

GHANAIAN WOOD ENERGY VALUE CHAIN

Beatrice Darko Obiri (PhD)

CSIR-FORESTRY RESEARCH INSTITUTE
Forest Products and Marketing Division

bdobiri@csir-forig.org.gh



Forestry Research Institute of Ghana

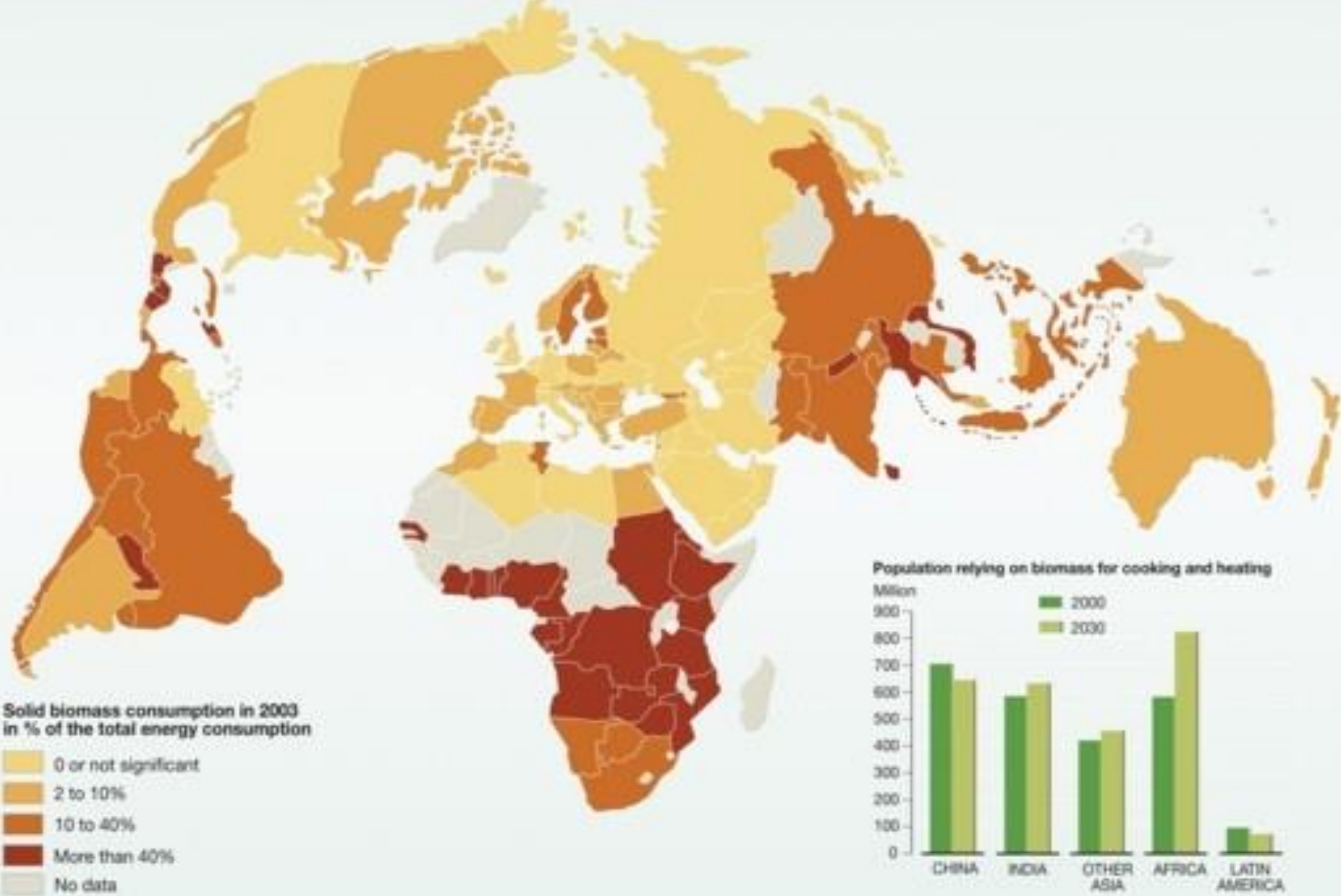
INTRODUCTION

❑ Biomass for energy including wood for energy is in the spotlight globally

- Renewable energy
- Wood is used for heat/energy everywhere in the world



Forestry Research Institute of Ghana



Source: World Resources Institute (WRI) searchable database.

Source: IEA 2002.

GHANAIAIAN CONTEXT

- **In Ghana wood is a major heat and income source**
 - **key to food and livelihood security in both urban and rural areas**
- Used by 73% and 25% of rural and urban people as a heating source for households
 - Food processing in the service industry
 - Institutions and industries
- Production, trade and consumption offers employment and livelihood for both rural and urban people (2 million+)



Forestry Research Institute of Ghana



MAIN DRIVERS OF WOOD ENERGY PRODUCTION AND DEPENDENCY

- **Poor agricultural income**
- **Major alternative income source in most farming areas**
- **Poor management of wood energy resources**
- **Concentration on timber**
- **Expensive alternative energy sources??**
- **Hardly any effective policy to regulate exploitation and marketing and trade in fuelwood and charcoal until recently?**
 - ❖ inadequate empirical INFORMATION for understanding the dynamics for policy planning



OBJECTIVE OF PRESENTATION

- PROVIDE Update on the status of the Ghanaian wood energy value chain with emphasis on:
 - Main Resources
 - Transformation/Production Technologies
 - Utilization Pathways



SOURCE OF INFORMATION

- Literature
- 6 Baseline studies (2011-2018) to inform the **design of options for sustainable wood energy production in Ghana**



