umbrella association which caters for all cocoa farmers. The impact of the CCP will be zero if the farmers which are the end-users of the project are not involved in the project implementation. The membership covers the entire country and conservative figure puts total membership at over one million. The association negotiates with government for cocoa prices, bonus and other incentives for the members. Already some members of the association are very active in the CCP project zones. The project will use the Association as a vehicle to transfer the excellent technologies developed by the project to its membership.

Forestry Commission
The Forestry Commission (FC) is the government agency responsible for management of the nation’s forest reserves and protected areas. It also regulates the utilization of forest and wildlife resources and

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5 Some of the information below is modified from the UNDP Biodiversity Report (Unpublished)
conservation, restoration, management and development through planning, implementation, monitoring and evaluation. The FC will play an important role under the CCP project since it will deliver the government policy on REDD+. The Commission is also involved in the following activities:

1) Assist the private sector and other agencies in the implementation of forest and wildlife policies;
2) Undertake the development of forest plantations for the restoration of degraded forest areas;
3) Develop forest plantations to restore degraded forest areas and regulate harvesting of timber, wildlife and other non-timber forest products to conserve Ghana’s biophysical heritage;
4) Expand the country’s forest cover and increase in the production of industrial timber;
5) Vet and register contracts and issue permits for export of forest and wildlife products;
6) Track the movement of timber, wood and wildlife products;
7) Develop and enforce apt industrial standards and trade guidelines for timber and wildlife products;
8) Promote the optimization of utilization of Ghana’s forest and wildlife products through value addition and promotion of lesser known species; and
9) Provide market intelligence to inform both Government and industry on pricing, trade and product trends.

**Environmental Protection Agency (EPA)**

Environmental Protection Agency is the main government agency responsible for the coordination of activities of local and international agencies and institution and the realization of environmental impact assessment for activities potentially degrading the ecosystem. It is also responsible for the formulation of policy and environmental standards for the country. The Agency promotes environmental governance though the issuance of permits and facilitates mainstreaming of Strategic Environmental Assessments (SEA) into sector policies. It coordinates, manage and monitor all National Action Programmes to Combat Drought and Desertification (NAP) projects at the National and decentralized levels. EPA is considered an important partner in the executing of the CCP project.

**Plant Protection and Regulatory Services (PPRS)**

Plant Protection and Regulatory Services is one of the divisions of the Ministry of Food and Agriculture. The Service is involved in the regulation of agricultural inputs for food crops; monitoring and for-casting of pests and diseases and storage of agro-chemicals against outbreaks of pests and diseases in the country. PPRS is also engaged in climate change activities and GHG emission programmes. The activities of PPRS may be complementary to EPA under the CCP project.

**Ministry of Food and Agriculture (MOFA)**

The Ministry of Food and Agriculture is responsible for all agricultural practices and food production in Ghana. Its extension services division is responsible for providing farmers with the necessary skills and knowledge for sound agronomic practices. With these responsibilities, MOFA has a key role in any effort to implement more sustainable and biodiversity friendly land use practices and coordinating them with the Ghana’s biodiversity conservation strategy. Although cocoa is a commodity crop, the sector itself is controlled by the Ministry of Finance through COCOBOD and not MOFA. An attempt was made under the World Bank Cocoa Sector Reform to transfer cocoa extension to MOFA—the Unified Extension System—but a policy change has kept cocoa extension separately under COCOBOD, making it the appropriate host for the CCP project. COCOBOD will closely coordinate its activities with the other ministries whose sectors are impacted by this project, especially the Ministry of Land, Forestry and Mines, which is responsible for the conservation of forests and wildlife.

