

**MANAGING AGRICULTURAL RESOURCES FOR BIODIVERSITY  
CONSERVATION: POLICY DIMENSION**

Final Report

Of

***A CASE STUDY OF EXPERIENCE WITH 'MANAGING AGRICULTURAL  
RESOURCES FOR BIODIVERSITY CONSERVATION' IN THE WEST AFRICAN  
REGION, WITH A SPECIAL REFERENCE TO GHANA.***

Prepared by

**EDWIN A. GYASI (Ph.D., Professor), Department of Geography and Resource  
Development, and LEWIS ENU-KWESI (Ph.D. Associate Professor), Department of  
Botany, University of Ghana, Legon, Accra, Ghana**

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## **1.0 THE IMPACT OF AGRICULTURAL PRODUCTION SYSTEMS ON THE CONSERVATION AND USE OF BIODIVERSITY**

### **1.1 Introduction**

Impact of agriculture on biodiversity is assessed according to the traditional, transitional and modern management systems identified by Okigbo (1998).

### **1.2 Traditional systems and their impact**

Sub-categories are those that occupy the land only temporarily and those that occupy the land more or less permanently.

#### **1.2.1 Nomadic herding**

The nomadic herding involves movement of large ruminants, mainly cattle, according to seasonal variations in browse and water availability in the dry savanna/sahel ecozones (Fig.1)

A common assumption is that nomadic herding necessarily impacts negatively on the biota by the extensive grazing, the use of fire to suppress undesirable plant species, while it degrades soils by regular trampling by animals on the move. It is contradicted by a report that in the Cameroon and northern Cote d'Ivoire, savanna landscapes are becoming more wooded as a result of pastoral activities. Major factors involved in this process are:

- grazing pressure that results in accelerated dispersal of seeds of trees through cattle manure;
- cattle dung that provides a favourable micro-environment for tree growth, especially by enriched soil fertility; and, above all,
- fire management regimes that favour trees (Bassett and Boutrais, 1996).

#### **1.2.2 Shifting Cultivation**

Shifting cultivation involves cropping within walking distance of successive temporary settlements. Through any of the following practices, it conserves biodiversity:

- controlled use of fire to clear vegetation on a selective basis;
- use of chopped non-burnt vegetation for mulching;
- minimal tillage;
- use of environmentally low-impact tools;
- agroforestry involving intercropping among the trees left *in situ*; and,
- integration of domestic animals.

These practices could usefully inform policy, even though shifting cultivation is unsustainable because of the reduced per caput agricultural land (Nye and Greenland, 1960).

#### **1.2.3 Bush fallow**

Bush fallow is a direct offshoot of shifting cultivation. It proceeds on a rotational basis in plots around fixed settlements. Otherwise the two systems are essentially the same in terms of crop diversity and farm management (Gyasi, forthcoming). A factor in the high crop diversity is

usage of varied edaphic conditions, breaks in canopies and other ecological niches within the farm. Another is a need to secure food supplies by producing a diversity of crops that respond differently to varying environmental circumstance, mature at different times, and serve different dietary or culinary purpose.

Studies in Ghana under the United Nations University Project on People, Land Management and Environmental Change (UNU/PLEC) indicate a reduction in the quantum and diversity of trees among which crops are inter-planted. Even so, tree species diversity still remains high (Table 1). This, together with the continued cultivation of many of the traditional crops and the introduction of new varieties, including leguminous ones, partly accounts for the generally high agrodiversity even in tenant farms (Table 2). Another factor is growing land use intensification as reported for densely settled southeastern Nigeria. However, while intensification appears to stimulate crop-biodiversity, it evidently evokes an opposite effect on composition of 'native' forest species (Okafor, 1991).