Forestry Research Institute of Ghana



METHODS: STUDY AREA

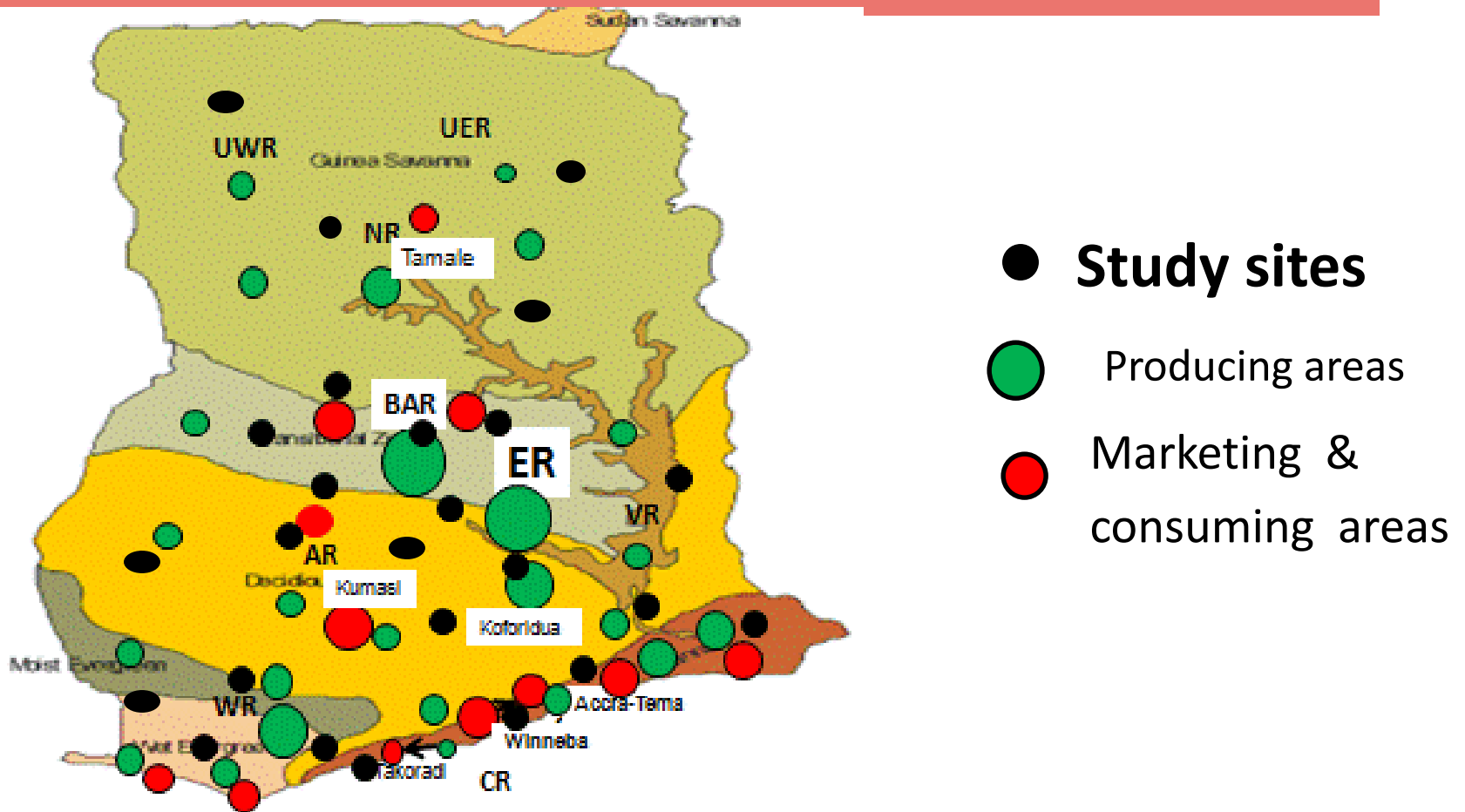


Fig 1: Ecological map showing study sites

DATA AND ANALYSIS

❖ Literature

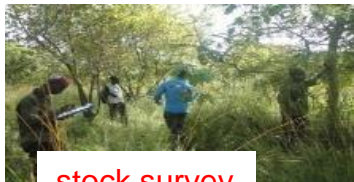
❖ Community consultations

❖ Questionnaire survey of over 1500 actors (resource owners, producers, transporters, traders, associations, officials)

▪ DATA

- Activities in value chain, costs and returns at nodes along the chain,
- Resource characteristics, availability, governance, processing technology and **profitability**, marketing and distribution, challenges and opportunities

