Capacity-building workshop for West Africa on ecosystem restoration to support achievement of the Aichi Biodiversity Targets Accra, Ghana – 5 to 9 October 2015

FORESTRY RESEARCH IN GHANA AND ECOSYSTEM RESTORATION

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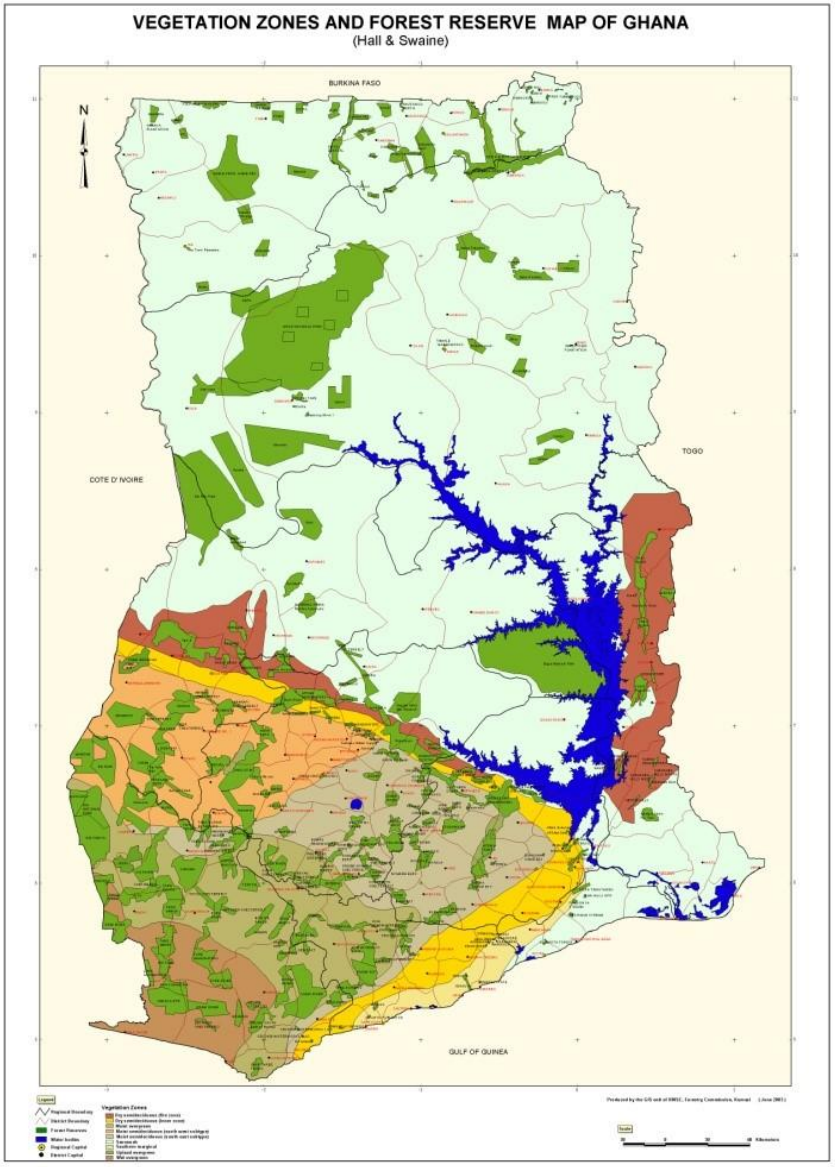
Presentation Outline

- Extent of forest ecosystem degradation & the drivers?
- Legal and policy framework for ecosystem restoration
  - Policy framework for research for SFM and ER
  - Research for development
  - Engaging key partners in SFM and ER
- Ecosystems Restoration opportunities
  - Priority areas of restoration
  - Techniques of ecosystem restoration interventions
  - Principles of ecosystem restoration
- Concluding remarks

Extent of tropical forest /ecosystem degradation

Forest type classification and biodiversity



- Two-thirds of Ghana's 238,500 square kilometres is savannah
- One-third is High Forest
- Over 2,100 plant species in the HF zone, 23 of which are endemic
- 730 tree species of which 680 attained a dimension of 5 cm or more at breast height
- 220 species of mammal, 721 birds, 850 butterflies
- HFs much like tropical forest in other regions: they show a high species diversity, multiple canopy layers, and slow growth rates for mature forests

Map prepared by FC

Extent of tropical forest /ecosystem degradation

The extent of tropical forest (TF)degradation in the tropics is vast:

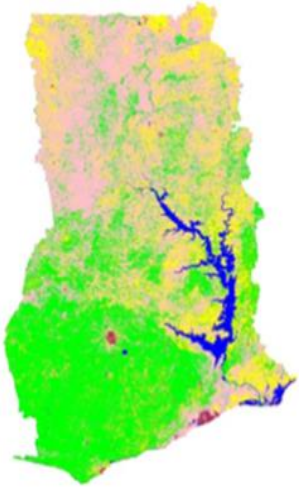
Globally,

- ✓ Some 350 million ha of TF land have been so severely damaged that forests won't grow back spontaneously(ITTO, 2002)
- ✓ a further 500 million ha have forest cover that is either degraded or has regrown after initial deforestation (ITTO, 2002)

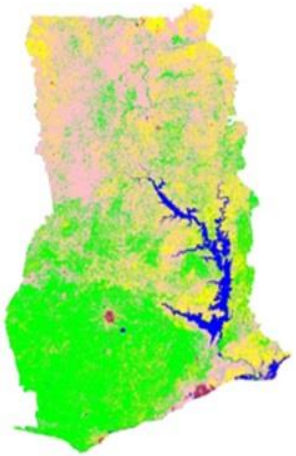
I**n Ghana**, 80% of her TF (8,348,865 ha) disappeared by 1990

- ✓ In 1996, an estimated 397,000 ha of the forest reserve land was classified as degraded and earmarked for conversion to forest plantations.
- ✓ Thus reduction in the capacity of these forests to produce goods and services and only limited biological diversity is maintained

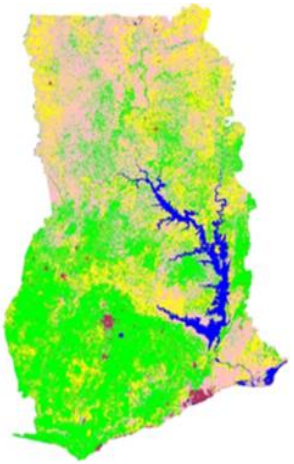
Land Use For Three Epochs (1990, 2000, 2010)