Generally government policy is to develop bush fallow through improved crop rotations, faster growing nitrogen fixing trees and other organic methods (Gyasi, 1996 a)

#### 1.2.4 *Parkland agroforestry*

Agricultural production impacts significantly on biodiversity through the agroforestry system whereby crops are grown among trees in semi-arid parkland areas. Commonly livestock, especially cattle, graze among the trees in fallow lands. The trees perform a diversity of economic and socio-cultural functions. It, therefore, seems paradoxical that, generally, tree densities in rural landscapes and sometimes in parklands are declining significantly, for example, in the village of Petit Samba, Burkina Faso. Causative factors include:

- drought, and increased demand for cultivated land;
- shortened fallow, which does not make for regeneration of trees;
- overstocking by nomadic herdsman;
- clearing of trees in favour of cash crops; and,
- official policies that promote chemical fertilizer-based crops at expense of trees.

However, where farmers perceive some tangible economic benefits from trees, they are likely to preserve and even take measure to increase them, as reported for Wolokonto village, Burkina Faso. There, parklands of *Borassus aethiopum* are expanding, as are shea trees densities in northern Cote d'Ivoire (Boffa, 2000).

#### 1.2.5 *Non-home garden agroforestry*

UNU/PLEC studies in the southern sector of Ghana's forest-savanna zone provide an illustration of impact of agricultural production on biodiversity. Key elements in the process before and after British colonization about the end of the 19<sup>th</sup> century are:

- European agricultural influences;
- expansion of oil palms by migrant farmers into the then thickly forested zone;

- subsequent introduction of cocoa, *Theobroma cacao*, and other crops into the zone by an ethnically wider diversity of migrant farmers;
- change from cocoa to food crops led by the environmentally resilient cassava, *Manihot esculentus*; and,
- a modification of the landscape to one dominated by a mosaic of forest and savanna species (Moor, 1936; Hill, 1963; Gyasi *et al.*, 1995; Gyasi and Uitto, 1997; Gyasi, forthcoming).

Among the management systems are home centred ones and outfields. The non-home garden agroforestry system operates through land rotation. It remains popular, but trees have diminished because of overfarming without appropriate tree conservation measures.

#### 1.2.6 Home garden agroforestry

In many areas in West Africa, home garden agroforestry is well developed (Agboola, 1979; Srivastava *et al.*, 2000). An example is areas settled by migrant Krobo farmers and other Adangbe-speaking people in the southern sector of Ghana's forest-savanna zone. Explanation of the high development of home garden agroforestry (*wenyangmo*, Adangbe word for it) there, lies in the *huza* arrangement whereby family houses are constructed linearly along a common base. From the base farming proceeds in the same general longitudinal direction uninhibited by absence of other dwelling units.

The home garden agroforestry type contains virtually all the wide varieties of crops found in the non-home garden agroforestry type, and more. A major factor in development of the high crop-agrodiversity (Table 2) is influence exerted by competing European powers, especially through agriculture in the nearby savanna littoral, during the pre-colonial and colonial era.

In most homes in *huza* areas crops are sustained, at least partially, by household refuse all year round. In valleys where many of the homesteads are located, an additional source of plant nutrients is soils washed from uphill (Gyasi, forthcoming).

#### 1.2.7 Forest island system

Rich islands of forests around villages characterize the forest-savanna mosaic zone of West Africa. A common view is that they are relicts of a once thick forest in a process of transformation to a forest-savanna mosaic and other formations increasingly deprived of forest species by grazing, arable farming and other forms of human pressure. A counter view holds that the forest islands actually represent an enrichment of a basically savanna vegetation by special management practices including nurturing of trees, as part and parcel of agriculture and, also in the past, as a military defence strategy (Fairhead and Leach, 1996).

Around villages in the central plateau of Futa Jalon highlands in Republic of Guinea, the semi-arid sudano-guinea savanna ecosystem is profoundly modified by *tapade*, a permanent plant-rich enclosed infield of home garden agroforestry managed by women (Barry *et al.* 1996; Fofona *et al.*, 1998).

### 1.2.8 *Non-agroforestry home gardening*

Use of the backyard for home gardens that, in the main, exclude trees, exerts an important influence on biodiversity. Close-spacing housing associated with population growth and a lack of settlement planning is, in the increasingly nucleated settlements, crowding out home gardens. A UNU/PLEC survey showed concentration of home gardens to be significantly higher in non-nucleated settlements (Gyasi, forthcoming).