❖ Quantitative and descriptive analyses



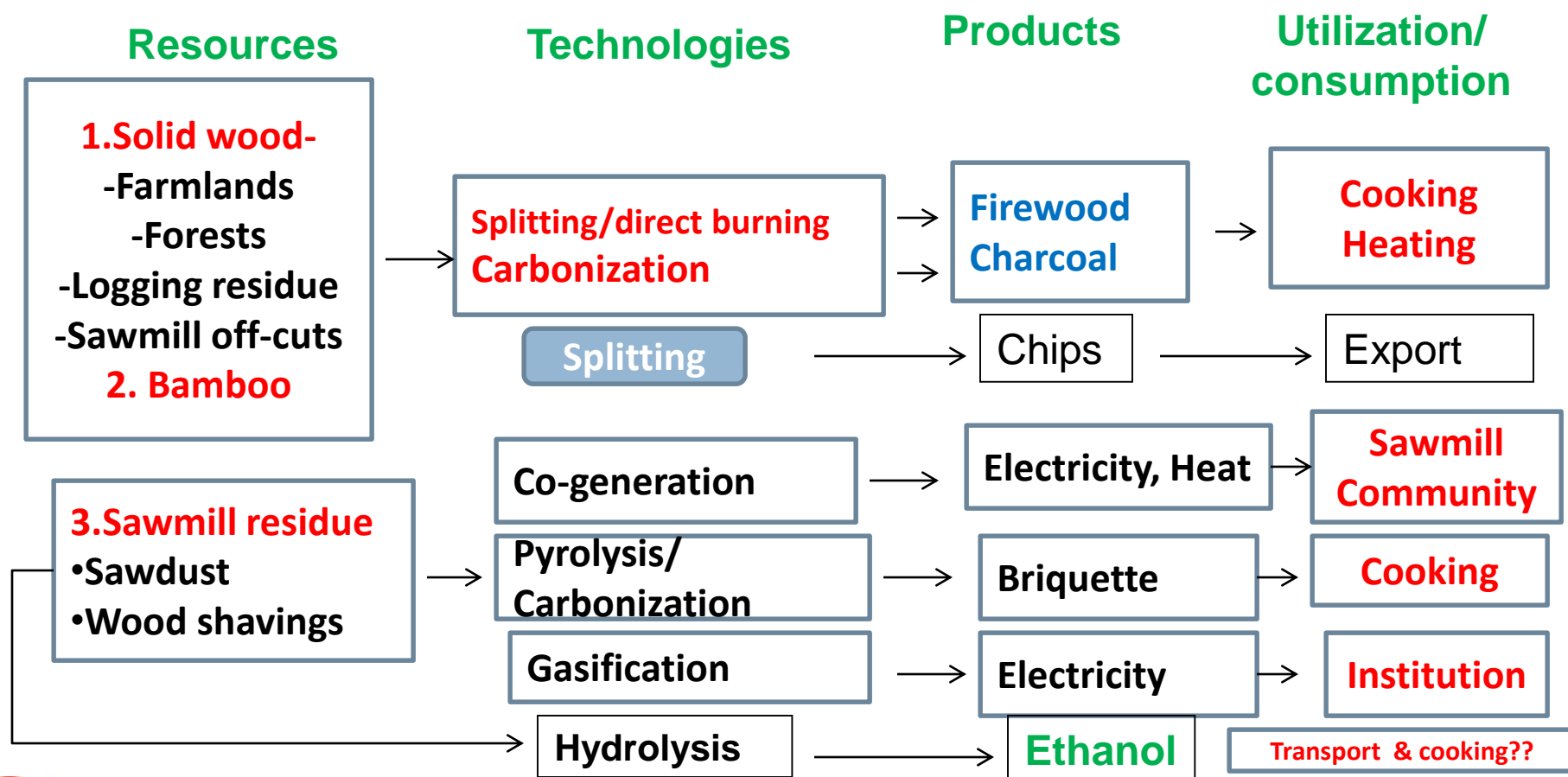
stock survey



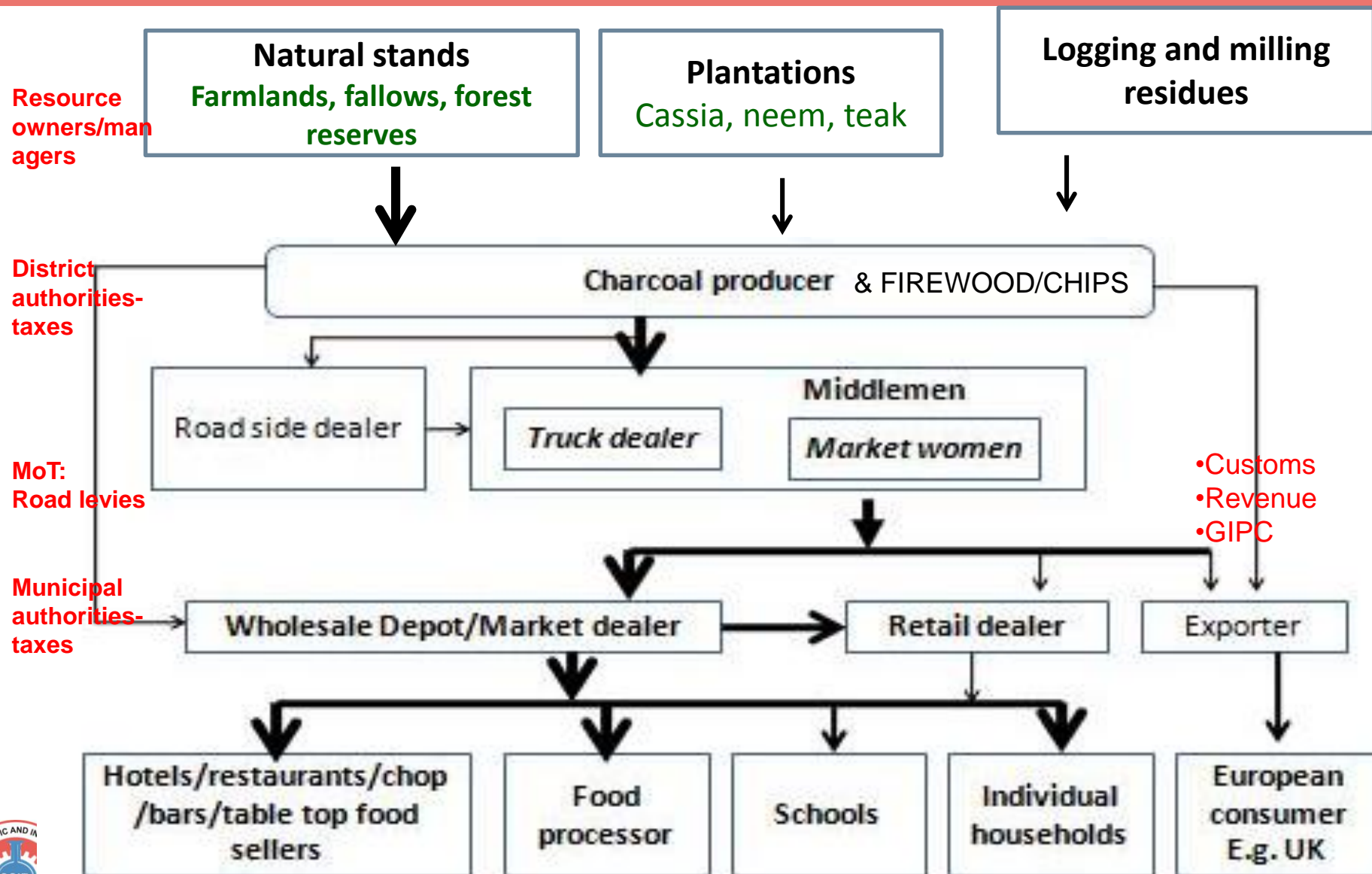
Forestry Research Institute of Ghana



Overview of the Ghana Wood Energy Value Chain

