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ETHNOBOTANICAL STUDY OF THE USE OF NATURAL DYE PLANT SPECIES IN THE SOUTHERN FOREST-SAVANNA TRANSITION ZONE OF GHANA

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Abstract

Ethnobotanical studies were carried out in the United Nations University People's Land-Use and Environmental Change (UNU/PLEC) demonstration sites of Gyamfiase-Adenya, Sekesua-Osonson and Amanase-Whanabenya with detailed floral inventory undertaken in the Gyamfiase-Adenya demonstration site. Ethnobotanical knowledge gathered from focus group discussions indicated that, a number of plant species were used traditionally as food colours and dyes for clothing. These included *Alchornea cordifolia, Carica papaya, Citrus sinensis, Combretum mucronatum, Lecaniodiscus cupanioides, Mangifera indica, Lonchocarpus cyanescense* and *Morinda lucida*. The use of these species for food colouring was widespread among females than among males. Food colouring was also found to be a common household practice although it was not commercialised. Floral inventory in the Gyamfiase-Adenya site indicated that *Albizia zygia, Bombax buonopozense, Ceiba pentandra, Cola gigantea, Morinda lucida, Rauvolfia vomitoria* and *Terminalia ivorensis* are left as standard trees *in-situ* on farms in traditional agro-forestry. Out of seven species screened initially as sources of materials for food colouring and dyes for clothing, *Morinda lucida* and *Combretum mucronatum* were predominant in the area. Whilst *Combretum mucronatum* was readily available in the fallows, *Morinda lucida* was found in each of the different land-use types (farms with annual crops, fallows and tree crop farms). Local communities with the support of district assemblies should be encouraged to maintain and pursue other effective and sustainable methods in the harvesting of these plants.

Introduction

Plants have been used for various purposes including food, housing, medicine, dyes, clothing, and leatherworks among others. The use of dye plants in enhancing food and clothing in communities, however, is a practice that has existed for several decades. The practice, though widespread, is more common among indigenous communities in remote areas, where dyes derived from plants are used both for colouring food products and clothing, as well as for other cultural purposes (Yujing, 2014). Traditional knowledge of local people also plays a major role in the identification of natural resources for commercialisation (Anon, 2005). Jansen &Cardon (2005) also recognised the important role in economic growth. ITDG (2003) further notes that, in most developing countries, the diverse sources of dyes produced from natural dyes contribute to improved livelihood, particularly, through its use and commercialisation.

Even though synthetic dyes have been

commonly used on commercial basis in Kenya, the use of natural dyes is still an old practice. Musyoki, Luvana & Kitheka (2012) in a study that documented the trees and other plant species used as sources of natural dyes and tannins, identified some plant sources for dyes and tannins. Some of these include *Commiphora holtiziana* (Haggar), *Acacia bussei*, *L. inermis* L (Elan) and *Commiphora campestris* Engl, among many others.

In Ghana the most popular use of plant dyes in the forest zone is for the preparation of saffron dyes from the bark of *Bombax brevicuspe* (onyinakobin) and *Lannea welwitschii* (kumanini) for dyeing funeral cloths (kuntunkuni) and for stamping the adinkra signs and symbols (Abbiw, 1990). Dyes derived from plants in forests are usually non-toxic and edible, and have, thus, been used as food colour in both traditional cooking and formal commercial catering (Abbiw, 1990). Throughout southern Ghana, forests serve as sources of food, especially during seasonal food shortages and other periods of hardship (Falconer, 1992). Forests contribute to all aspects of rural life providing food, fodder, fuel, medicine, building materials and household items, as well as many more intangible benefits such as cultural symbols, ritual artefacts and sacred sites. The southern forest – savanna transition zone of Ghana, within which the study was carried out, is known to contain very diverse plant species with a vegetation zone which contains most of the country's valuable timber species.

The paper provides a compilation of a comprehensive inventory of forest species in three communities of southern forest-savanna transition zone of Ghana including the demographic characteristics of the people in the selected communities. The ethnobotanical uses of dye plant species in the transition zone and the sustainability methods of harvesting dye plant species in the selected communities have also been discussed.