### 1.2.9 *Compound farming*

Through mixed food cropping that takes place at expense of endemic tree species, natural biodiversity of savanna and sahel parkland is modified profoundly by compound farming around compound houses. Sustained by household refuse and by manure generated by the livestock, the land immediately around the compound is the most intensively cropped. Next is a less intensively cropped zone of short fallows, which grades into an outer open area commonly used for grazing. Beyond, much further away, lie 'outfields' of yams and other staples cultivated within the more open parkland vegetation, which cattle and other livestock may graze. The open layout of compound houses facilitates the system. Outstanding examples occur in: Nigeria, around Soba, Kano and Katsina and among the Kofyar people; Ghana, in rural areas of the northeast and northwest; and Burkina Faso, in Mossi, Dagari and Bobo areas (Morgan, 1969; Morgan and Pugh, 1969; Benneh, 1972; Agboola, 1978; Netting and Stone, 1996).

## 1.3 *Transitional systems and their impact*

The transitional systems are hybrids of traditional and modern ones. They impact negatively on plant-biodiversity by the growing specialization on crops. A government policy to accelerate agricultural production and a popular desire to maximize yields and profits by specialization through 'green revolution' inputs explain their expansion at the expense of the more biodiverse traditional ones.

## 1.4 *Modern systems and their impact*

Among the modern systems, the most outstanding in terms of actual and imminent impact on biodiversity, is the large-scale monocultural plantation system. Others include horticulture.

### 1.4.1 *Plantation system*

Introduction of the exotic plantation system in the 18<sup>th</sup> century, has transformed vast areas of diversified humid forest ecosystems, most especially in Cote d'Ivoire, Liberia, Nigeria and Ghana, into monocultural ones focussed on the oil palm, *Elaeis guineensis*, rubber, *Hevea brasiliensis*, coffee, *Coffea*, and cocoa, *Theobroma cacao*. On the effects of oil palm plantations in Ghana, Gyasi writes as follows, "The resilient, diversified indigenous agriculture, modeled on the forest ecosystem and based on eco-farming principles borne out of the peasants' intimate knowledge of the natural environment, is being replaced by the risk-prone monocultural system, with devastating consequences for the forest ecosystem" (Gyasi, 1996 b: 352). A similar effect is reported of the Risonpalm nucleus estate in Nigeria (Gyasi, 1987). This process of

agroecological erosion is fuelled by external demand, profit maximization and pressures of production exerted by the expanding population (Okafor, 1991).

Other modern systems registering a similar erosive effect on natural biodiversity are small-scale monoculture, ranching and intensive battery type poultry farming.

#### 1.4.2 Horticultural system

Modern horticulture or market gardening evidently enhances agricultural biodiversity. An example is the shallot-centered farming developed in an area marked by insufficient rainfall and humus deficient sandy soils in Anloga in Ghana's southeastern coastal savanna plains. It is an indigenous system that integrates modern techniques and methods. Its development reportedly started in the 1930s through reclamation of marshy depressions within an area then dominated by grass and coconuts. It is characterized by:

- labour intensive multiple cropping, focused primarily on shallot, *Allium ascalonium*;
- intercropping of the shallots by various crops, including leguminous and nitrogen-fixing ones on small sandy beds, often with maize in the alleys;
- strict adherence to uniform planting periods among the farmers as a pest-and disease-minimization strategy;
- mulching and hoeing under of weeds and crop residues;
- manual and small mechanical pump irrigation; and,
- soil fertility creation and regeneration by externally sourced inorganic artificial chemical fertilizers, by internally sourced green manure, fish residue and excess small fish and, most especially, by externally sourced cow dung (*nyimi*), bat droppings (*drumi*), poultry waste (*koklomi*) and other organic material, whose use is encouraged by official policy not only because it is known to farmers, but also because it is "cheap, benefits soil structure and soil moisture holding capacity, reduces the need for chemical fertilizers and helps to increase the efficiency with which these are used by the plant" (Ghana, Republic of 1990: 64; see also, Gyasi, 1997; Dzokoto, 2000).