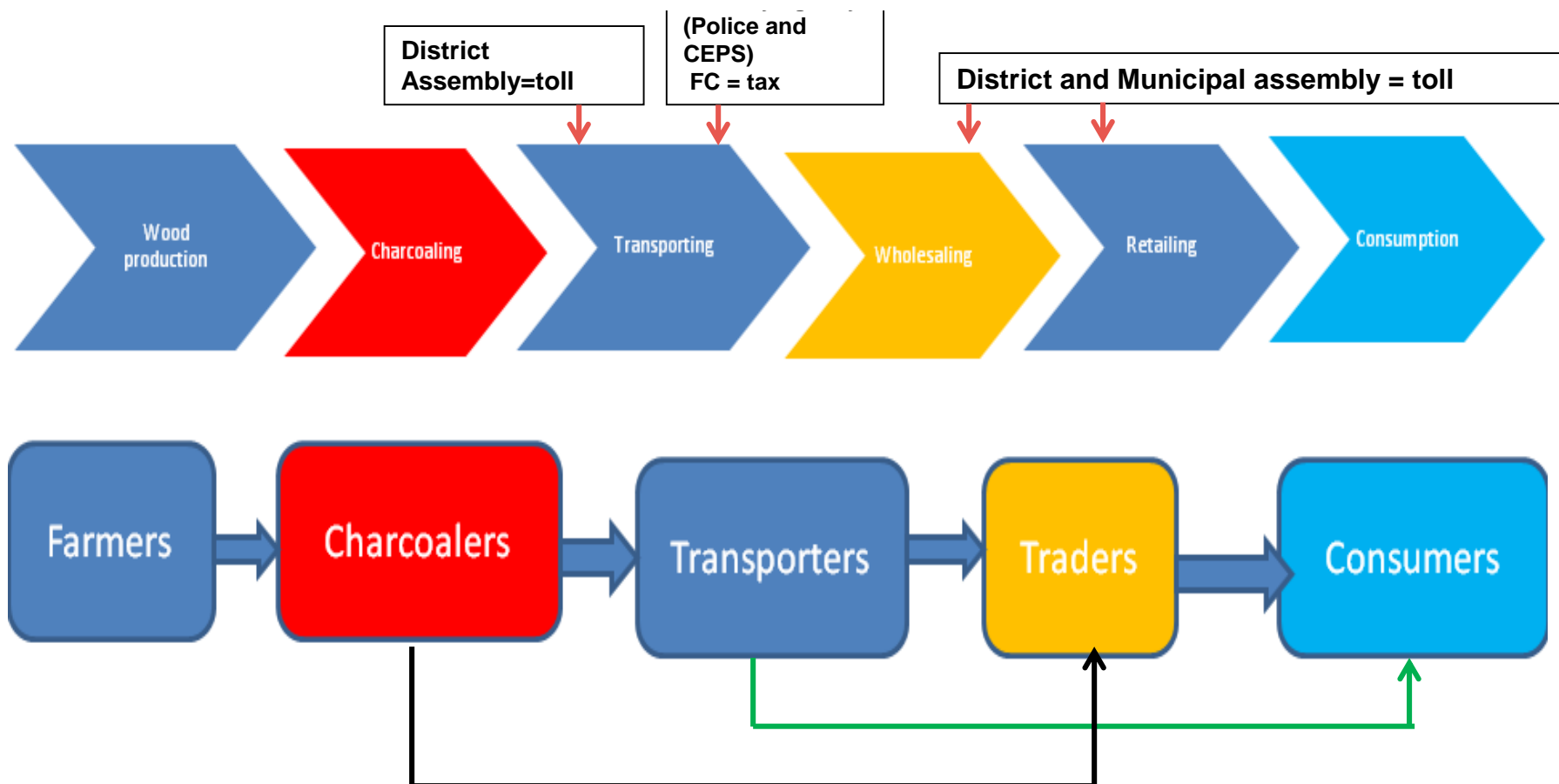


Charcoal and firewood supply chain



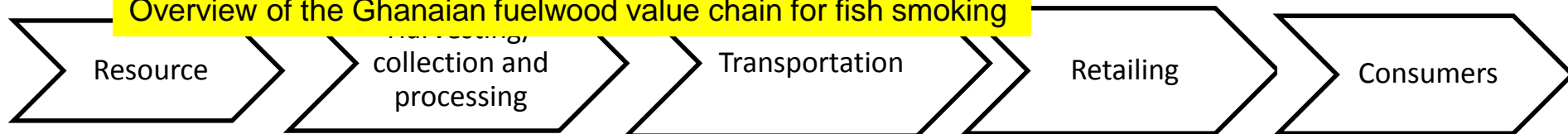
OVERVIEW OF CHARCOAL VALUE CHAIN

- ❑ 80% men in production and transportation
- ❑ 90% women involved in marketing and utilization