**Wildlife Division**

Under the overall responsibility of the Forestry Commission, the Wildlife Division is responsible for the regulation of off-reserve wildlife utilization. It will play a key role for the implementation of Outcome 1, whose objective is to make sure that reduced deforestation and increased off-reserve habitat will indeed
translate into healthier wildlife populations and not be undermined through unsustainable levels of hunting in farm and forest areas. The Wildlife Division will work closely with Conservation International and with the French Embassy in the implementation of these tasks, which also include the strengthening of the Community Resource Management Areas (CREMA) system in Ghana.

Centre for Remote Sensing and Geographic Information Systems (CERSGIS)

International Stakeholders and donor agencies

United Nations Development Program
UNDP Ghana, through the implementation of its various programs and projects, has become an important interface between the Government of Ghana at the upstream level and the local/district Assemblies at the downstream level. These programs and projects focus on capacity building for national governance and economic management, private sector, mainly informal, micro and small enterprise development, microfinance, district level poverty reduction and community-based environmental management activities. UNDP is the project’s implementing agency. It will play a leading role in setting up the project management structure in cooperation with COCOBOD, in the monitoring and evaluation of project progress, and also in the scaling up of the project lessons beyond the national scale.

French Embassy in Ghana
The French Embassy is working on four main fields including politics and diplomacy, cooperation and cultural action, defense cooperation and economic and commercial relations. It has facilitated CIRADs work in Ghana. The Embassy has developed a wildlife management program, which includes the rehabilitation and management of Community Resource Management Areas (CREMAs) in collaboration with Ghana’s Wildlife Division and several national NGOs. The Embassy will be in important partner of the project in efforts to build a better enabling environment for conservation have been closely aligned with the planned activities of the Embassy.

International NGOs

International Union for Conservation of Nature (IUCN)
The IUCN is the world’s oldest and largest global environmental organization, with more than 1,000 government and NGO members and almost 11,000 volunteer experts in some 160 countries. The aim is to help the world find pragmatic solutions to the most pressing environment and development challenges. IUCN works on biodiversity, climate change, energy, human livelihoods and greening the world economy by supporting scientific research, managing field projects all over the world, and bringing governments, NGOs, the UN and companies together to develop policy, laws and best practice. The IUCN has been identified as a major partner in the Cadburys Cocoa Partnership project which aims at securing the economic, social and environmental sustainability of around a million cocoa farmers and their communities in Ghana, India, Indonesia, and the Caribbean. While the UNDP have been tasked to facilitate the development of an environmental strategy for the partnership in Ghana, IUCN have been requested to provide additional inputs into the development of this strategy based on its field and policy experience in Ghana and other countries. (The detailed report from the IUCN is incorporated in this report).

GTZ
Deutsche Gesellschaft Für Technische Zusammenarbeit (GTZ) supports the German Government in achieving its development objectives by providing viable, forward-looking solutions for political, economic, ecological and social development in a globalised world to improve people’s lives on a sustainable basis. It is active in sustainable cocoa production in the country and a possible good partner in the execution of CCP programme. Some of the activities undertaken by GTZ include: a) Agriculture promotion i.e. encourage growth in the agriculture sector by implementing political and institutional reforms as well as
investment programmes and b). Private Sector Promotion thus help to remedy structural weaknesses and build capacities for the benefit of MSME development. GTZ supports projects in the fields of peace mission training, tropical forest conservation, water supply and special-needs education. All projects and programmes contribute to HIV/AIDS prevention.

**FAO**
The Food and Agriculture Organization (FAO) objectives include raising levels of nutrition, improving agricultural productivity, bettering the lives of rural populations, and contributing to the growth of the world economy. The FAO aids development by collecting, analyzing and disseminating data on an international basis.

Other FAO activities include sharing policy expertise for devising national agricultural policies, supporting planning activities, drafting effective legislation and help to create national strategies for achieving rural development and hunger alleviation goals. It also provide a meeting place for nations by providing a setting where rich and poor nations can come together to build common understanding.