Experimental

Location

The study was conducted in the United Nations University's People Land Use and Environmental Change (UNU/PLEC) demonstration sites at Sekesua-Osonson (in the Krobo area), Gyamfiase-Adenya (Akwapim North) and Amanase-Whanabenya (Akwapim South), all in the southern forest-savanna transition zone of Ghana. The main sites selected for the study included: Sekesua – Osonson; Gyamfiase – Adenya; and Amanase – Whanabenya.

Sekesua – Osonson. Sekesua – Osonson UNU/PLEC, Ghana, demonstration site is situated in the Eastern Region of Ghana within the southern forest-savanna transition zone. The ecosystem of the site provides the right environment for the growth of different crops and other plants adapted to humid and dry conditions. The characteristically high agro-diversity observed reflected the cultural imprint of migrant Krobo cocoa farmers (PLEC News and Views, 2003) despite the system of monoculture that was also evident in the area.

Gyamfiase – Adenya. This site is about 70 km inland from Accra, the capital of Ghana and is in the Eastern Region. It is situated off the main Mamfe – Adawso road. The inhabitants are mainly natives and settler farmers. Gyamfiase has a sacred grove estimated to be about 20 ha in size. Apart

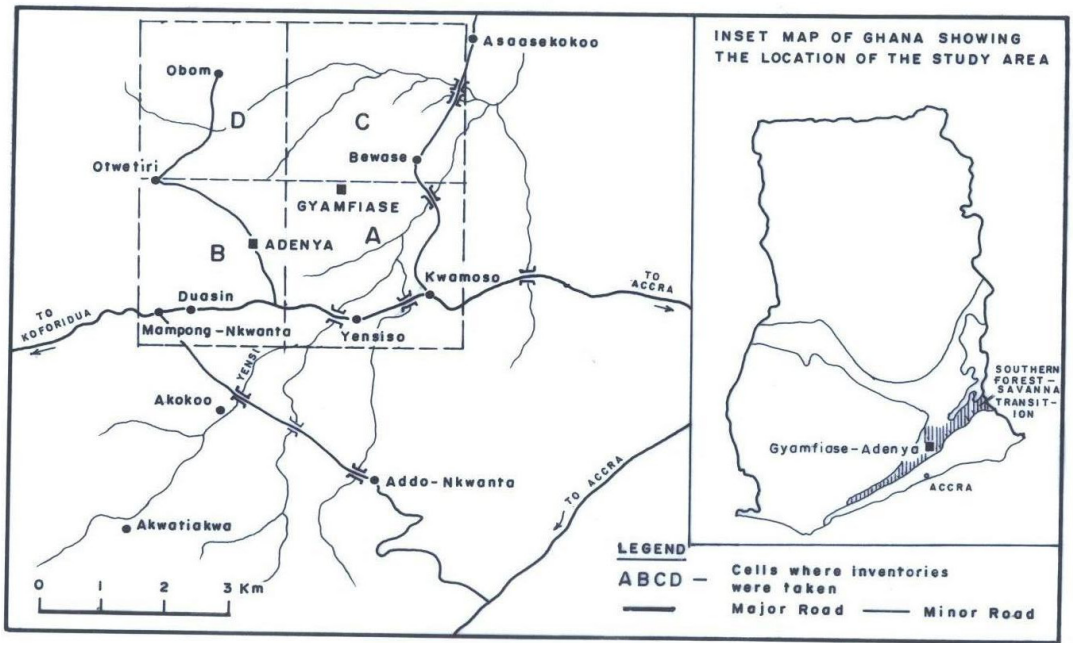

Fig. 1. Map of the study area

from the Gyamfiase village, there are about four other villages namely Bewase, Adenya, Obom and Otwetiri that surround the Gyamfiase sacred grove (Gyasi *et al*., 2004).

Amanase – Whanabenya. This town is inhabited by a mixture of the offsprings of migrant Akuapim and Siade/Shai people, and a growing component of recent migrant Ewe settler farmers. Landholding arrangements are both the mosaic and linear huza type. Average annual rainfall ranges between 1,200 and 1,450 mm. The main food crops grown in this area include cassava, maize, plantain, cocoyam and oil palm. Apart from farming, people in the area also indulge in cassava processing, distillation of local gin (akpeteshie) and extraction of oil from fruits and kernels of oil palm (Gyasi *et al*., 2004).