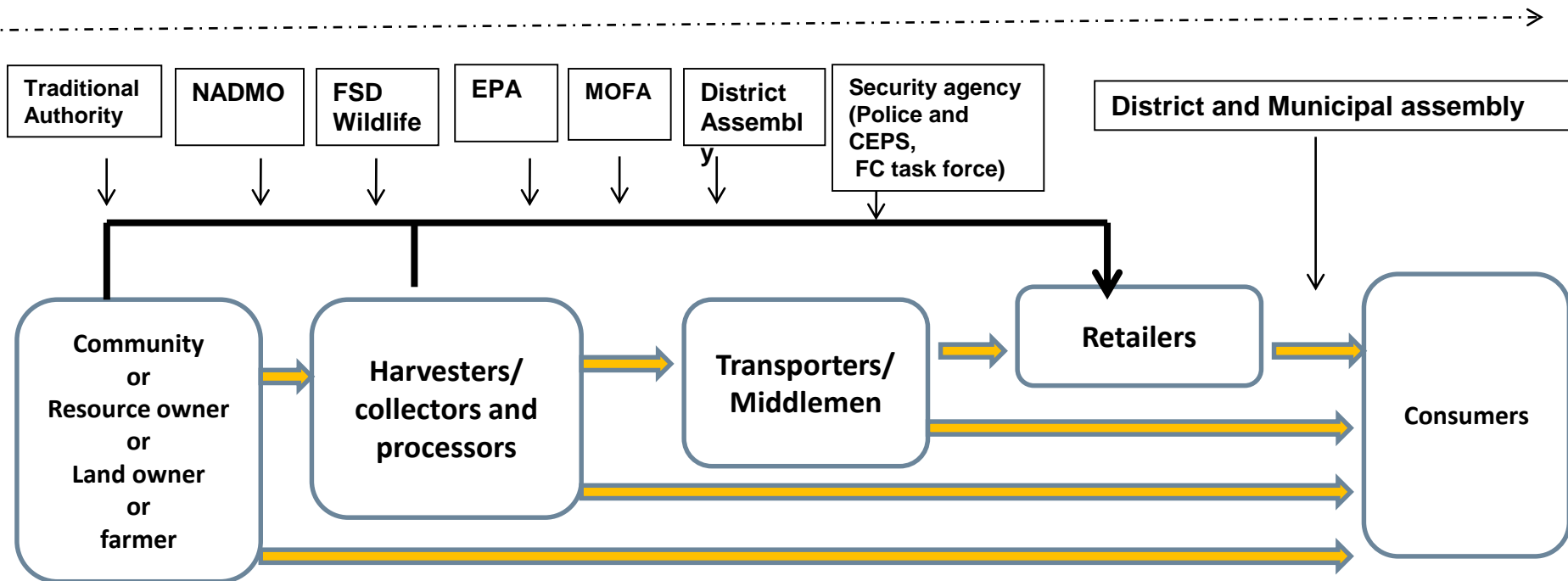


charcoal value chain actors, activities & inter-connections

Overview of the Ghanaian fuelwood value chain for fish smoking

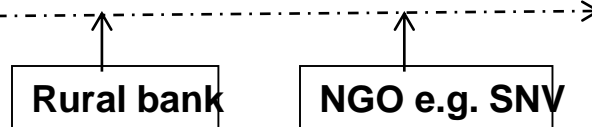


Regulatory entities (policy, law enforcement, etc.): Energy Commission, Forestry Commission, MLNR, EPA, etc.



Enabling influences

Business, finance, research, academia and development entities, etc.