LU of 1990,

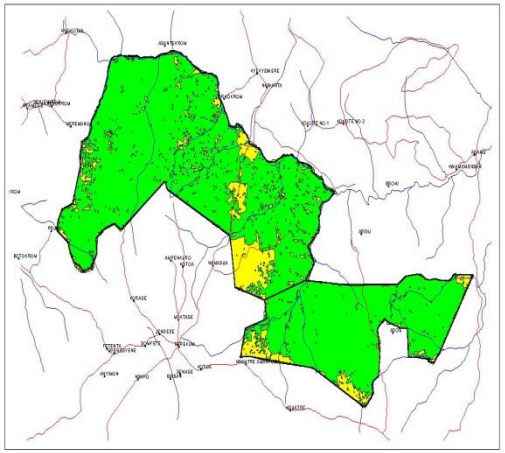


2000



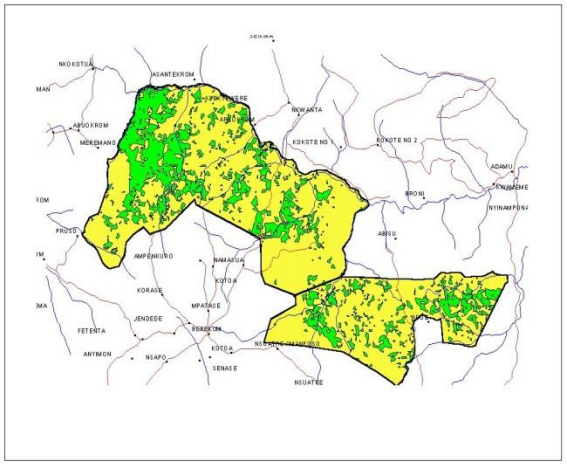
2010

Trends Of Forest degradation and Deforestation – Tain II FR



Non Forest Cover

Forest Cover



Map was developmed by the FC

Extent of tropical forest /ecosystem degradation

Frequencies of star rated species in the studied 40 ha plot

Star Ratings	No. of species	Frequency (F)	F ≥70 cm dbh
Black star (urgent conservation attention needed)	0	0	0
Scarlet star (Over exploit)	2	10	3
Red star (in balance with AAC)	2	16	1
Pink star (L known)	5	22	2
Green star (no conservation required)	21	293	9
Blue star (widespread internationally but rare in GH	1	4	0
Others	13	486	13
Total	**44**	**831**	**28**

Drivers/ reasons for forest ecosystem degradation

- **Agricultural expansion (**e.g. cattle ranching, shifting cultivation/traditional slash and burn**)**

✓ Deforestation as a result of Food Crop Cultivation in HFZ covers an area of 1.2 million ha

Drivers/ reasons for forest ecosystem degradation

❑ Logging and fuel wood harvesting

- ❑ Wood removal for Fuelwood and charcoal estimated at 30 million m^3 $year^{-1}$
- ❑ Timber harvest is currently 3.72 million m^3 $year^{-1}$
  - ✓ 2 million m^3 $year^{-1}$ is legal and from Formal sector
  - ✓ rest (1.72) million m^3 $year^{-1}$ is illegal and is mainly to supply the Domestic Market.

Drivers/ reasons for forest ecosystem degradation

❑ Annual Wildfires

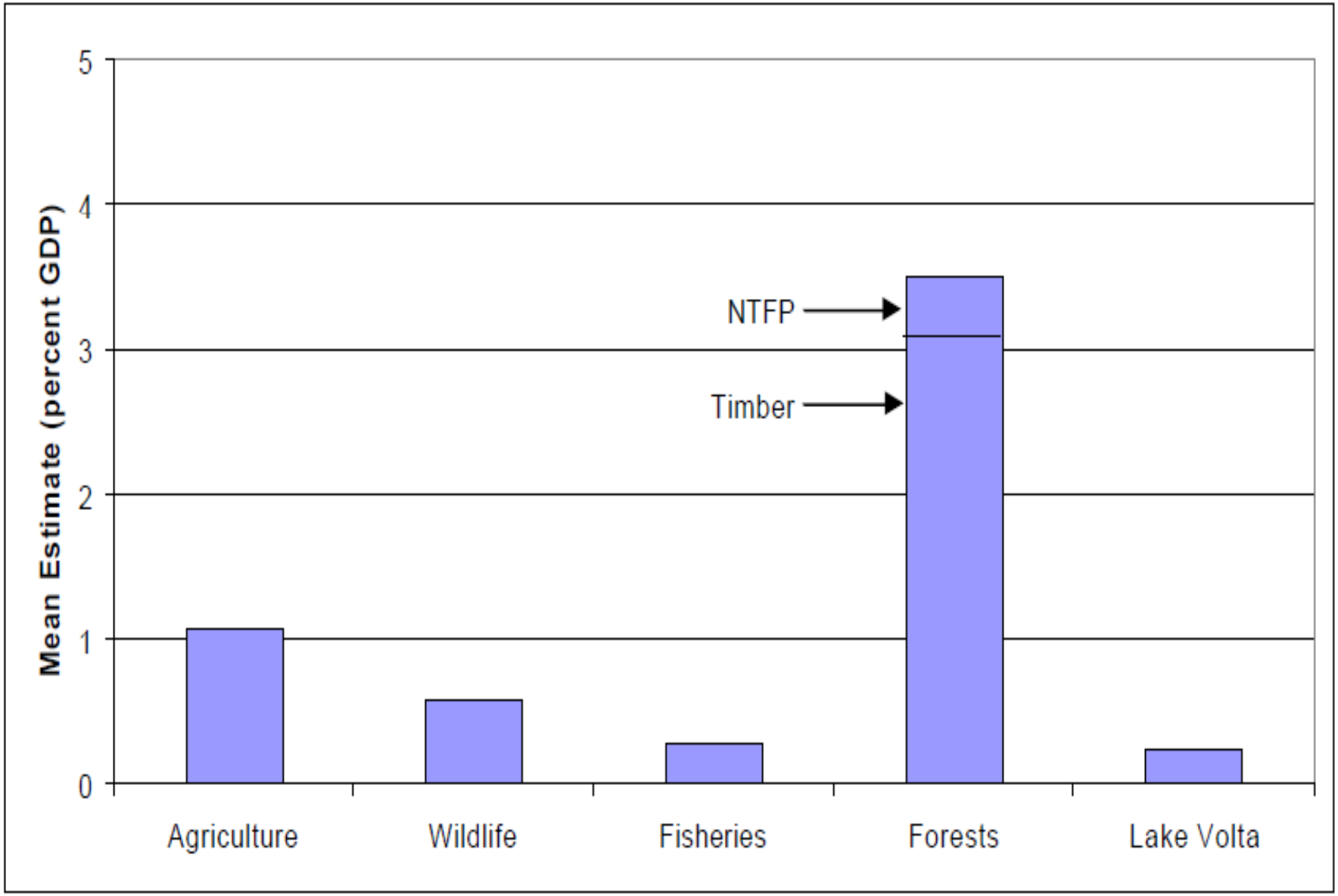
✓ FC estimates suggests over 4.8 million cubic meter timber lost through fire since 1983