Similar rural based horticultural systems occur in: oases of the sahel; 'fadama' areas, flood-recession lands bordering rivers such as Sokoto and lakes such as Chad in Nigeria; and Gao area along the Niger in Mali, and Walo area along the Senegal (Morgan and Pugh, 1969; Abumere, 1978).

Other examples are intra-urban and peri-urban horticulture practiced within and around major urban centers, particularly in the backyard, near drainage channels, and within other depressions and vacant lots. An instructive case is the system developed by Jola migrants of rural origin in Ziguinchor, capital of Senegal's Casamance region (Linares, 1996).

## 2.0 SUMMARY OF STATUS AND TRENDS OF KEY ASPECTS OF AGRODIVERSITY

Following Brookfield and Padoch (1994) and Almekinders *et al.*, (1995), key aspect of agrodiversity is farmers' choice of crops, and their land, water and biota management practices.

The most important plant genetic resources in the West Africa include those summarized in Tables 3, 4 and 5

In the First National Biodiversity Reports submitted to the UNU Conference of the Parties, Senegal reported that many farmers continue to cultivate traditional crops. However several varieties of cowpea, *voandzu* (bambara groundnut), rice (*Oryza glaberrima*, *oryza sativa*), *fonio* (*Digitaria exiles*), millet (*Pennisetum americanum*) and sorghum (*sorghum bicolor*) are disappearing, as are traditional rice varieties in Ghana due to drought and introduction of modern ones.

UNU/PLEC studies in Ghana indicate a profound modification of agrodiversity by increased raising of a wider diversity of cultivars of cassava, *Manihot* sp., and of legumes. The process is associated with population demands, migration and deteriorating soils. On the whole, changing demands and human migration are significant factors in changing the agrodiversity. It is illustrated by change from oil palms to cocoa, and from cocoa to food crops in Ghana and Nigeria.

Significant changes in agrodiversity are associated with a land and water management project on soil conservation and multiple cropping in Yatenga province in Burkina Faso. Based on an indigenous technology of Dogon farmers of Mali, it involves construction of contour rock bunds to minimize water runoff, and integration of the indigenous *zai* technique of multicropping plots enriched by manure and holes filled by compost. *Zai* and other indigenous techniques are a basis of land reclamation measures. Dramatic yield increases are reported (Thrupp, 1992; UNDP, 1992; Srivastava *et al.*, 2000). In Ghana, similar successes have been achieved in an attempt to prevent water runoff and soil erosion in the Bongo District of the Upper East Region.

The policy lesson is to encourage diversification of vegetables consumed and research into the development of appropriate technologies for land and water management based on traditional knowledge and modern science.

### **3.0 APPROACHES TO THE CONSERVATION AND MANAGEMENT OF THE FOLLOWING COMPONENTS OF AGROBIODIVERSITY IN NATIONAL AGRICULTURAL PLANS AND IN NATIONAL BIODIVERSITY STRATEGIES**

#### **3.1 Pollinators**

Smallholder farmers in West Africa recognize and value wild bees not only for honey production, but also as principal pollinators particularly of tree crops such as mangoes, citrus, pawpaw. Other important pollinators that they value are ants, bats and small birds. They recognize groves and crevices in tree trunks as important habitats for wild bees.

A list of some known pollinating agents of cocoa (*Theobroma cacao*) and kola/cola (*Cola nitida*) in West Africa is presented in Table 6 (Sarfo, 2001 - personal communication; Kaufmann, 1973 a, 1973 b 1974 a, 1974 b, 1974c, 1974d, 1975). Research in Ghana shows that the pollinators require cool, dark and moist habitats. They mostly breed in: buttresses of shade

trees, dead decaying logs, decaying litter, hollowed-out trunks of trees with litter, and piles of decaying cocoa husks and plantain suckers (Sarfo, 2001 – personal communication).

In Ghana the Plant Genetic Resources Centre, a policy advisory arm of the Ministry of Environment, Science and Technology, recently started the development of a sanctuary for butterflies, which are important pollinators of plant species. In Ghana's Bia National Park alone, there may exist about 600 butterfly varieties.