Weather and climate

The study area falls under the wet semi-equatorial climatic region with two rainfall maxima. The mean annual rainfall is between about 1250 and 2000 mm. The first rainy season is from May to June, with the heaviest rainfall in June, and the second rainy season is from September to October. The dry seasons are quite pronounced. The highest mean monthly temperature of about 30 °C occurs between March and April and the lowest of about 26 °C in August. Average monthly relative humidities (RH) (based on figures recorded each day at 12 noon) are highest (75-80%) during the two rainy seasons and lowest (70-80%) during the rest of the year (Dickson & Benneh, 2004).

Vegetation and soils

Akwapim is in the moist semi-deciduous forest zone of Ghana. This vegetation zone contains most of the country's valuable tim-

ber trees species. The moist semi- deciduous forest is distinguished by trees in its upper and middle layers exhibiting deciduous characteristics during the long dry season when the influence of the harmattan is greatly felt. The deciduous habit of the trees, in this belt, is by no means as strong and definite as among the deciduous trees of the temperate zone. Trees of the lower layer of this forest remain evergreen during the dry season and so do most of the young trees of the species which belong to the two uppermost layers. This may be due to the generally moist conditions under the lower tree storey.

Due to the rapid expansion of the cocoa industry in this vegetation zone, very little of the original forest remains and most of what is left is secondary forest. The size of trees in the secondary forest depends on how long it has been abandoned by farmers for the soils to recover (MEST, 2002). The principal soils, which cover nearly the whole area, are forest Ochrosols, i.e. highly coloured soils. They develop over the same kinds of highly weathered parent materials. Under reduced amounts of rainfall, the Ochrosols are not as highly leached as Oxysols of rain forests, with the result that they contain greater quantities of nutrients and are generally alkaline. The soils support many tree crops including cocoa (Dickson & Benneh, 2004).

Data collection

Focus group discussion (FGD) was used to elicit information from selected community members comprising males and females 18 years and above in each of the three study areas: Gyamfiase (16 males, 15 females), Amanase (5 males, 14 females),and Sekesua (4 males, 6 females). A total of 56 participants were involved in the study. The FGD was ideal because it helped to extract detailed qualitative information from participants. A focus group discussion guide was used to obtain information on the participants' beliefs and perception on the following: Knowledge of use of plants for dyes, cosmetics and insecticides, use of plant parts for various purposes, sustainability of the harvesting techniques, and plant propagation and availability.

Description of field floral inventory

A detailed floral inventory was carried out at Gyamfiase-Adenya. The area was divided into four cells comprising Cell A, Cell B, Cell C, and Cell D (Fig. 1). Each cell consists of a number of communities which also serves as the boundary of the cell. The boundary of Cell A starts from Kwamoso, through to Gyamfiase Adenya Junction, Gyamfiase Adenya, Bewase and back to Kwamoso. Cell B starts from Gyamfiase Adenya Junction, through Mampong Nkwanta, Otwitiri, Gyamfiase Adenya, and back to Gyamfiase Adenya Junction. Cell C starts from Gyamfiase Adenya through Apenkwa, Asaasekokoo, Bewase and back to Gyamfiase Adenya. Cell D starts from Gyamfiase Adenya, Otwitiri, Obom, Apenkwa and back to Gyamfiase Adenya.

In accordance with similar methods employed by Bakang, Oduro & Nkyi (2004), in each of the four cells (A, B, C, D), ten 20×20 m^2 sample plots (each with ten $1m^2$ sub or nested plots) were randomly sited and all the trees and shrubs present were identified and counted.

In each $1m^2$ subplot, all non-tree and shrub species, i.e. herbs and grasses were

also identified and counted. The utility value or ethnobotany of each species encountered was also recorded with the assistance of participating expert farmers.