Drivers/ reasons for forest ecosystem degradation

- Flooding

- Mining and mineral exploitation
- Urbanization include roads, settlements and other infrastructural development

Figure 1: Annual Cost of Depletion by Natural Resource Type



Source: ISSER, CSIR-FORIG & World Bank, 2006

Legal and policy framework for ecosystem restoration

Policy framework for research for SFM and ER

- **Research and education are essential pillars for SFM and ER.**

- ✓ The scientific basis for forest policy and management decisions must come from research
- ✓ SFM and ER decisions must be validated by research
- ✓ Future SFM and ER policy and management needs must be projected by research

Policy Framework for Research for SFM and ER

❑ 1908/09 Forest Policy

- ✓ **Aimed at conserving a sufficient area of forest for** (i) protection of water supply (ii) Prevention of soil erosion and (iii) protection of Cocoa Landscape – **NO MENTION OF RESEARCH**

❑ 1948 Forest Policy

- ✓ Policy objectives included (i) **Research in all branches of Scientific Forestry** (iii) Prevention of soil erosion and (iv) land use planning

❑ 1994 Forest and Wildlife Policy

- ✓ Policy statement 5 policy thrusts broad implementation strategies including **"Promotion of research and science** and human resource development**"**.

❑ 2012 Forest and Wildlife Policy

- ✓ Has Broad Heading on **"Forest and Wildlife Institutional Strengthening, Education, Research and Training"**

Policy framework for research for SFM and ER

- **Recognising the need for research in a successful foresty practice, research institutions were established and placed under CSIR**

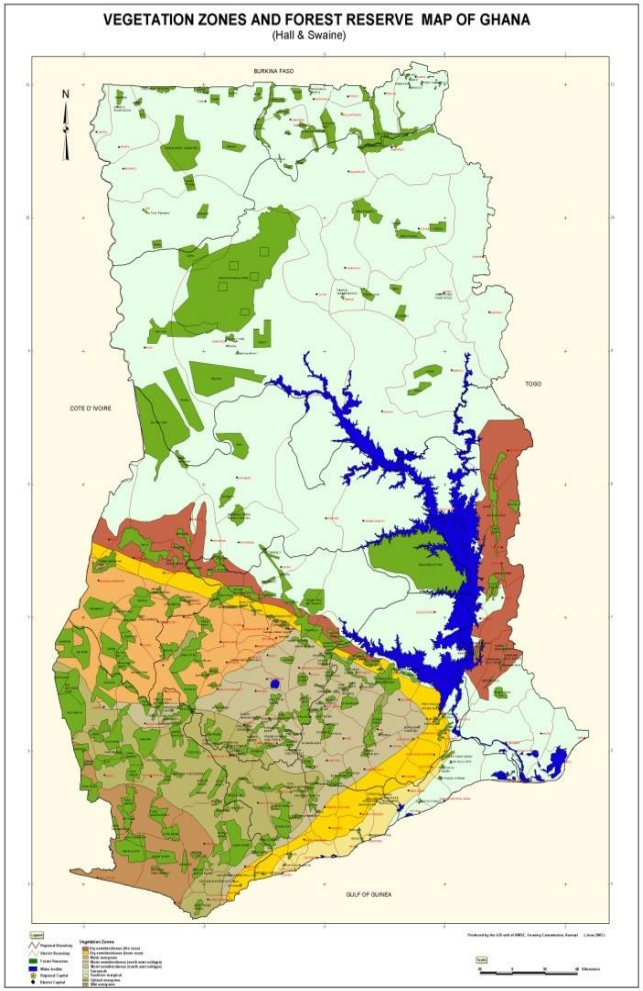
- **Among them is the Forestry Research Institution of Ghana (FORIG)**

Mandated to

- **Undertake forest, forest products and related research, disseminate and commercialise research outputs and services**

✓ 1962: Started as a research unit within Forestry Department.
✓ 1964: Established as a Research Institute and named Forest Products Research Institute under Ghana Academy of Sciences.
✓ 1968: Moved to Council for Scientific and Industrial Research (CSIR).
✓ 1980: Transferred from CSIR to the newly created Forestry Commission by Act of Parliament (Act 405).
✓ 1991: Renamed Forestry Research Institute of Ghana (CSIR-FORIG).
✓ 1993: Returned to CSIR by another act of Parliament (453).

CSIR-FORIG research stations in Ghana



ECO-ZONE	FOREST LOCATION	REGION
1. WET/MOIST EVERGREEN	SUBIRI, BENSO	WESTERN
	BIA TANO	BRONG AHAFO
2. MOIST SEMI-DECIDUOUS (N/W)	BOBIRI - KUBEASE	ASHANTI
3. MOIST SEMI-DECIDUOUS (S/E)	PRA-ANUM, AMANTIA SOUTH FORMANGSU, DADIESO MPRAESO JIMIRA	EASTERN EASTERN EASTERN EASTERN
4. SAVANA RESEARCH	BOLGA, BAWKU	UPPER EAST
5. DRY SEMI-DECIDUOUS	AFRAM HEADWATERS-ABOFOUR ASENANYO YENKU, WINNEBA	ASHANTI WESTERN CENTRAL

CSIR-FORIG research focus areas 1960s

Type of trial	Species		Date
	Indigenous	Exotic	
Growth	20	4	1966-1985
Enrichment planting	10		1960-1977
Taungya	14	4	1960-2005
Thinning	10	3	1960-1973
Spacing	10	8	1967-1970

Focusing on growth, productivity, yield prediction of individual trees.

Indigenous species trials since the 1960s

Pericopsis elata **in enrichment planting at Asenanyo (1970s).**

Pericopsis in mixed crop trial with 8 other indigenous species at Amantia (1960s).