The FAO brings knowledge to the field i.e. mobilizes and manages millions of dollars provided by industrialized countries, development banks and other sources to make sure projects achieve their goals. It provides the technical know-how and a limited source of funds. In crisis situations, FAO work side-by-side with the World Food Programme and other humanitarian agencies to protect rural livelihoods and help people rebuild their lives.

**Climate Focus**
Climate Focus is a proven international leader in providing advisory services on climate change regulation and the carbon trading market. Climate Focus’ technical, financial and legal teams work in tandem to provide a comprehensive suite of services to respond to a particular needs. Climate Focus’ expertise reaches back to the inception of the carbon market over 10 years ago. The founders are internationally recognized experts that helped create the carbon market through their work in the Dutch government and the World Bank – pioneer organizations in defining the rules of the international carbon market. These founders now lead an international team of experts that provide the specific technical and legal expertise necessary for success wherever your organization or project is located. Climate Focus has worked with clients and projects in over 50 countries. The Climate Focus legal team is one of the most experienced and respected in the industry. Matching this experience and respect, the Climate Focus technical team has been instrumental in not only evaluating and implementing hundreds of emission offset projects, the team has also developed several of the standards by which such projects are assessed.

**Rainforest Alliance**
The Rainforest Alliance works to conserve biodiversity and ensure sustainable livelihoods by transforming land-use practices, business practices and consumer behaviour. Most of the communities living in the country’s most fragile, biodiverse and ecologically important ecosystems face intense pressure to exploit their resources. To combat the lure of illegal and irresponsible harvesting, damaging tourism development, slash-and-burn agriculture and other quick fixes, the Rainforest Alliance helps communities to derive economic benefits from the goods and services that result from sustainable farming, forestry and tourism. The Rainforest Alliance is involved in assisting farmers to produce cocoa sustainably and under environmentally friendly manner to have their produce certified. Rainforest Alliance will play a role in the implementation of the project by its involvement in tree diversification in the cocoa farms.

Also to meet rapidly growing demand for third party certified cocoa, Rainforest Alliance has been investing in building the supply of certified cocoa in West Africa. The Rainforest Alliance approach is to work with the value chain: farmers, their organizations, traders of cocoa beans (export and import); processors,
producing liquor, butter, cake/powder and chocolate. Additionally, because Ghana’s external trade in cocoa is managed by COCOBOD, it works with the board to build support for voluntary certification.

**Eco-agriculture Partners**

This is an international NGO working worldwide to mobilize and support cross-sectoral landscape initiatives to jointly achieve agricultural development, rural livelihoods and healthy ecosystems. Ecoagriculture Partners develops methods and tools for multi-stakeholder groups to plan, assess and monitor eco-agriculture landscapes. EP synthesizes and disseminates state-of-the-art information about technical and institutional innovations for ecoagriculture, including the role of agriculture in climate change adaptation and mitigation. The organization supports and strengthens leaders in ecoagriculture. EP works collaboratively to promote alignment of policies for agricultural development, ecosystem management and climate action. The organization promotes markets that provide incentives for scaling up of ecoagriculture approaches, with a focus on payments for ecosystem services (PES), eco-certification, and market diversification. EP provides advisory services to organizations working in agriculture, environment and rural development, including the World Bank, the Inter-American Development Bank, the Bill and Melinda Gates Foundation, the David and Lucile Packard Foundation, FAO, UNDP, and others. The Ecoagriculture will be an important partner in all the implementation of the CCP programme.

**Forest Trends**

FT has been active working on community and forestry issues, studies and policy engagement in critical countries at the international level for the past 10 years. The NGO analyses strategic markets and policy issues catalyses connections between forward-looking producers, communities and investors, and develop new financial tools to help markets work for conservation and people. Through all their work, Forest Trends seeks to enable a new era of conservation that is financially sustainable. The Forest Trends has also helped demonstrate the efficacy of markets and payments for ecosystem services through its Business Development Facility (www.forest-trends.org/programs/bdf.htm). The programme demonstrates how to apply ecosystem services concepts and bring them into practice. The Forest Trends will be involved in the CCP project in the area of certification.