Data analysis

The collected plants species were identified by plant ecologists from the Ghana Herbarium, Department of Plant and Environmental Biology, University of Ghana, Legon. All plant collections made were properly vouchered, with voucher herbarium specimens preserved at the Ghana Herbarium. The bark of the stems of *Mangifera indica* and *Morinda lucida* and the leaves of *Lecaniodiscus cupanioides, Combretum mucronatum, Alchornea cordifolia*, and *Lonchocarpus cyanescens* were collected and air-dried for about three weeks before they were pulverized into fine powder separately. The data obtained were used to plot species-area curves for the determination of the total number of species present in a cell, and also the frequencies and densities of each of the species. The girth or circumference at breast height of each tree species found in each sample plot was measured. The availability or conservation status of the species was also identified.

Results and Discussion

Demographic structure of communities

There were 31 participants present at Gyamfiase, 19 at Sekesua and 6 at Amanase. The ages of participants ranged between 18 and 70 years. Out of the 31 people present at Gyamfiase, 15 were females and 16 males. At Sekesua, there were 14 females and 5 males. There were 2 females and 4 males at Amanase (Table 1). There were more female respondents on the average (51.8%) than males (48.2%). This, therefore, suggested that the information provided captured more of the female knowledge on environmental resources than the males. The major occupation of the participants in the focus group discussion was mostly farming.

TABLE 1

Results of attendance and participation in the focus group discussion

Location	*Males*	*Females*	*Total*
Gyamfiase	16(51.6%)	15(48.4%)	31%
Sekesua	5(26.3%)	14(73.7%)	19%
Amanase	4(66.7%)	2(33.3%)	6%

Plant species diversity of the forest-savanna transitional zone

Table 2 shows the number of species, families and life forms found in the forest-savanna transitional zone.

Natural dye plants species in the study area

Tables 3 and 4 show the natural dye plant species used for food and clothing in communities in the study area.

Social and cultural uses of plant species in the study area

Plant species in the study area served the following purposes: Medicinal, food colour,

TABLE 2

Summary of plant species diversity at Gyamfiase-Adenya of the forest-Ssavanna transition zone

	No. of species	*No. of families*	*No. of life forms*
Cell A	89	42	4
Cell B	74	32	4
Cell C	64	36	4
Cell D	69	38	4
Total	296	148	16

TABLE 3

List of natural dye plant species used for colouring food for human consumption

S/N	*Scientific name*	*Common/Local name*	*Life form*	*Part used*	*Purpose*	*Locality available*
1	*Mangifera indica* L.	Mango	Tree	Leaves, bark, colour of plantain	Give cassava the Gyamfiase	Amanase,
2	*Alchornea cordifolia* Müll.Arg.	Christmas bush, 'Agyama'	Shrub	Leaves	Give cassava the colour of plantain	Amanase Gyamfiase Sekesua
3	*Psidium guajava* . L	Guava	Tree	Leaves, bark, colour of cocoyam	Give cassava the Amanase, Sekesua	Gyamfiase,
4	*Combretum mucronatum* Schumach. & Thonn.	'Nkanfohama', 'Duankanfo', Laga	Climber	Leaves of the female species	Give cassava the colour of cocoyam.	Gyamfiase, Amanase. Sekesua
5	*Combretum* sp. Hutch.	'Ohwerem barima'	Climber	Leaves, colour of cocoyam.	Give cassava the	Amanase
6	*Lecaniodiscus cupanioides* Planch. ex Benth.	'Odwenyinaa'	Tree	Leaves	Give cassava the colour of cocoyam	Gyamfiase
7	*Musa paradisiaca* L.	Plantain	Shrub	Dried peels, colour of plantain.	Give cassava the Sekesua	Gyamfiase,
8	*Bambusa sp*. McClure	Bamboo	Woody	Suckers, colour of plantain	Give cassava the	Gyamfiase
9	*Citrus sinensis* (L.) Osbeck	Lemon	Tree	Leaves colour	Give cassava a slight yellowish	Sekesua
10	*Carica papaya* L.	Pawpaw	Shrub	Stem peel of the male species	Give cassava the colour of cocoyam	Amanase Gyamfiase
11	*Morinda lucida* Benth.	Buronya dua	Trees	Bark	Gives yellowish colour to cloth	Gyamfiase
22	*Lonchocarpus cyanescens* (Schum. and Thonn) Benth	Aho	Climber	Young tender leaves and flowers	Gives blue colour to cloth	Gyamfiase