Odum trial in Pra Anum

Nauclea in pure stand in Pra Anum

CSIR-FORIG research focus areas since 1960s

- **Over the years, need for ecosystem restoration through plantations and agroforestry has led to more research addressing**

  - ✓ **Species selection, propoagation and improvement**
  - ✓ **Soil water and micro-climate**
  - ✓ **Competition and complementarity research**
  - ✓ **Research into Lesser Used Species (LUS)**
  - ✓ **NTFP's Research**

Growth and provence studies

Growth and provenace studies

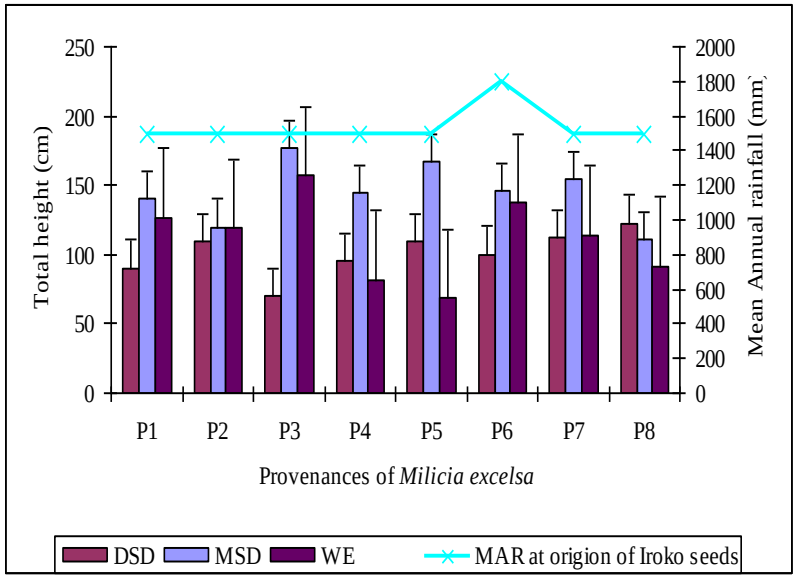


Figure 1. Ranking of provenances of *M. excelsa* for total height after 36 months of growth in the dry semi-deciduous (DSD) (Site I), moist semi-deciduous (MSD)(Site II)) and wet evergreen (WE) (Site III) forest zones of Ghana. Standard error of mean on bars.

Species, provenance and site selections for restoration

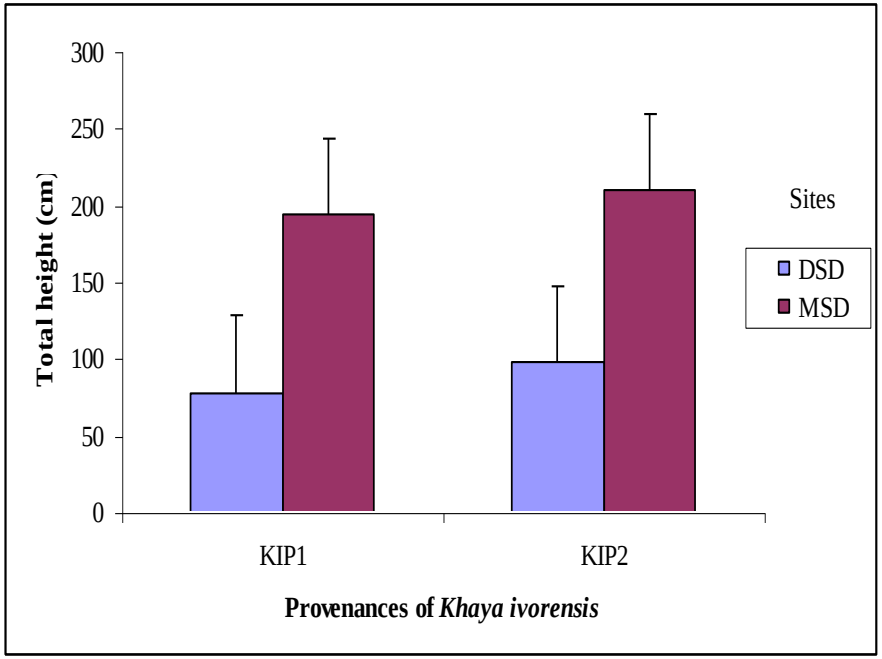
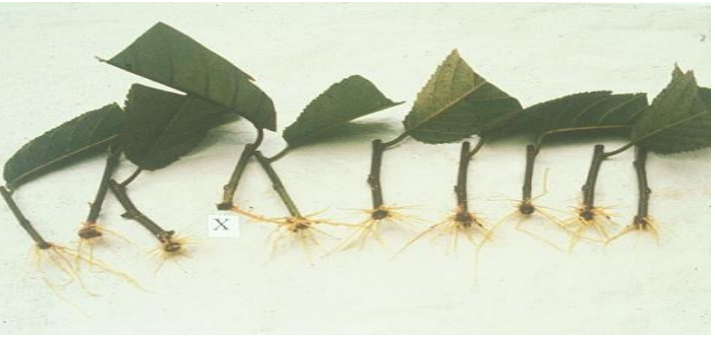


Figure 2. Ranking of provenances of *K. ivorensis* for total height after 36 months of growth in semi-deciduous (DSD) (Site I), and moist semi-deciduous (MSD)(Site II)) forest zones of Gha error of mean on bars

Propagation technique Research



Stem and root cuttings

In vitro tissue culture

Grafted plant

Air layering

Identifying provenances that are resistant to pest and diseases

Khaya anthotheca – multiple **branching in response to shoot borer attack**

Odum seedling with large and heavy galls as a result of ***Phytolyma lata*** **attack**

Species responses to environmental stresses

Table 4: Net photosynthesis (P_N), stomatal conductance (Gs), transpiration (E), (means and SE in parenthesis) of *M. excelsa* (Iroko) seedlings (from three populations Ghana) subjected to two watering regimes. F_p, population effect, F_w, watering effect, F_w*_p, watering*population effect. ** P< 0.01 *** P< 0.001.

Watering treatment	Pop	P_N (mol m^{-2} s^{-1})	Gs (mol m^{-2} s^{-1})	E (mmol.m^{-2} s^{-1})
25% field capacity	AHW-1	4.16 (0.25)	33.75 (2.42)	0.44 (0.05)
	KK-6	5.40 (0.40)	36.00 (3.95)	0.63 (0.08)
	EMH-1	3.93 (0.26)	32.14 (2.50)	0.44 (0.07)
100% field capacity	AHW-1	4.47 (0.21)	37.25 (2.41)	0.55 (0.06)
	KK-6	8.55 (0.23)	92.66 (2.28)	1.16 (0.04)
	EMH-1	7.75 (0.35)	81.25 (3.42)	1.04 (0.08)
$P>F_p$		<0.001***	<0.001***	<0.001***
$P>F_w$		<0.001***	<0.001***	<0.001***
$F>F_w*_p$		<0.001***	<0.001***	<0.001***

Table 5. Pearson's product-moment correlation coefficients (r) among photosynthetic traits and seedling growth traits of *M. excelsa* (Iroko). TB= total dry biomass; TLA= total leaf area; P_N= net photosynthesis; E= transpiration; Gs = stomatal conductance; **= significant at P< 0.01

Trait	TB	TLA	P_N	E
TLA	0.799**			
P_N	0.742**	0.723**		
E	0.974**	0.725**	0.974**	
Gs	0.758**	0.732**	0.977**	0.957**

✓**Soil water and micro-climate**

Species recruitments and biodiversity research

Teak plantation .