**Katoomba Group**

The Katoomba Group, a member of the Forest and Trends family of initiatives, is a global network of practitioners working to promote the use of and improve capacity for developing ecosystem services payments. It collaborates in West Africa with Nature Conservation Research Centre (NCRC) and Forest Trends to form the Katoomba Ecosystem Services Incubator. The Group serves as a forum for the exchange of ideas and strategic information about ecosystem services transactions and markets. It also enables collaboration between practitioners and PES projects and programmes. The Katoomba Incubator was launched in late 2007 to support community-focused projects that contribute to significant innovation in carbon and other PES, drawing on the strengths of the Katoomba Group and its ability to bring together the best local and global expertise for projects. The Incubator was involved in the development of Ghana Cocoa Carbon Initiative and the organization of several workshops on Carbon and Cocoa: the relationship between cocoa farming, deforestation and carbon sequestration and Ghana Readies for REDD. The Group may serve as a useful partner in the development of carbon and PES markets under the CCP project.

**West Africa Fair Fruit Company (WAFF)**

WAFF started in 2005 as a non-profit social business in the fruit and processed fruit export sector of Ghana, Burkina Faso, Cote d’Ivoire and Sierra Leone. It aims to promote and strengthen sustainable sources of income and employment for rural poor women and men through production and export of organic and Fairtrade fruit from West Africa. Its mission is to provide access to markets linked to fair trade and organic importers in Europe. It also provides technical assistance to farmers, processors and buyers as well as training and consultancy in technical development, production and quality management. WAFF
currently works in three main areas: fruit, cocoa and climate change. It also manages projects to design
new certification standards and new approaches to sustainable trade. In 2008, WAFF started managing
pilot projects to test a new certification code for sustainable cocoa (Utz) in Ghana and Cote d’Ivoire.

Pro- Natura International (PNI)
The PNI is an international environmental NGO. The objective of the PNI is to create awareness among
cocoa farmers on the sustainable environmental best practices for cocoa production and the planting of
AF trees on their farms to earn an additional income. It became an affiliate of A.G Leventis programme
which is hosted by the College of Agriculture and Consumer Sciences, University of Ghana for the train-
ing of Young Farmers in 2002. This affiliation became possible when PNI observed that the Leventis has
introduced a course in Agro-forestry as a way of sustaining environmental practices into its curriculum.
The programme included the identification of useful trees which can be incorporated into cocoa farms and
trees which are currently becoming extinct in the forest. In addition to the above the Leventis programme
has developed excellent capacity for water use policy, Environmental advocacy and project management
for NGOs. The activities of the PNI to date have mainly centered at two cocoa growing areas of Kade in
the Eastern region and Jasikan in the Volta region. The Pro Natura International is working with 185
farmers in each of the three villages within the two sites and it is hoped that by the end of the project
about 185,000 trees would have been planted in the selected communities

Conservation International
CI is an international NGO devoted to conservation of the Earth’s living natural heritage—global biodi-
versity—and to demonstrating that human societies are able to live harmoniously with nature. With ap-
proximately 850 staff and partners in the field, CI develops strategies to raise awareness of conservation
issues and helps bring about positive changes in laws, policies and attitudes toward biodiversity. CI will
bring its expertise in biodiversity science, landscape planning, corporate engagement, community based
conservation, and enterprise development to bear on the project. Working as one of the members of the
PSC, CI will ensure that biodiversity conservation is prioritized within all project decisions. CI will also
play an important role in the implementation of all five project outcomes.