It is important to encourage research on identification, biology, ecology and habitat conservation of pollinators. Appropriate by-laws banning the use of uncontrolled fires should be enacted and/or enforced.

### **3.2 Soil biodiversity**

In West Africa the presence of earthworms is the most common and popular indicator of soil fertility among smallholder traditional farmers. Soil biodiversity research seems to have received relatively little attention, although soil biodiversity conservation is recognized as a priority, notably in the National Agricultural Investment Policy in Ghana.

In Senegal, the Soil Regenerative Agriculture Centre (SRARC) is working with the Rodale Institute to promote sustainable agriculture based on soil regeneration for small-scale farmers of cereals and legumes who had been experiencing soil degradation. Soil regeneration is through the use of compost and of manure. Local farmers play a key role in developing and evaluating these technologies, which have resulted in significant yield increases, as has usage of chemical fertilizer, even though the cost-benefit ratios have yet to be assessed (UNDP, 1992).

In Burkina Faso, the adoption of *tassas* and *zai* traditional technologies on abandoned, degraded drylands has added worms and other organisms involved in nutrient recycling to restored pastures (Srivastava *et al.*, 2000).

In Ghana, acidification and salinization associated with the use of agro-chemicals is recognized as a factor in declining quality of certain soil types. The National Environmental Policy recognizes that agrochemicals impact on chemical, biological and physical structure of soils, but fails to indicate their potential detrimental effects on soil biodiversity. There is evidence of variations in response of soil micro-organisms to the type and concentration of pesticide used particularly primagram and kocide 101.

UNU/PLEC work in Ghana reveals farmers long-standing awareness that certain trees, notably, *Milletia thonningii*, *Ficus surr* and *Ceiba pentandra*, combine well with field crops, while others are antagonistic to crops. Researched information about this is vital for the development of area-specific agrodiversity packages for soil biodiversity conservation and food production on a sustainable basis (Owusu-Bennoah and Enu-Kwesi, 2000). Other observations are that soil pH tends to increase with fallow under *Chromolaena odorata*, while levels of exchangeable cations are higher in fallow areas, and organic C and total N and P improve in fallow areas dominated by *C. odorata* (Gyasi *et al.*, 1995).



In Ghana, the Sasakawa Global - 2000 (SG. 2000) Project started in 1986 with the aim of improving the precarious food situation through increase production of maize and sorghum by 'green revolution' methods. It resulted in substantial yield increases, and has influenced national agricultural extension policy.

Policy should emphasize use of compost and manure to augment organic and inorganic content of soils, thereby improving their porosity and the microhabitat of soil organisms.

### **3.3 Biodiversity that provides mitigation of pests and diseases**

West Africa experiences perennial food shortages as a result of heavy pests and disease infestations before and after harvesting. Paradoxically however, the use of the synthetic non-biodegradable pesticides, fungicides and insecticides can worsen the precarious food situation because such synthetic agro-chemicals are lethal to other agriculturally important biodiversity in the agro-ecosystem, eg. non-flying insect pollinators and soil invertebrates and micro-organisms. Research should focus on this issue and on identification of appropriate integrated biological control methods that may exist naturally with the help of traditional agro-ecological knowledge.

In Ghana, the National Environmental Policy acknowledges that certain traditional agricultural practices e.g. bush fallow and agroforestry offer good prospects for soil fertility regeneration and control of noxious weeds, pests and disease. The Ministry of Food and Agriculture has been implementing Integrated Crop and Pest Management (ICPM) programmes (Table 7). The International Institute of Tropical Agriculture (IITA) and the German Technical Cooperation (GTZ) support much of the ICPM programme. About 90% of biocontrol technology programmes in Ghana is adapted from external international research centers such as the IITA, which provides similar support to other countries of the West African sub-region. The ICPM follows a Participatory Technology Development (PTD) approach in providing extension to farmers. The Pesticide Control and Management Act 1996 (Act 538) embodies Ghana's policy on pesticide imports (Ghana, Republic of, 1996). It covers registration, licencing, dealers, safeguards and other general regulations relating to pesticides. There is provision for a Pesticide Control Board and a Pesticide Technical Committee. However Government subsidies on agrochemicals have been removed.