A mixed species of 3- year old *Khaya anthoteca, Terminalia ivorensis* and *Terminalia superba* growing in the project site in *Afrensu-Brohuma* Forest Reserve

✓Competition and complementarity research

How different systems support biodiversity recovery

Species recruitments and biodiversity research

Table 4 Mean species richness and diversity parameters of a mixed stand indigenous plantation, surveyed in a degraded forest land in Ghana before and after its establishment

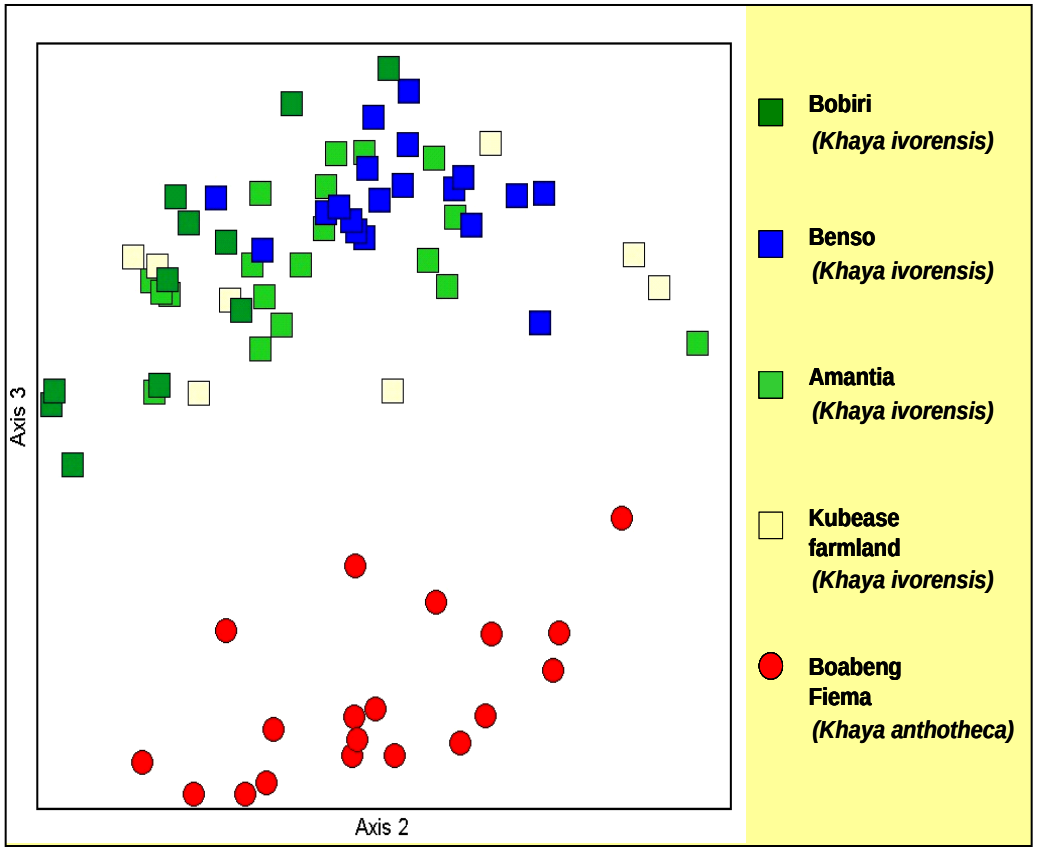
Indices	Year of assessment	Ha plot	Standard deviation
Species richness (S)	2001	22	5.77
	2008	92	6.04
Evenness	2001	0.83	0.02
	2008	0.64	0.01
Shannon index (H)	2001	2.51	0.01
	2008	2.64	0.02
Individual no.	2001	147	8.98
	2008	4419	103.88

- ✓ How different systems support biodiversity recovery
- ✓ Competition and complementarity research

Bioindicaors

Focus on the use of cryptogamic epiphytes as bioindicators:

- **Levels of anthropogenic disturbance**
- **Effects of mahogany depletion on associated biodiversity**
- **Growth conditions within natural and managed forest stands**



Ordination of mahogany trunks in epiphyte species space using non-metric multidimensional scaling (NMS). The data points represent sample units (61 *Khaya ivorensis* and 19 *K.anthotheca* trunks) in epiphyte species space (26 taxa of epiphytic lichens). The ordination was rigidly rotated to align estimated annual precipitation of sampling sites with the vertical axis.

Data from M. Kukkonen 2005: The conservation needs of mahogany *Khaya ivorensis* in Ghanaian farmlands. New insights from socio-economic and bioindicator studies. (MSc. thesis, work supervised by Prof. J. Rikkinen).

Research into Lesser Used Species (LUS)

- **35 LUS, have proved to be good substitutes to the dwindling traditional species**

  - **High value species now threatened such as Odum, Dahoma, Essia etc. have been substituted by Awiemfosamina (*Albizia* spp), Bonsamdua (*Distemonanthus* spp)and Pampena**

  - **Within the last 10 years about 10% of species for export and domestic markets have been made up of new LUS.**

  - **LUS estimated to have contributed about $24 million per annum to the export value and $15 million to the domestic market value**