Forestry Research Institute of Ghana



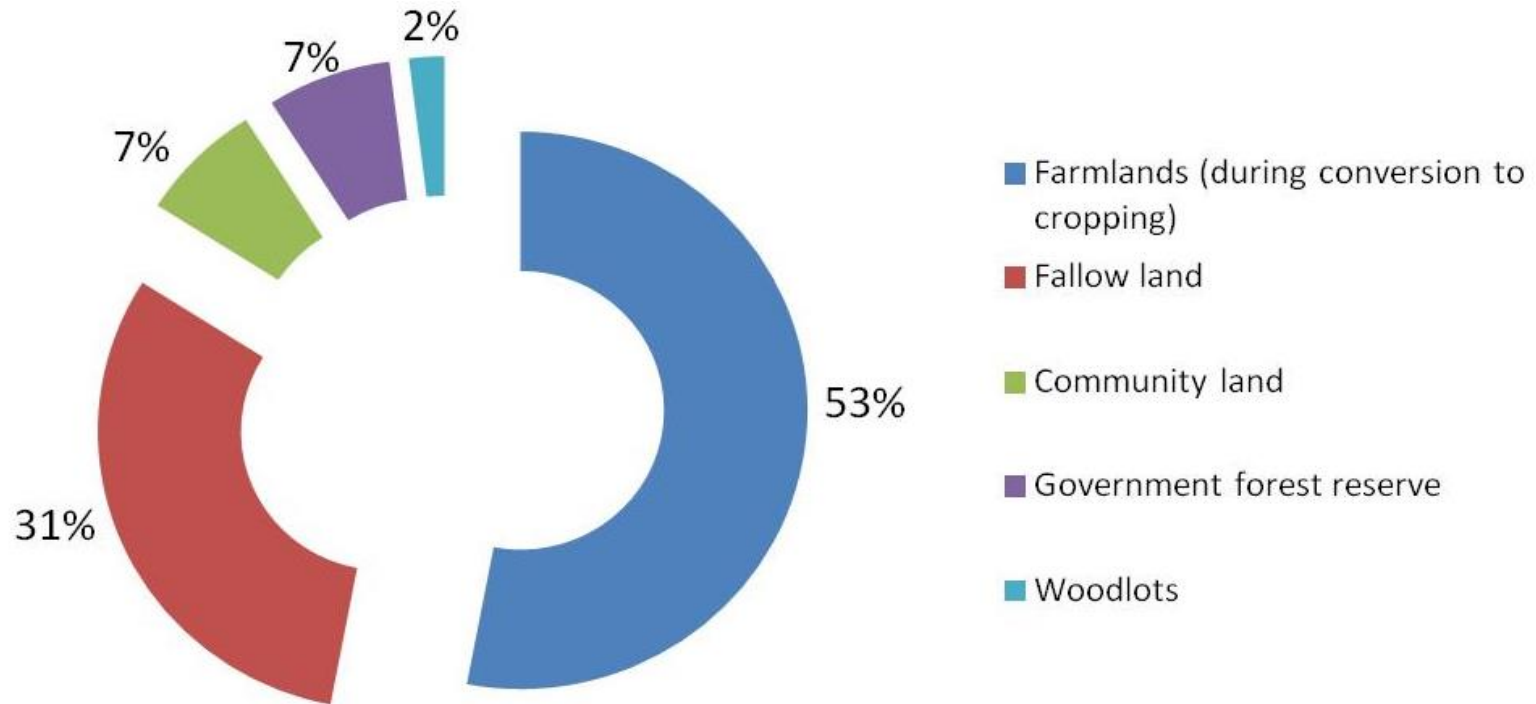
Fuelwood fish smoking



Resource: Sources for charcoal and firewood

■ 98% of producers extract wood for fuel from natural sources

■ 2 million cubic meters per annum (FIP, 2012)

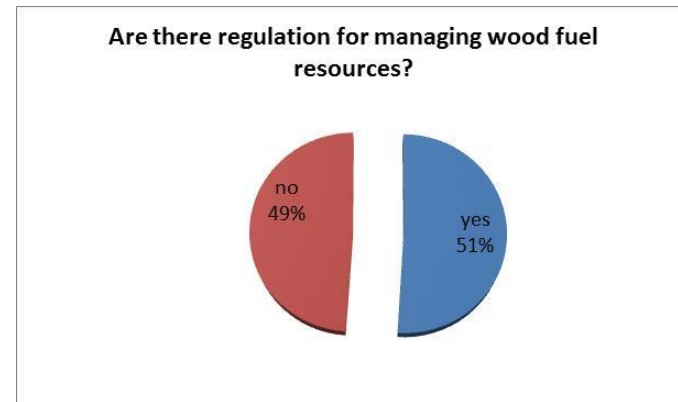




Forestry Research Institute of Ghana

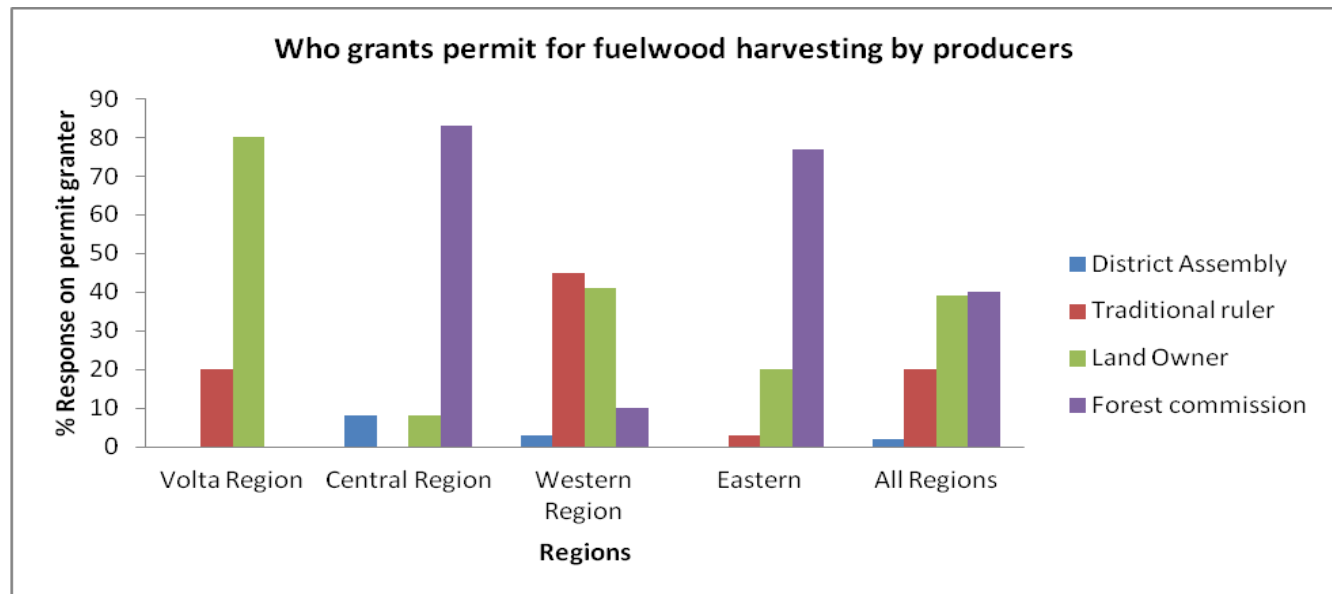
Use and management of resources

- All year round production
- Uncoordinated inter-sectoral efforts for resource management
- **No standard management of fuelwood resources except natural regeneration**
- **Average regeneration age is 7 years (local knowledge)**
- Erosion of traditional conservation measures



RESOURCE GOVERNANCE

- **ACCESS to WOOD FOR CHARCOAL and Firewood**
- Government land: **paid permit from FSD**
 - *Communal land*: **fee paid to chief by gangs/ no payment by locals**
 - *Family land & Farm land*: **sharing agreement for in-kind payment with charcoal produced**
 - **Farmland- Firewood: Pay Owner or owner harvest for sale**
 - **Woodlots –Firewood- Pay Owner or owner harvest for sale**