CABI Bioscience (CABI)
CABI is a statutory intergovernmental agency, mandated to address the generation, access and use of
scientific knowledge in support of sustainable development. In 1986, CABI became a UN-treaty level
international organization, now owned at Head of State level by 44 Member Countries, including Ghana.
Operating in direct connection with national partners through a network of centers around the world, CA-
BI plays key roles in the international development and use of applied biological sciences, in particular
towards the development of sustainable agricultural systems. CABI has extensive experience in research
and extension in cocoa systems, including via an active role within the STCP. Within this CCP project,
CABI will play an important role in supporting COCOBOD in the development of an information data-
base on the Ghanaian cocoa sector and the use of existing experiences in the definition of best practices
for cocoa farm rehabilitation. It will also be involved in several other activities of the project.

Local Stakeholders

Samartex Timber & Plywood Co. Ltd.
Samartex is based in the Western Region. In order to ensure its long-term supply of timber, the company
has initiated an agroforestry project in forest fringe communities to integrate the planting of timber trees
on cocoa farms. Samartex will bring these experiences into the project and cooperate with the project in
scaling up such schemes throughout the cocoa growing region. Already the company has been requested
to produce 350,000 tree seedlings for the CSSVP.
**Sustainable Tree Crops Program (STCP)**

The STCP constitutes a coordinated and innovative efforts made by farmers and producer organizations, industry and trade, national governments, research institutes, the public sector, policy makers, donors and development agencies to facilitate the improvement of smallholder agricultural systems based on tree crops in West and Central Africa.

The goal of STCP is to improve the economic and social well being of smallholders and the environmental sustainability of tree crop farms in West and Central Africa. STCP is hosted and managed by International Institute for Tropical Agriculture, Ibadan, Nigeria (IITA). It is a regional development partnership of governmental, civil society and private sector organizations that is working to achieve economically and socially sustainable cocoa production in West Africa (www.treecrops.org). STCP is presently active in Ghana. Its work covers farmer services, research, and policy and market information systems. The STCP Action Plan was initiated in Ghana in late 2002 and, among other activities, includes a training program for farmers based on the Farmer Field School (FFS) methodology. The STCP is also involved in the following: spray minimization, crop rotation techniques, Agribusiness skills training and child labour sensitization and HIV/AIDS awareness. STCP will play a major role in the project by bringing its agronomic and farmer training expertise, market and production system knowledge, and its regional network for dissemination of learning into the project. STCP will also be strongly involved in the implementation of the tree diversification component.

**Agribusiness in Sustainable Natural African Plant Product (ASNAPP)**

ASNAPP was established in 1999 as an International NGO to help develop the Natural Plant Product Industry in Africa and translate its full potential into economic benefits for rural/communities in Africa. The mission is to help create, develop and support successful African businesses in the natural products sector to provide income, employment and development, using world class science, technologies, partnerships and business approaches. ASNAPP activities in the domestication of indigenous, wild and threatened plants, and ensuring adherence to good agricultural practices are also consistent with efforts targeted at addressing Global Warming. In Ghana the focus of the NGO has been on how to protect and sustain medicinal plants and other economic trees in the forest. ASNAPP is a potential partner in the CCP project in environmental management and value-added product development by community and/or in source country.

**Nature Conservation Research Centre (NCRC)**

NCRC is the leading conservation NGO in Ghana catalyzing and influencing site level reduction of emission from degradation and deforestation (REDD) projects in the country. It is rapidly becoming a sub-regional organization with project involvement in 6 countries across the West African sub-region. NCRC’s role has focused on screening, catalyzing, capacity-building, funding and providing early encouragement and guidance to the first generation of projects. NCRC has worked closely for many years supporting rural communities, traditional leadership and farmers in building local institutions to access payments for ecosystem services in Ghana. NCRC has become a strong advocate for community-level ownership and benefit sharing of revenues generated from conservation activities.