NTFPs RESEARCH

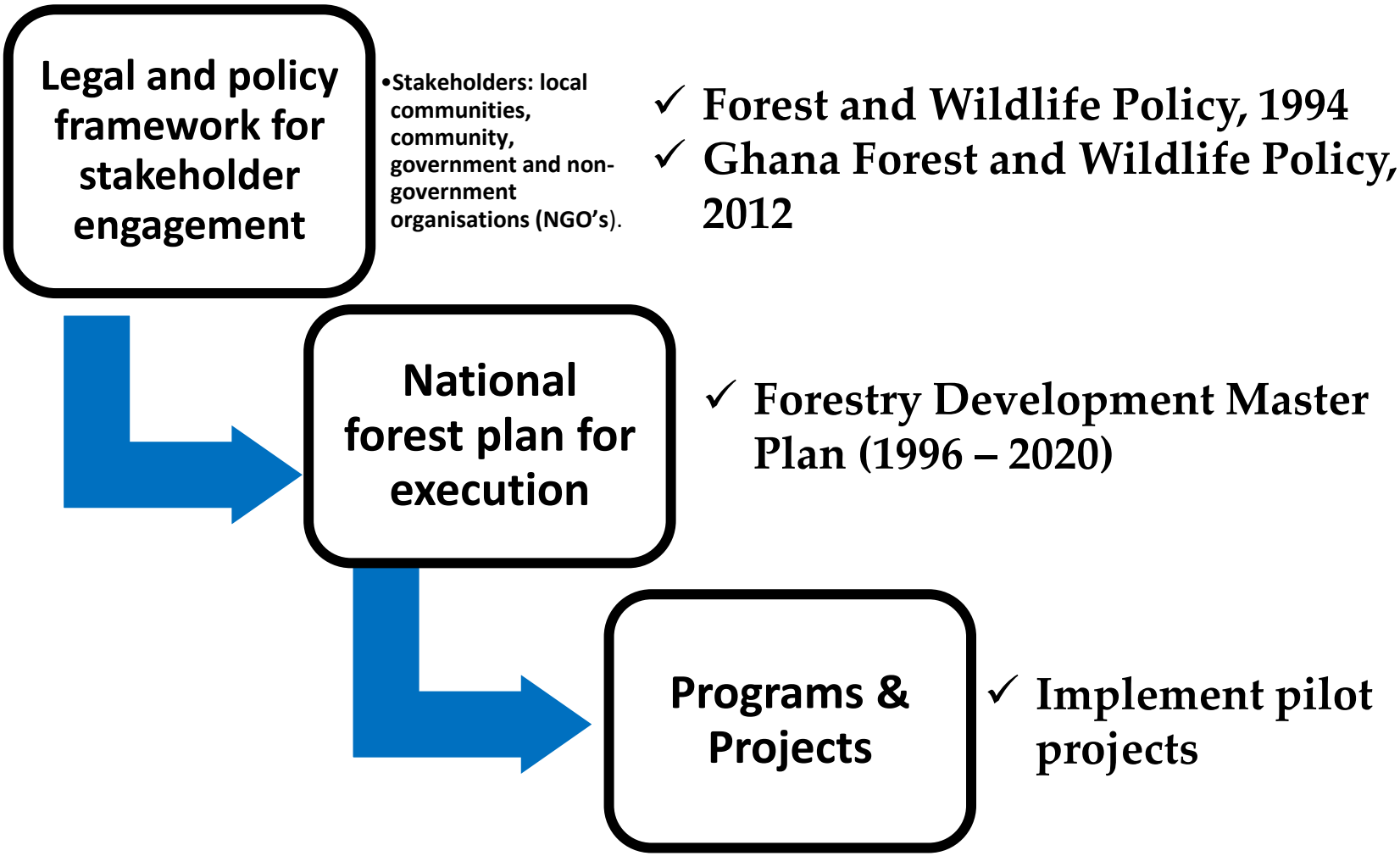
Mushroom cultivation

Snail farming technology

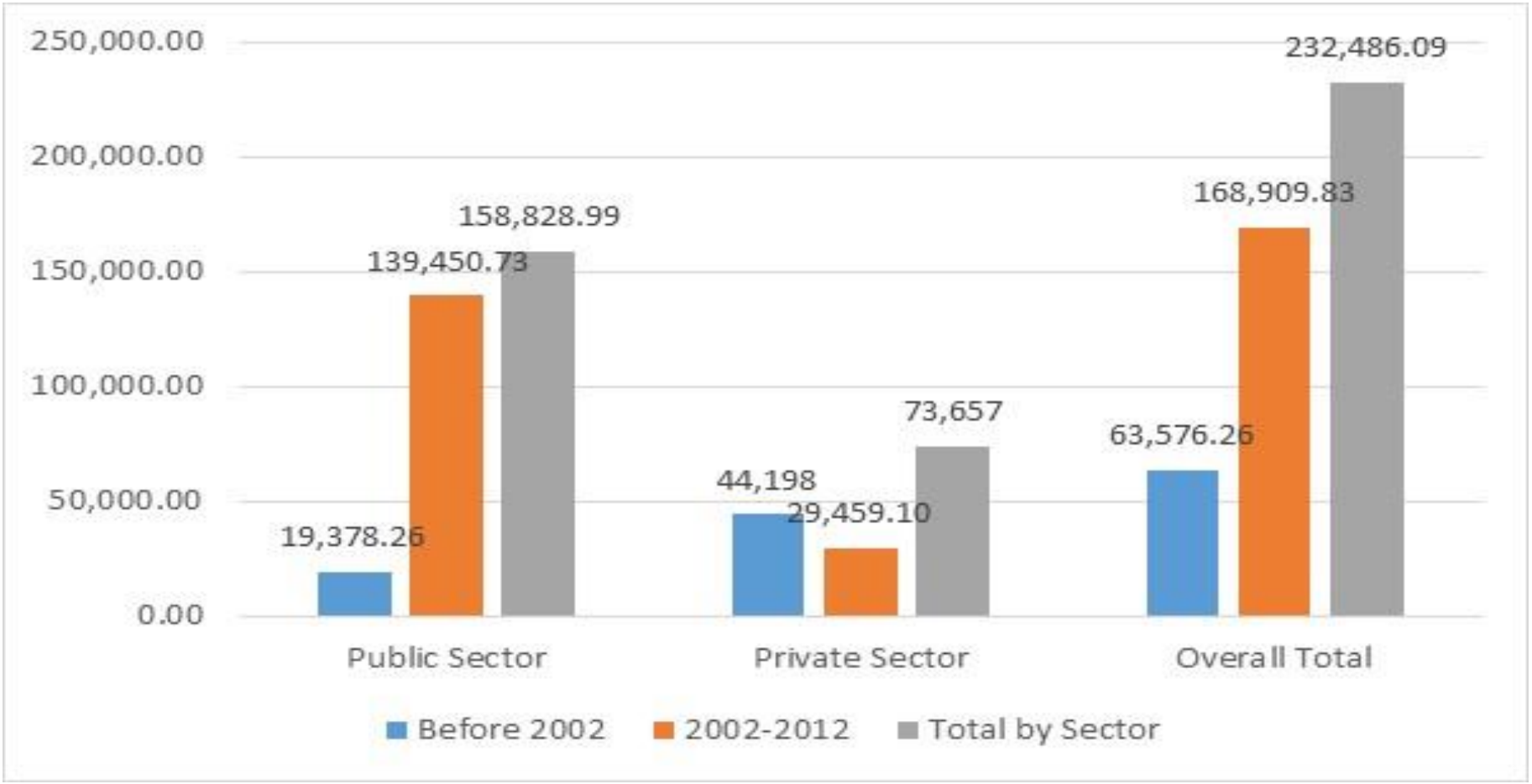
Bee keeping Technology

Plant medicinal value research
(*Tetrapleura tetraptera*)

Framework for engaging key partners in SFM & ER



Participation in degraded land rehabilitation & restoration by sector



NATIONAL FOREST PLANTATION DEVELOPMENT PROGRAMME (NFPDP), 2002-2012)

Ecosystem Restoration Opportunities

What is ecosystem restoration

- "--is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed.