clothing colour, insecticide, traditional agro-forestry, timber, spices, fauna feed, construction, and fuel wood. Participants highlighted some characteristics that accompanied the use of plant species as food dyes, change in the presentation of the food, change in the colour of the food but no effect on the original taste of the food, and reduction in the starch content and gluey nature of food, for example in the cassava (fufu) (Table 3). Respondents emphasised the use of dyes for food colour and clothing. The use of dyes for clothing has been reported world wide and especially in the use of *Morinda* species as dyes for clothing (Raja & Sujata, 2014). The use of plant materials as food colour for

TABLE 4

Cummulative number of species for Cell A

Plot	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
New species	32	7	5	13	11	3	5	2	4	0
Cumm no. of species	32	39	44	57	68	71	76	78	82	82

garnishing is a common practice in most of the communities. An example of this is in the preparation of 'waakye' (rice and beans cooked together). In the preparation of this food, sorghum leaves are cooked together with the food to give it its characteristic brick red colour. But sorghum is a plant of the northern territories. The information on the use of some plant species as dye stuff for food colour and clothing conforms to reports by other investigators (PROTA, 2006), where *Morinda lucida* has been cited as a source of dye for clothing.

However, the observation that *Combretum mucronatum* (Table 3) is used as a food dye has not been previously reported although other species of *Combretum* (i.e. *C. glutinosum*) have been reported as a plant for tannin production (PROTOA, 2006). Similarly the use of other species such as *Mangifera indica* (mango) has also been reported in other studies (Morton, 1987). It was observed that the knowledge of food colouring was practiced by both males and females.

Results and observations from interactions with the local people indicated that, there were a number of tree species in the zone that are known to be as good as timber and are useful for making furniture, doors and railway sleepers. Examples of such species include *Terminalia ivorensis, Piptadeniastrum africanum and Terminalia superba*. The farmers indicated that, plants that are deliberately left *in situ* on farms can combine well with crops in traditional agro-forestry and enhance their growth and yield. Some of these include: *Cola gigantea, Tetrapleura tetraptera, Milicia* (Chlorophora) *excelsa* and *Holarrhaena floribunda*. However, plant species such as *Baphia nitida* and *Alchornea cordifolia* which were also found *in situ* did not combine well with crops on farms.

The information provided by the farmers on specific standard trees that combine well with crop to enhance both their vegetative growth and yield is similar to the information that has been provided in other studies (Asafo *et al*., 2004; Poku, 2004). Similar species of trees have also been cited by Nkyi (1989). According to the participants, dyes for clothing were generally scarce at Amanase (FGD-Amanase, pers.com.2006) even though *Morinda lucida* and *Lonchocarpus cyanescens* were named as plants that were used as cloth dyes in the area. For example, when the bark of *Morinda lucida* is boiled together with white cloth, a yellowish colour is obtained. The young tender leaves and flowers of *Lonchocarpus cyanescens* (a climber), when pounded and soaked in a pot with a white cloth gives a blue colour after about 3 to 5 days. Harvesting techniques used by the community were found to be sustainable.

Sustainability and conservation

Findings from the study generally showed that, the communities employed sustainable harvesting techniques in the harvesting of food colouring plants. According to the local people, harvesting of dye plants and the subsequent use for food colouring involves the process of carefully breaking off a small branch of about 10-15 leaves so that the shoots are not destroyed, and placing them underneath a pot before filling with food item of a sizeable meal and cooked together. This process is similar to that observed by Bukuluki *et al*. (2014) on harvesting practices of medicinal plants found in Uganda.