**Africa Cocoa Coalition**

Africa Cocoa Coalition is a coalition of autonomous non-governmental conservation organizations formed in 2006. The aim of the coalition is to strive to promote total quality cocoa production in Africa cocoa producing countries whiles improving the social, economic and environmental conditions to ensure sustainable cocoa economy. The mission of ACC is to work with all the relevant stakeholders to ensure the adoption of sustainable best practices in the cocoa industry and to promote equitable returns to all players in the global cocoa value chain (producers, industry and consumers). Among the major activities carried out by the Coalition include: education and awareness creation, promotion of best practices in co-
coa production, formation of farmer associations, promotion of Farmer field schools, facilitating micro-
credit schemes to farmers, training and capacity building and advocacy and policy review. ACC may be a 
possible partner in most of the programmes to be undertaken by the CCP.

**Conservation Alliance**
Conservation Alliance is an alliance of NGOs operating in Ghana, Benin, Nigeria and Sierra Leone. 
Partnerships are CA’s main mode of operation. It brings together the people and skills needed to build 
Africa’s capacity to conserve biodiversity through sound science, local initiatives, and research for human 
development. The vision of CA is conservation of biodiversity for human development by improving the 
quality of life for fringe communities through the conservation and sustainable use of biodiversity. The 
strategic programmes being pursued by CA include climate change, biodiversity conservation, enhance-
ment of ecosystem services, agriculture and food security.

**Friends of the Earth**
Friends of the Earth-Ghana is a Ghanaian environmental organization. The activities of FOE-Ghana 
cover policy and legislation issues, forestry and mining, biodiversity, water resources and fisheries, deser-
tification, genetically modified organisms (GMOs) and women empowerment. The vision of the NGO is to 
create a sustainable national and global society where environmental protection and meeting people’s 
needs go hand in hand. The NGO is involved in lobbying, advocacy and campaigning. It is active in envi-
ronmental and livelihoods projects in partnership with local communities. CCP can partner with FOE-
Ghana to increase understanding of communities of their rights and responsibilities in forest use and man-
age. The NGO together with CCP will work with the communities and timber companies to build 
their capacity and knowledge about forest certification and Ghana’s new forest laws, especially social 
responsibility agreements.

**Ministry of Lands, Forestry and Mines (MLFM)**
The Ministry formulates, monitors and evaluates forest resources of the country. Sustainable management 
and utilization of Ghana’s lands, forests, wildlife and mineral resources is under the control of the Minis-
try. Rehabilitation and promotion of resource development programmes aimed at reforesting suitable har-
vested sites, rehabilitating degraded mining areas and afforesting denuded lands. The CCP has identified 
MLFM in the executing of some of the outcomes of the programme especially governance, and rehabilita-
tion of denuded lands with the appropriate forest trees.

**Wienco**
Wienco (Ghana) Limited was established in 1979 and is a joint venture Ghana-Dutch Company involved 
in businesses in the agriculture sector. The core business of the company is importation and distribution 
of fertilizers and other agricultural inputs. Wienco as a major importer of fertilizer and stocks a wide ran-
d of fertilizers including special blends for specific crops. The company is also involved in producing and 
distributing certified organic compost produced in co-operation with Volta River Estate Limited (VREL) 
in Akosombo. The mission of the company among others is to provide the quality fertilizer and agricu-
tural inputs through an extensive distribution network.

**Yara**
Yara is the world’s leading mineral fertilizer company; the only one with a truly global presence and a 
permanent presence in Africa. Previously a part of Hydro, Yara has in particular focused on private-
public partnerships that support the African Green Revolution, venturing into partnerships in four coun-
tries as part its African business strategy. Africa represents a minor commercial market for Yara’s prod-
ucts today, but African agriculture has a great potential for growth depending on improved soil fertility 
increased inputs and quality seeds. Yara actively supports the call for an African Green Revolution, and
has become a key partner in developing sustainable agriculture, improving productivity and increasing production - moving towards food security. Even though Yara is not in cocoa its experience in private-public partnership could be explored for the implementation of the CCP.