Species extracted

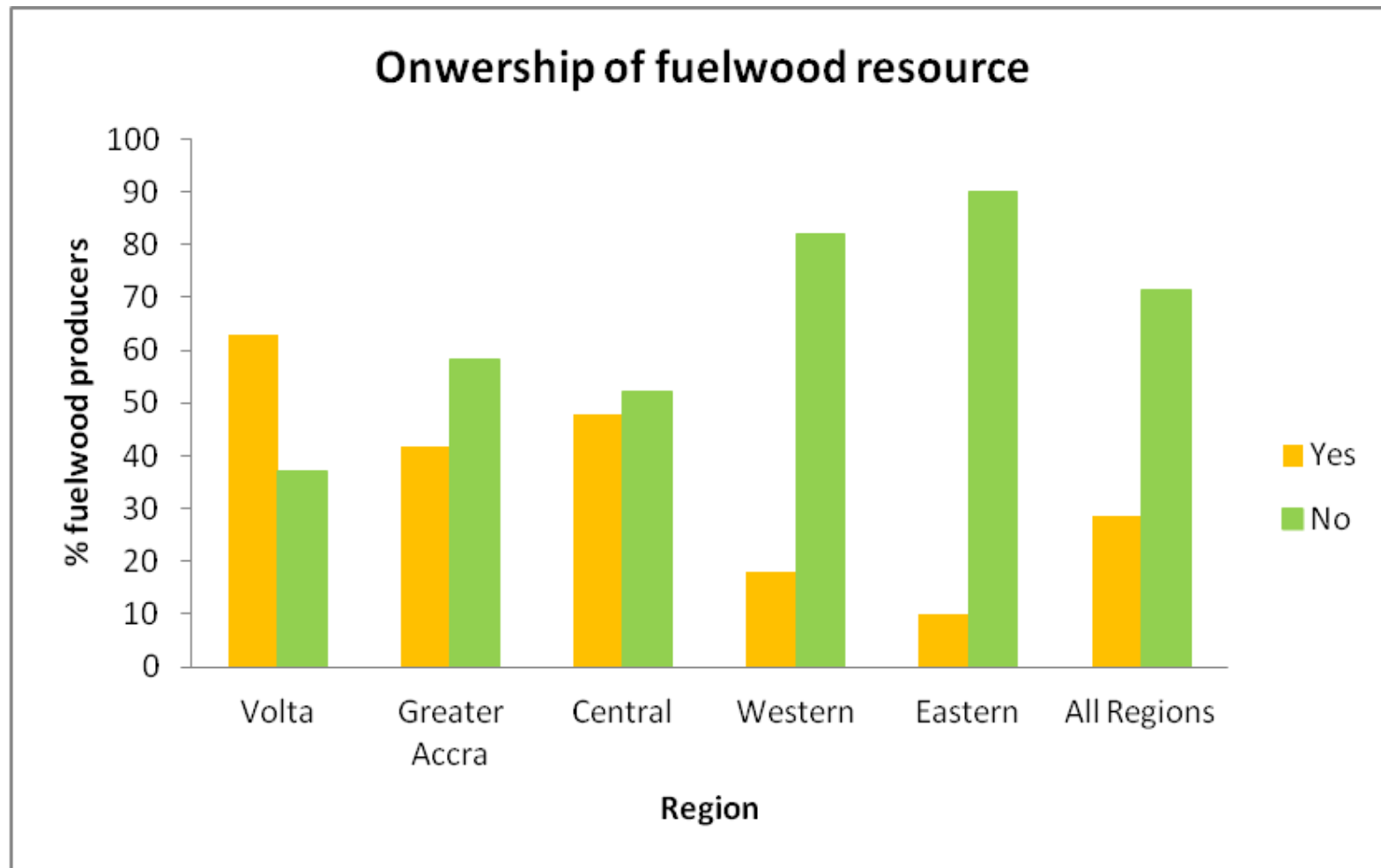
- 70 species reported by producers being extracted for fuel around Ghana
- Most frequently extracted are native hard wood species
 - with high calorific values
 - Anogeissus, Ptericarpus, *Vitellaria paradoxa*, Khaya, Etc- **transition and savannah**
 - , Celtis, Albizia- **Forest Zones**
 - Mangroves, Neem, Cassia- **Coastal**