Floral inventory

Flora were sampled in the four different cells (A, B, C and D) of the Gyamfiase-Adenya demonstration site. There was an increase in the cumulative number of species encountered as the area sampled or the number of plots sampled increased, and levelled off between sample plots nine and 10 where no new species were encountered (Fig. 2). This implied that sampling was efficient and effective, and that the total number of species present in cell A can be estimated at 82 (Table 4). Three land use types were sampled namely fallow, annual crop farm, and tree/cash crop farm. The distribution of species according to land-use types in this cell indicated that there were more species (47 out of 82) found in the farms with annual crops either as a monocrop or in a mixed cropping system, when compared to either the fallow or the farm with tree/cash crops.

There was a steady increase in the cumulative number of species encountered as the area sampled increased (Fig. 3). This increased up to plot 10, where an estimated number of 70 species were encountered (Table 5) (Cell B). Although there was a tendency for the cumulative number of species encountered to level off between plots nine and 10, two new species had been encountered in the 10th plot. The distribution of species according to land-use types in this cell indicated that there were more species (39) found in the fallows than those in the farm with annual crop either as in monocropping or a mixed cropping system. In Cell B, no farm with tree/cash crops was encountered for sampling.

There was an increase in the cumulative number of species encountered as the area sampled increased, and levelled off between sample plots nine and 10 where no new species were encountered (Fig. 4). This implied that sampling was efficient and effective and that the total number of species present in Cell C can be estimated at 64 (Table 6). The

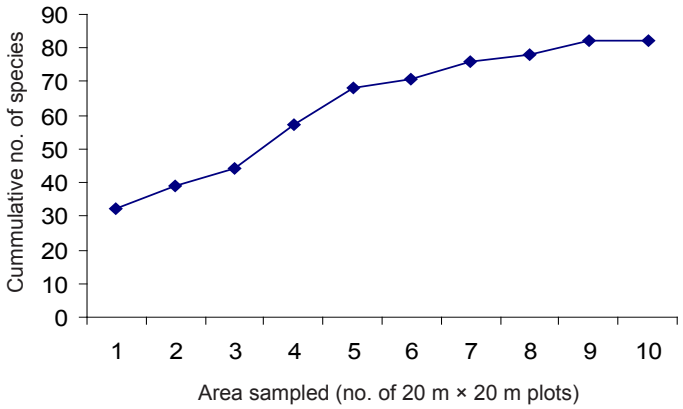

Fig 2. Species-area curve for Cell A

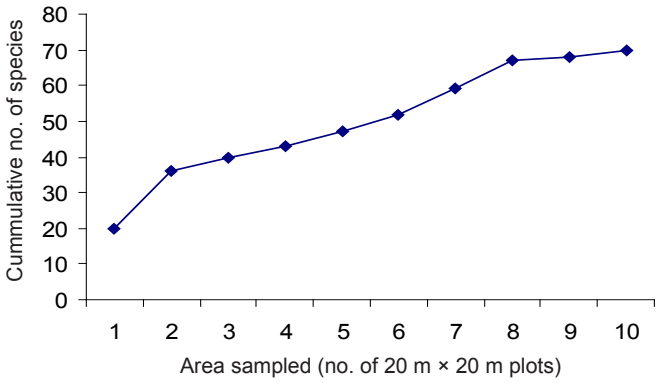

Fig. 3. Species - area curve for Cell B

distribution of species according to land-use types indicated that there were less species (29) found in the farms with annual crops either as a monocrop or in a mixed cropping system when compared to the fallows (35). In Cell C, there was no farm with tree/cash crops encountered for sampling.

It was realised that there was a steady increase in the cumulative number of species encountered as the number of plots sampled increased (Fig. 5). This increase levelled off between plots eight and nine where no new species were encountered, but in plot 10 where a matured fallow of about 7 years was encountered for sampling, two new species were encoutered to give an estimated number of species present in Cell D as 61 (Table 7). The distribution of species according to land use types indicate that there were more species (34) in the farms with annual crops either as a monocrop or in other mixed cropping system when compared to either the fallow or the farm with tree/cash crops.