Information relating to agrochemicals in other West African countries could not be accessed for this report.

### **3.4 Crop and livestock genetic resources**

The establishment of special scientific centres of research and extension is a popular policy strategy for conservation and development of natural resources.

In Ghana, the Plant Genetic Resources Centre (PGRC) of the CSIR holds a special mandate to conserve plant genetic resources by both *in situ* methods in farmers' fields and elsewhere, and *ex situ* methods through gene banks. Other relevant institutes include Crop, Oil Palm and Savanna Agricultural Research Institutes of CSRI, which are empowered to research into various aspects of crops, to disseminate the findings, and to provide farmer-support services.

Similar activities are carried out in Ghana and elsewhere on livestock by the animal research institutes and universities. A special research project at the Centre for Conservation of Biodiversity in Ghana's Kwame Nkrumah University of Science and Technology focuses on domestication of a specie of *Thyronomys*, the small wild herbivorous grasscutter, as a protein source.

A policy implication is that an effective animal domestication and husbandry, would meet meat protein requirements, thereby minimizing wildlife depletion by hunting.

### **3.5 Diversity at the landscape level**

Earlier classical inventory of floral diversity in West Africa include that by Hutchinson and Dalziel (1954). Hall and Swaine (1981) and Hawthorne and Abu-Jaum (1995) have also provided relevant floral inventory updates for Ghana. The vegetation zones are characterized by a mosaic of landuse patterns or stages and field types, which are indicative of a dynamic flux. Socio-economic, market and demographic forces drive the changing situation. They modify the ecology and generally degrade the environment with a concomitant loss of biodiversity. Data from PLEC studies have identified a number of landuse stages and field types, some of which serve as important repositories for *in situ* conservation of a rich diversity of crop and other plants including medicinal ones (Tables 8, 9, 10). Some of these land use types, particularly home gardens are productive all year round. Sometimes variations in the nature of original vegetation in some countries in West Africa have come from attacks by pests e.g. mirids in the forest zone of southwestern Nigeria (Moss, 1969) and pathogens eg. *Phytophthora infestans* and viral infections, notably swollen shoot disease in cocoa growing areas of Ghana.

At the landscape level, there seems to be a positive relationship between security of tenure and biophysical status. Preliminary findings of UNU/PLEC studies in Ghana and reports about other areas in West Africa suggest this (Gyasi, 1998, 1999). Examples of the measure needed to strengthen security of tenure are embodied in various policy statements including Nigeria's land use decree and Ghana's land title registration law.

### **3.6 Wild biodiversity in agro-ecosystems**

Ghana's national environmental policy recognizes that certain indigenous agricultural practices e.g. bush fallow, agroforestry and no-burn agricultural land preparation, favour conservation of wild biodiversity in agro-ecosystems. Data obtained from PLEC studies in Ghana indicates that, on the basis of utility value, the species richness of the observed agricultural landuse stages or field types consisted of a large proportion of non-crop or wild species most of which appeared to have medicinal value, with only a few serving as fodder for domesticated livestock (Table 11). The highest numbers of plant species were found in orchards/plantations (cocoa, oil palm), fallows, home gardens (non-agroforest), annual cropping (monocultures and mixed) as well as in edges.

A possible way of encouraging biodiversity conservation within and out the wild is through the ecosystems approach, which views species and related elements in their totality rather than as individuals. Another is the UNU/PLEC model based upon indigenous knowledge,

participatory principles and collaboration between farmers, scientists and government agents. Through it PLEC is registering significant positive impact on biodiversity within agricultural and other land uses in demonstration sites in Ghana and Guinea.