**CERSGIS** is an autonomous technical institution within the University of Ghana, Legon, with capacity in remote sensing and the use of geographic information systems (GIS). CERSGIS has already contributed important spatial information on the impact of land use on vegetation patterns over time in selected pilot villages in the Western Region during the PDF-B, which has helped to shape the project strategy. CERSGIS will play an important role in the project in the development of visual tools (aerial photos or satellite images) for the negotiation of conservation outcomes (such as defined limits to deforestation or rehabilitation needs) between the project and the communities. CERSGIS will also participate in the implementation of the compliance monitoring program in the participating communities and will work with COCOBOD, CABI and STCP in the development of a database on the cocoa economy of Ghana.

**Forest Research Institute of Ghana (FORIG)**

FORIG is one of the research institutes under the Council for Scientific and Industrial Research (CSIR). The mission of the Institute is to conduct user focused research that generates scientific knowledge and appropriate technologies which enhance the sustainable development, conservation and efficient utilisation of Ghana’s forest resources, and to disseminate the information for the improvement of social, economic and environmental well being of the people of Ghana.

FORIG will play a lead role in the implementation of tree diversification. It also has a bridging role through its involvement in many other activities in the land use sector, including the Novella project that is presently promoting the use of Allanblackia trees for seed production, including on cocoa farms. FORIG will also be actively involved in mass production of economic trees for distribution to cocoa farmers under the project.

**Council for Scientific and Industrial Research (CSIR)**

CSIR is a public research centre made up of 13 research institutions. These institutions have a statutory responsibility to carry out research particularly related to agriculture and industry to find solutions to problems that affect Ghana’s development. CSIR works in partnership with both local and international organizations such as the International Development Research Center (IDRC) and the United Nations Food and Agricultural Organization (FAO), government agencies and private organizations. Some of the member institutions include Crops Research Institute, the Soil Research Institute, the Water Research Institute, Food Research Institute, Plant Genetic Resources Institute and the Institute for Industrial Research. It has a team of experience scientists in agriculture research for development (AR4D) activities.

**Agro-Eco** is an international NGO working worldwide to mobilize and support cross-sectoral landscape scale initiatives to jointly achieve agricultural development and improve rural livelihoods and healthy ecosystems. Agro-Eco Partners develops methods and tools for multi-stakeholder groups to plan, assess and monitor eco-agriculture landscapes. The Partners synthesize and disseminate state-of-the-art information about technical and institutional innovations for ecoagriculture, including the role of agriculture in climate change adaptation and mitigation. The organization supports and strengthens leaders in ecoagriculture and works collaboratively to promote alignment of policies for agricultural development, ecosystem management and climate action. The organization promotes markets that provide incentives for scaling up of ecoagriculture approaches, with a focus on payments for ecosystem services (PES), eco-certification, and market diversification. The NGO coordinates a new global network on PES in agricultural landscapes and publishes a quarterly international newsletter, ecoagriculturePES. EP provides advisory services to organizations working in agriculture, environment and rural development, including the World Bank, the Inter-American Development Bank, the Bill and Melinda Gates Foundation, the David
and Lucile Packard Foundation, FAO, UNDP, and others. Agro-eco can be a strong CCP partner in certification and payment for ecosystem services.

Private sector

**World Cocoa Foundation (WCF)**

WCF responds to its 55 members’ interest in coordinating their responses to certain issues on which cocoa and chocolate companies have similar interests, such as pest and disease control, farmer training and reduction of child labor. They have found it efficient to tackle such issues collectively through WCF and the sustainability project that they all support in West Africa, STCP. Additionally, WCF co-funds an agroforestry project with the Danish Tree and Landscape Institute, which is coordinated with STCP and CI. In 2005, WCF launched the Initiative for African Cocoa Communities to provide a further service to its members by administering funding the companies provide to projects in the region.