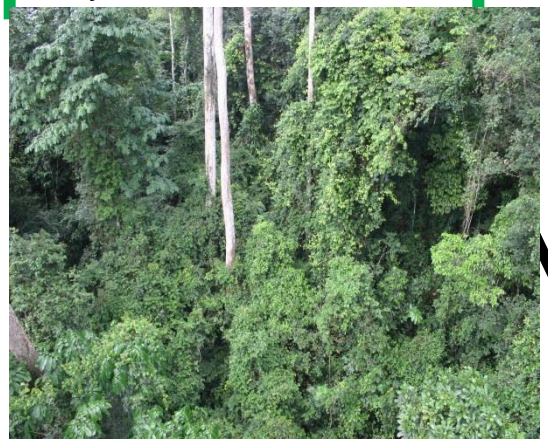
- --increases natural capital and the output of natural goods and services."

Society for Ecological Restoration, April 2004

Priority area for ecosystem restoration

Primary/ Managed forests

Its natural structure, functions have not undergone any changes that exceed the elastic capacity of the ecosystem

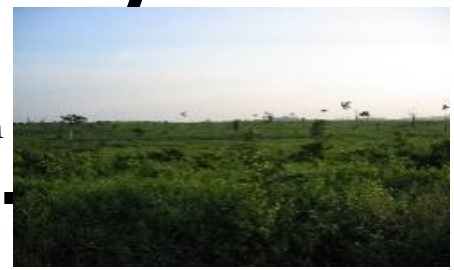


Secondary forests

Termed "Successional Forests" regrowth after disturbance

Degraded primary forests

its structure, processes, functions and dynamics are altered such that the capacity of these forests to fully recover from exploitation in the near to medium term has been compromised



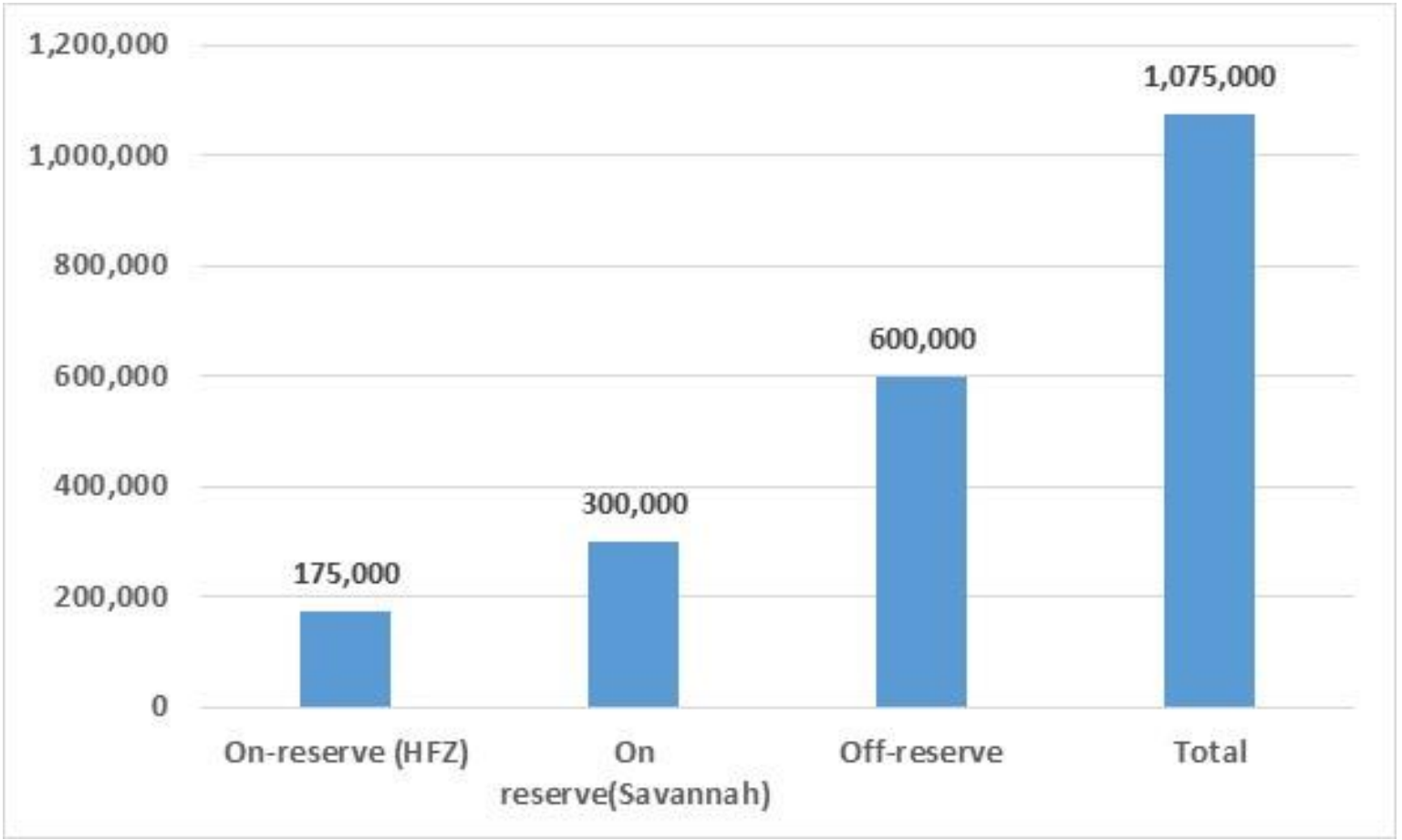
Degraded forests

Has lost structure, function, species composition and/or productivity.