### 3.7 *Traditional knowledge of agrodiversity*

Farmers demonstrate an awareness of the necessity of using biophysical resources sustainably. They show an awareness of a need to secure supplies of food, wood, medicinal herbs and other vegetal resources and products by diversifying agriculture through, among other practices, the following:

- mixed cropping, crop rotations and mixed farming;
- cropping among trees left *in situ*, a traditional agroforestry system;
- timing of planting and harvesting in ways that, generally, synchronize with the seasons;
- minimum tillage and controlled use of fire for vegetation clearance;
- leaving slashed vegetation to decompose *in situ* in the practice called *oprowka* by Akan people in Ghana;
- bush fallow for regenerating vegetation and soil fertility;
- usage of manure and household refuse to sustain productivity of soils, and of earth mounds to conserve soil moisture;
- staggered harvesting of crops;
- storage of crops, notably yams, *in situ*, in the soil, for future harvesting and for seed stock;
- usage of either extensive or intensive method, or of both, depending upon the agricultural circumstances; and,
- terracing, bunding and contour farming.

The crop production capacity of soils is commonly assessed by colour, texture and presence or absence of certain species of endemic plants. This taxonomic system betrays a close understanding of local conditions. It informs the way and manner the different crops are planted. Farmers demonstrate knowledge of weeds and pests, including how they relate to crops.

Knowledge about trees and their agricultural significance is exceptionally great and very much cherished. Krobo people of the southern sector of Ghana's forest-savanna zone regard rather seriously, preservation of such trees as *lelo*, *sablatso*, *ayisatso*, *nyabatso*, *awamba*, *kumelo*, *agbatafotso* and *mokotso* (all Adangbe words), because of a belief that, they indicate soil quality, enhance soil moisture content, and provide ideal shading conditions for yams and other shade-loving crops. The practice of tree conservation is common in West Africa. It includes nurturing of useful naturally propagated species, notably *Cassia siemens*, by pruning and regulated harvesting, taboos against felling, and teaching children tree management. A female PLEC-Ghana farmer echoes:

*“Trees are important: they protect the soil; the leaves drop and add nutrient to the soil; when some are cut and burnt, the ashes add nutrient to the soil. So when we cut all the trees, how do we get organic matter?”* (Anonymous PLEC female farmer, Sekesua-Osonson PLEC demonstration site, 1995).

UNU/PLEC is carrying out various studies on trees. They include one aimed at determining the scientific basis of the claim by local people that certain species of trees, notably, *Ceiba pentandra*, *Holarrhena floribunda* and *Newbouldia laevis* combine well with food crops (Owusu-Bennoah and Enu-Kwesi, 2000).

The traditional knowledge of agroforestry and the biodiverse agricultural systems underpinned by that knowledge form an integral part of the established culture. As such, they provide a convenient entry point for concerted biodiversity conservation.

#### **4.0 POLICIES, REGULATORY MECHANISMS AND THE IMPLICATIONS OF AGRICULTURAL DEVELOPMENT ON AGRODIVERSITY MANAGEMENT**

Relevant policies and regulatory mechanisms are embodied in various official declarations for each of the 16 countries. They involve those that focus specifically on agriculture, and those that focus on themes which, though different, bear significantly on agriculture. However, with the major exception of Ghana, only a limited number of policy documents could be accessed (Table 12).

Inadequate emphasis upon traditional knowledge and systems of biodiversity conservation is a major policy shortcoming. Driven by a need to accelerate food production, policies tend to place excessive emphasis upon use of green revolution methods, which results in monocultures. Policy also woefully fails to recognize that the situation whereby, in West Africa, diets traditionally draws on a wide diversity of local food sources is rapidly changing in favour of European/American food types, to the detriment of conservation of the local landraces. Another policy flaw is inadequate attention to the need for public sensitization to the growing threat to biodiversity, and to the need for building of a popular grassroots capacity for biodiversity conservation. Also, commonly, policies fail to realize that since only limited areas can be excluded from human use, it is important to seek biodiversity conservation as part and parcel of the systems of land uses, especially agricultural land use. Finally is inadequate emphasis upon incentives that would induce popular conservation.