Floral inventory check on the availability of plant resources in the study area

The levelling-off of the species-area curve as noted for the different Cells following information obtained after the use of 10 samples plots in each Cell in the study is indicative of the effectiveness and efficiency of the sampling methods used. This observation was confirmed by Asafo *et al*. (2004) in a previous study. The number of species observed in the various cells (Cell A = 82, Cell B = 70, Cell C = 64 and Cell D = 61) and the frequencies and densities recorded were a true reflection of each of the species encountered in each Cell. *Ocimum basilicum* (akokobesa) was identified by the participants to be readily available in the study area, however, results of the deliberate floral inventory suggested otherwise. *Alchornea cordifolia* was reported to be readily available during the focus group discussion, but observations from the deliberate field inventory indicated that it occurred only in Cells A, B and C but not in Cell D, and their frequencies (Cell A and C = 10% , Cell B = 20%) and densities (Cell A = 0.1, Cell B and C = 0.2) were also very

TABLE 5

Cummulative number of species for Cell B

Plot	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
New species	20	16	4	3	4	5	7	8	1	2
Cumm. no. of species	20	36	40	43	47	52	59	67	68	70

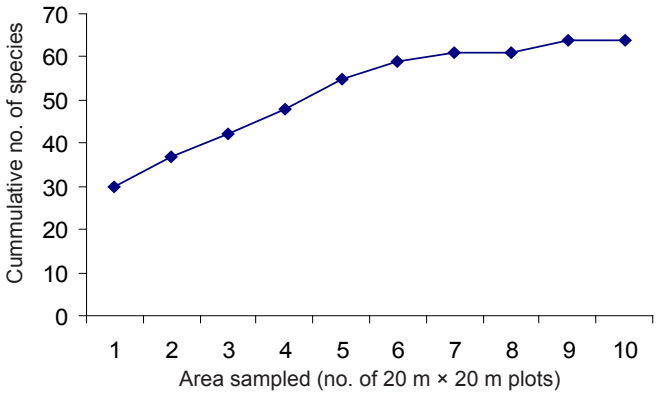

Fig. 4. Species-area curve for Cell C

confirmed the availability of *Morinda lucida* in the study area. This was attributed to its relatively high frequencies (Cell A - 40, C B - 30, Cell C – 20, Cell D - 40) even though relatively low densities were observed (Cell A - 1.0, Cell B - 0.6, Cell C - 0.3, Cell D - 0.4). The low densities observed implied a measured and sustainable use of *Morinda lucida* in order to

TABLE 6

Cummulative number of species for Cell C

Plot	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
New species	30	7	5	6	7	4	2	0	3	0
Cumm no. of species	30	37	42	48	55	59	61	61	64	64

low. *Alchornea cordifolia,* therefore, may not be readily available in the study area as reported by the local people.

Mangifera indica (mango) was found in only Cell B with a frequency and density of 10 per cent, and 0.1, respectively, in both the fallow and the annual crop farm land-use types. However, numerous mango trees were found during the traverse walks, an indication that probably it was not a good agro-forestry tree and, hence, it is not left *in situ* on farms. *Lonchocarpus cyanenses* was reported by the local farmers at Gyamfiase-Adenya as a cloth-dyeing plant, known to impact blue colour to clothings. However, this was not identified throughout the entire sampling in all the four Cells, except in one farmer's pen-house in Adenya, an indication that the plant was scarce in the Gyamfiase –Adenya.

The results and the field inventory both avoid depletion despite its availability in the area. The observed frequencies and densities of *Combretum mucronatum* recorded pointed to its predominance in the fallow land-use type but not in tree/cash crop farm land-use types. The species may, thus, be adapted to that habitat with its peculiar micro-climate. This was confirmed by the information provided by the local people.