WCF will play a very important role in the CCP project, both as a forum for developing and disseminating the concept of a sustainable production landscape, and as a body with expertise to participate in defining the detail of what that means at origin. Thus it will participate fully in developing the standards that the project adopts as a basis for negotiating community commitments to biodiversity management. Because of its weight as the body representing major companies, it will support dialogue with COCOBOD to develop an operational system enabling participating companies to link their buying to project sites. Further, as the key platform for dialogue on issues of common concern to industry, it will support disseminating information about the project and the educational process of understanding the relationship between biodiversity and sustainable production in Ghana.

**Individual Companies**

The cocoa and chocolate companies have a critical role in the project both during and after its life because of the power of the market in determining behavior across the value chain. During the early stages of the project, companies will evaluate demand-side information that the project generates, learn more about the environmental aspects of sustainability, and define their response through their buying operations. Internalizing into company operations a market incentive for communities to adopt an agreed standard that conserves biodiversity will take time and may not be achieved to a great extent in the early stages of the project; but it represents one of the most important strategies for facilitating the introduction of a traceability system that operates at a community or district level and for achieving sustained positive impact on biodiversity beyond the project’s life.

Because the companies have such expertise in production and trading systems, they will participate in all aspects of project design and monitoring, having key input in particular to research, defining standards, developing the training curriculum and supporting extension. Much of this involvement will link in to and build on work that companies are currently supporting through STCP and also on discussions that some of the companies have been involved in through their participation in round tables and other forums for developing sustainable approaches to product sourcing. Several very important individual companies are already seriously evaluating their degree of involvement in these areas over and above their contributions through WCF.

**Licensed Buying Companies (LBC) and Associate Producer Organizations**

The LBCs will play an important role in the implementation of traceability systems for cocoa from communities that participate in the project. They may also be involved in some aspects of compliance monitoring (for example levying a fee on the cocoa traded under the system to finance the monitoring), in providing financial incentives for farmers and communities to adopt sustainable environmentally friendly cocoa production practices, and in farmer training. The project will involve the LBCs that are active in a
region in discussions about the project implementation at an early stage and will attempt to establish linkages between LBCs and international cocoa trading companies that are interested in purchasing traceable cocoa. The LBC Kuapa Kokoo, which was also involved in CI’s Kakum Conservation Cocoa project, has an active farmer training program with which the project will cooperate in the development and implementation of its Farmer Field School program.

Cocoa farmers and their communities
The cocoa farmers of Ghana are the key stakeholders of this project and were represented in the project design workshops. Most cocoa farmers in Ghana are not organized into associations, which makes it more difficult to reach large numbers of farmers through a project. However, CI’s experience in the Kakum Conservation Cocoa project was that in cooperation with the traditional authorities, effective mobilization of cocoa farmers is not too difficult. According to the project strategy and approach, it will work with entire communities rather than individual farmers or associations of dispersed farmers. The role of community leaders, traditional authorities and local government will be crucial in this process.

Traditional authorities
In Ghana, traditional authorities such as chiefs and landowners have custodial responsibilities for forest and wildlife resources and thus exert significant influence on the utilization of these resources. All land-use practices within a chief or landowner’s jurisdiction are permitted only with their approval. Before the advent of modern conservation practices, chiefs enforced traditional conservation practices and norms such as sacred groves, totems, sanctions and taboos. The chieftaincy institution in Ghana is well organized and provides crucial support in ensuring both good governance of natural resources and the maintenance of peace, unity and progress of society. In recognition of this, the State has created formal institutional structures to harness the traditional potential for good governance through the ten Regional Houses of Chiefs. The project will collaborate with these Houses to ensure buy-in to the project objectives and establish efficient interaction with the communities. The chiefs will also play an important role in the enforcement of agreed production standards within the communities that participate.

District Assemblies
The District Assemblies are local government structures established by the State to ensure effective governance and development planning throughout all 110 administrative districts of the country. They are composed of elected representatives. The project will collaborate with the Assemblies to obtain support for the project objectives and approach. The districts are in position to create awareness of innovation among the communities and whip up interest in the CCP programme.
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