#### **5.0 CONSTRAINTS TO THE USE OF SOUND POLICIES AND PRACTICES**

Identified constraints include the following:

- a lip service by governments to policy
- a weak legal basis for enforcement;
- a lack of motivation and appropriate training for policy implementing agents;
- inadequate popular knowledge and understanding of sound policies and practices;
- a desk bound officialdom;
- ineffectual governance associated with a motley of factors including social conflicts;
- continued centralization of decision and of logistics for policy implementation;
- erosion of traditional values, knowledge and institutions;
- a complex, confused system of resource tenure that does not encourage biophysical conservation by, especially tenants, because of a lack of security of title to land and trees;
- a pervasive rural poverty; and,

- a lack of human and material capacity at the grassroots.

## 6.0 EXAMPLES OF BEST PRACTICE

Examples of best practices include the following:

- the Integrated Crop and Pest Management (ICPM) programmes of the Ministry of Food and Agriculture in Ghana, which avoids use of toxic, synthetic, non-biodegradable agrochemicals and their lethal effects on biodiversity in the ecosystem;
- the Plant Protection and Regulatory Guidelines for Ghana, which seeks to avoid deliberate or accidental introduction of new species and pathogens;
- *oprowka* no burn farming, which prevents the detrimental effects of fire on biodiversity;
- traditional agroforestry systems, which ensure resource recycling of water, nutrients, improves soils and ameliorates climate/microclimate;
- use of *Mucuna* to promote short fallows, and to fix nitrogen;
- use of *Newbouldia laevis* as live stakes for yams because their basically vertical root system facilitates downward expansion of the tubers, whilst the canopy provides shade and the leaves mulch;
- *in situ* yam conservation in homegardens agroforestry, which ensures yam germplasm and continuous availability of food;
- use of poultry manure to improve soil fertility and the use of conserved forests for apiculture and other value addition or income-generating ventures; and,
- stone lining of hill slopes and the *zai* and tassas techniques to minimize soil erosion.

## 7.0 RESULTS AND LESSONS LEARNED

A key lesson is that indigenous knowledge and practices provide a solid basis for strengthening policy impact. Soil biodiversity, pollinators and biodiversity that provides mitigation of pests and diseases require greater research attention, as do systems of land use intensification that conserve biodiversity and increase yields simultaneously.

## 8.0 GUIDELINES OR POLICIES THAT HAVE RESULTED FROM THIS EXPERIENCE

It is obvious that only limited portions of land could be prevented from human use. Given this, then a cardinal rule of policy should be to seek conservation of biodiversity as an integral part of using the land, especially for agriculture. Such a policy is a cost-effective complement to the modern system of conserving, *ex-situ*. An added advantage is the promise of rural development held by a policy of encouraging biodiversity conservation within agriculture.

Policy ought to explicitly recognize a need to expand food production whiles, at the same time, conserving biodiversity. A stratagem of achieving this is to encourage a mix of large scale plantations as well as other forms of monoculture that enjoy economies of specialization, and biodiverse agricultural production systems modeled on traditional ones, most especially agroforestry and compound farming system. Modern horticulture modeled on the shallot-centred system of Ghana and the urban oriented system of Senegal also deserves encouragement. Development of plantations may be modeled on the modern nucleus estate version, which

involves a core monocultural plantation as well as neighboring small scale diversified outgrower and smallholder units (Gyasi, 1987, 1992, 1996 b).

It is important to emphasize policies that protect and nurture the now endangered centuries old accumulated knowledge that underpin the traditional biodiverse production systems. An approach to this and the general goal of promoting biodiversity conservation is to motivate farmers and other biophysical resource managers through, especially, activities that generate more value of direct benefit to them. A similar purpose would be served by capacity strengthening. These, then, imply that conservation holds promise as a strategy for achieving improvements in rural livelihoods. Policy ought to stress this conservation-development nexus.

We see the main role of government as creating an environment that enables and facilitates farmers and other primary actors to conserve. A similar facilitating role can be played by non-governmental organizations. This is demonstrated by achievements of UNU/PLEC which, additionally, has demonstrated the efficacy of enhancing conservation through the triad of farmers, scientists and government agents. Integration of the UNU/PLEC approach, therefore, stands to enrich policy output.

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