A whole range of services are affected

Priority areas for ecosystem restoration

Potential Degraded lands for plantation development



Source: FC and MLNR, 2013. Ghana Forest Plantation Strategy (GFPS) 2015-2040

Enrichment planting (assisted regeneration)

Planting of desired tree species in a modified natural forest or secondary forest or woodland with the objective of creating a high forest dominated by desirable (i.e. local and/or high-value) species

•**some cases, degraded forest land may still be capable of supporting natural regeneration**

Community Woodland Reserves before the Project

2 Years after Reservation

Planting of trees as woodlot

Fig. *Cassia siamea plantation* **.**

Fig Degraded Forest in Pamu Brekum in Dormaa Forest District of Ghana.

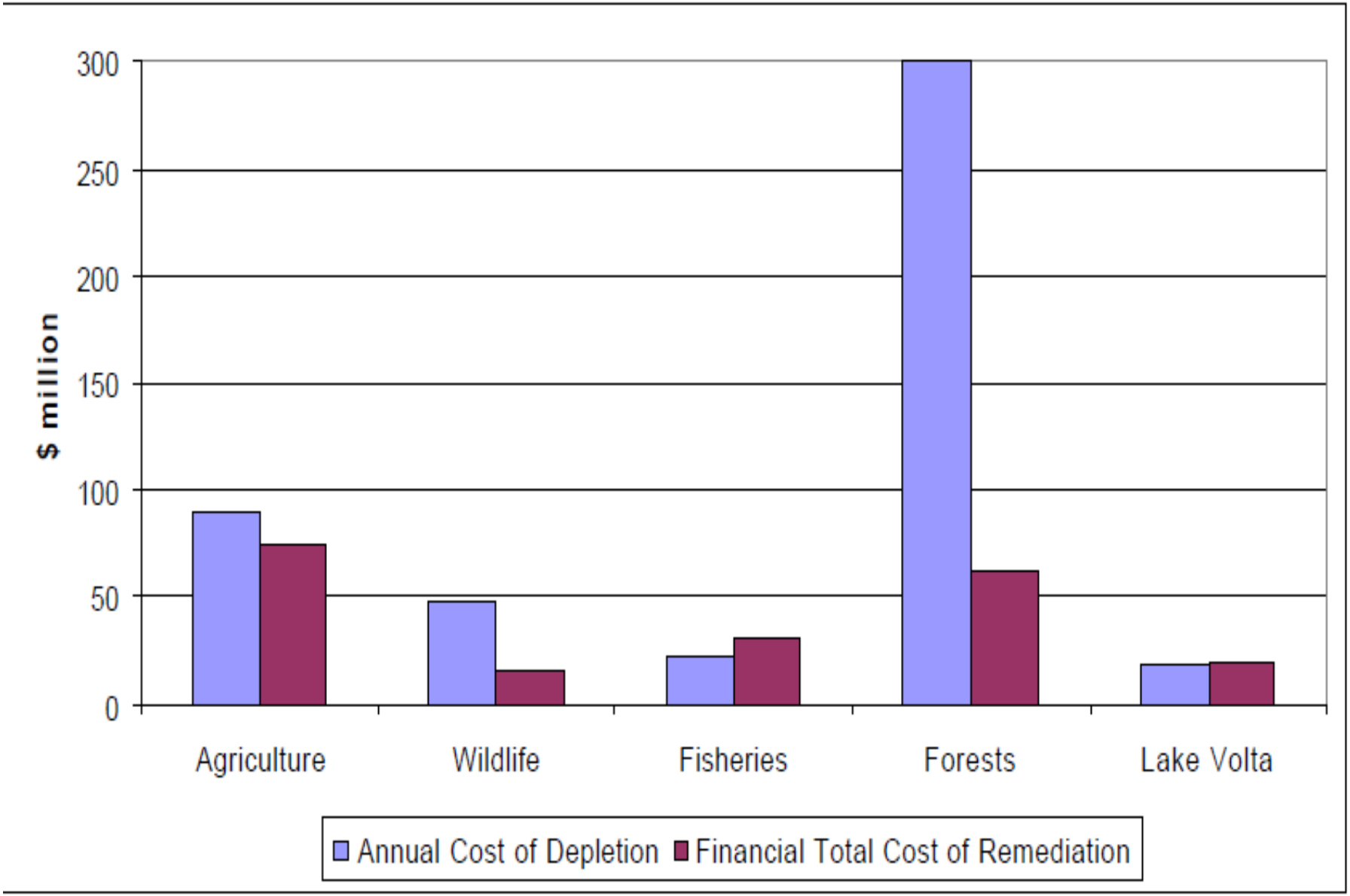
MTS (Agroforestry) model

Reforestation/ Restoration Species

- **Over 70% of** plantations consist of ***Tectona grandis*** (Teak).

- **30% established** with species including
  - ✓ *Cedrela odorata* (Cedrela),
  - ✓ *Terminalia spp*.(Ofram and Emire),
  - ✓ *Gmelina arborea* (Gmelina),
  - ✓ *Senna siamea* (Cassia),
  - ✓ *Eucalyptus* spp,
  - ✓ *Heritiera utilis* (Nyankom),
  - ✓ *Aucoumea klaineana* (Aucoumea),
  - ✓ *Nauclea diderrichii* (Kusia),
  - ✓ *Khaya ivorensis* (Mahogany),
  - ✓ *Triplochiton scleroxylon* (Wawa)
  - ✓ *Mansonia altissima* (Oprono).

Figure 2: Comparison of Costs of Depletion and Costs of Remediation



Source: ISSER, CSIR-FORIG & World Bank, 2006

Principles of Ecosystem Restoration and management (ER&M)

- **There are many principle of ER and management:**
  Now focusing on two as follows:

- **The objectives of ER&M must be based on societal choices**

  - ✓ Different ER&M actors have their own **economic, cultural** and **society needs.**

  - ✓ Ecosystems should be managed for their intrinsic values and for the tangible or intangible benefits .

  - ✓ Both **cultural** and **biological diversity** are central components of the ecosystem management

Principles of Ecosystem Restoration and management (ER&M)

- **ER&M must ensure that ecosystem structure and functioning are maintained for ecosystem services.**

- For this
  - ✓ a dynamic relationship within species, among species and between species and their abiotic environment, as well as the physical and chemical interactions within the environment is essential

  - ✓ Restoration of these interactions and processes is of greater significance for the long-term maintenance of biological diversity .

Concluding remarks: The way forward

Current mandates	→	Future mandates
❑ Individual sites & species		☑ Entire site and multiple Species
❑ Managing system for few benefits		☑ Managing for multiple benefits
❑ Passive stakeholder engagement	→	☑ Genuine stakeholder engagement
❑ Resource Management by Sectors		☑ Integrated Resource Management

Focus on restoring and managing ecosystem parts → **Focus on ecosystem relationships, processes, and tradeoffs**

Thank You