Cell A recorded more plant species (82) than all the other Cells. Cell D on the other hand recorded more tree and shrub species from both the sampled plots and the traverse walks compared to Cell C, which contained more fallow lands comprising predominantly of grasses. Some of the different standard tree species recorded during rapid sampling through the study site (from Okuto-Aboabo, close to the main Accra-Suhum road) included *Albizia zygia, Holarrhaena floribunda, Spathodea campanulata, Bombax buo-*

TABLE 7

Cummulative number of species for Cell D

Plot	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
New species	25	9	11	5	3	3	3	0	0	2
Cumm no. of species	25	34	45	50	53	56	59	59	59	61

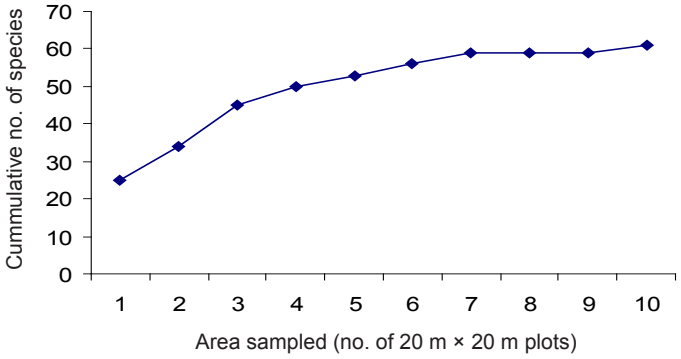

Fig.5 . Species-area curve for Cell D

nopozense, Milicia excelsa and *Terminalia superba.*

Observations from rapid sampling of a six acre cocoa agro-forestry farm in the study area revealed undergrowth that consisted predominantly of regenerations of *Mallotus oppositifolius*. Other relatively larger trees encountered on-farm included: *Antiaris toxicaria, Ceiba pentandra, Albizia zygia, Cola gigantea* and *Tetrapluera tetraptera,* whilst the smaller woody species identified included: *Rauvolfia vomitoria, Baphia nitida, Baphia pubescens, Morinda lucida, Psidium guajava, Alchornea cordifolia* and *Lecaniodiscus cupanioides*. A number of woody species including *Cnestis ferruginea, Rauvolfia vomitoria, Baphia nitida, Baphia pubescens, Ceiba pentandra, Albizia zygia, Cola gigantea, Tetrapluera tetraptera, Moringa* sp, *Morinda lucida, Holarrhaena floribunda, Spathodea campanulata, Bombax buonopozense, Milicia excelsa, Alchornea cordifolia, Dialum guineesis* and *Lecaniodiscus cupanioides* were identified during traverse walks/drives from Sekesua to Adwenso, all within the study area.

It was observed, generally along the various traverse drives, that clearing and felling of trees for farming purposes in the Amanase-Whanabenya demonstration area was less rampant compared to what existed in Gyamfiase-Adenya and Sekesua-Osonson. This observation was also made in an earlier studies during the United Nations Universities People Land-Use and Environmental Change project (UNU/PLEC) (Gyasi & Uitto, 1997).

Conclusion and recommendations

Responses from participants clearly indicated a fairly balanced traditional knowledge and awareness of forest plants (especially dye plants and their uses) among both males and females in the study area. The use of plant materials for food colouring, though not commercialised in the area, was found to be practiced by females who were mostly involved with the household cooking. The practice of food colouring was found to be common mostly when plantain and or cocoyam were out of season. Harvesting of the

dye plants by the local people did not result in the total destruction or posed threat to plant species diversity. Methods employed in the harvesting of the plant species for use appeared sustainable. Unlike the food colouring practice, the art and knowledge of cloth-dyeing was not common with the local communities.

The following standard trees were found *in-situ* on farms in traditional agro-forestry: *Albizia zygia, Bombax buonopozense, Ceiba pentandra, Cola gigantean, Morinda lucida, Rauvolfia vomitoria* and *Terminalia ivorensis* during the study. Data from the field inventorying indicated that *Morinda lucida* and *Combretum mucronatum*, were readily available in the study area, an assertion that was made by participants at the focus group discussion. Whereas *Combretum mucronatum* was readily available in the fallows, *Morinda lucida* was found in each of the three land-use types (farm with annual crops, fallow and tree crop farms).

It is recommended that, concerted efforts should be made by the communities with the support of their district assemblies to maintain and further explore the use of more effective and sustainable methods of harvesting of dye plant species, especially *Morinda lucida* and *Combretum mucronatum*, given their availability and use. Further research on *Morinda lucida* and *Combretum mucronatum* to determine the exact identities of the naturally-occurring food colours and dyes for clothing is also suggested.

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