Obiri et al 2014 and 2015

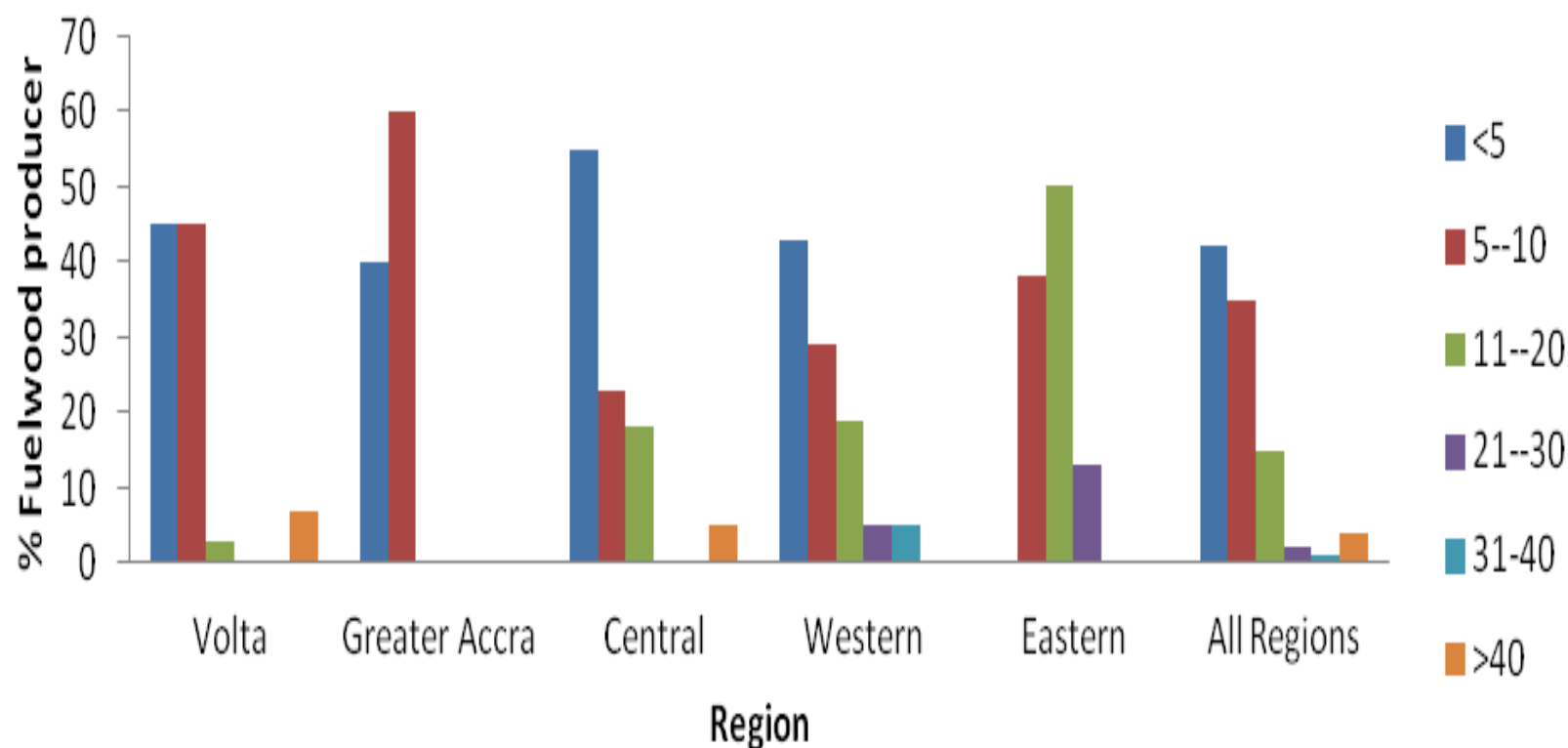


Forestry Research Institute of Ghana

OWNERSHIP OF FUELWOOD RESOURCES



Fuelwood plantation sizes owned by producers



IMPORTANT SPECIES

VR-Mangrove: Fuelwood, construction



CR, GAR-Albizia (Okoro) : firewood, timber



CR, GAR- Celtis (Esa) : firewood, timber



WR-Rubber: latex and firewood



GAR, CR, VR- Neem: firewood, medicines



WR, CR-Cocoa: chocolate and firewood



VEHICLES IN FUELWOOD TRANSPORT

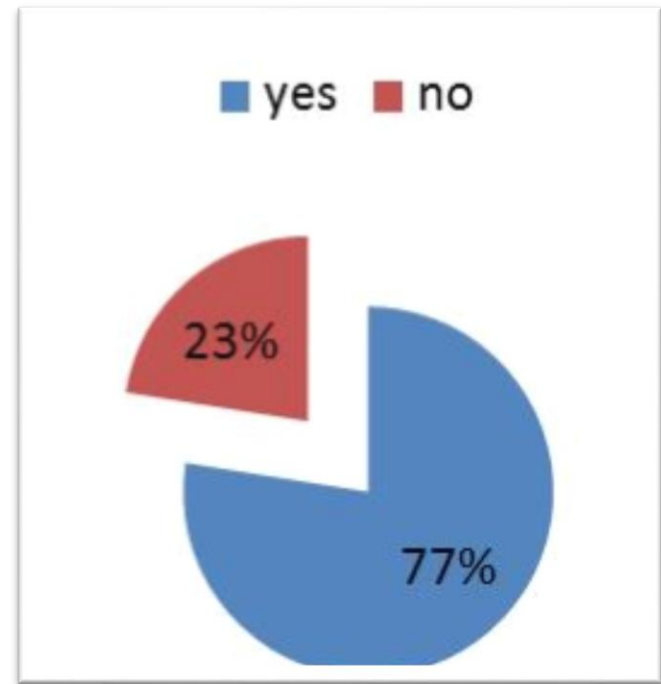


Wood fuel species availability

❖ Declining stocks of preferred fuelwood & charcoal species

Commercial producers

➤ 5-20km to harvest wood for charcoal

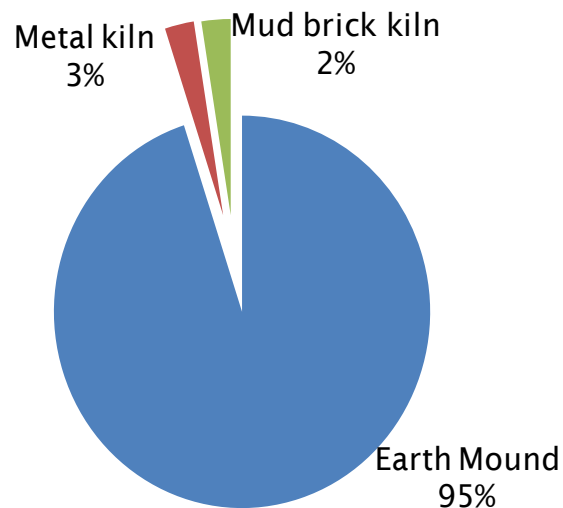


Production technologies -Firewood

Chainsaw & Machete/cutlass for harvest and cross cutting into chunks
Axe for splitting for use



PROCESSING TECHNOLOGIES



Earth mound



Brick kiln



Metal kiln

🌍Economics: profitability

Profitability	Earth Mound	Brick kiln	Metal kiln
NPV (GH¢)	2,400	3,240	22,290

PRODUCTION CAPACITY-Earth mound

- 1- 4 or more mounds set to burn for one production cycle in 10-15 days
- Average mound size: **43-76m³**
- Wood volume per mound: **3-7.5**
- **Output per cycle** (producer reported figures)



Mean (40kg bags)	116
Min	2
Max.	700
STDEV	122
N	204

***Min** = subsistence producer to supplement farm income

****Max** = commercial production by gangs



Forestry Research Institute of Ghana

DISTRIBUTION AND MARKETING

- Packaging in 40/20 kg bags
- Distribution/Transportation
 - **150- over 300 (40kg) bags charcoal per truck**
- ❖ **Road accidents common from toppling**
- ❖ **75% distributed within Ghana urban markets**
- ❖ **Rest for regional and international markets**

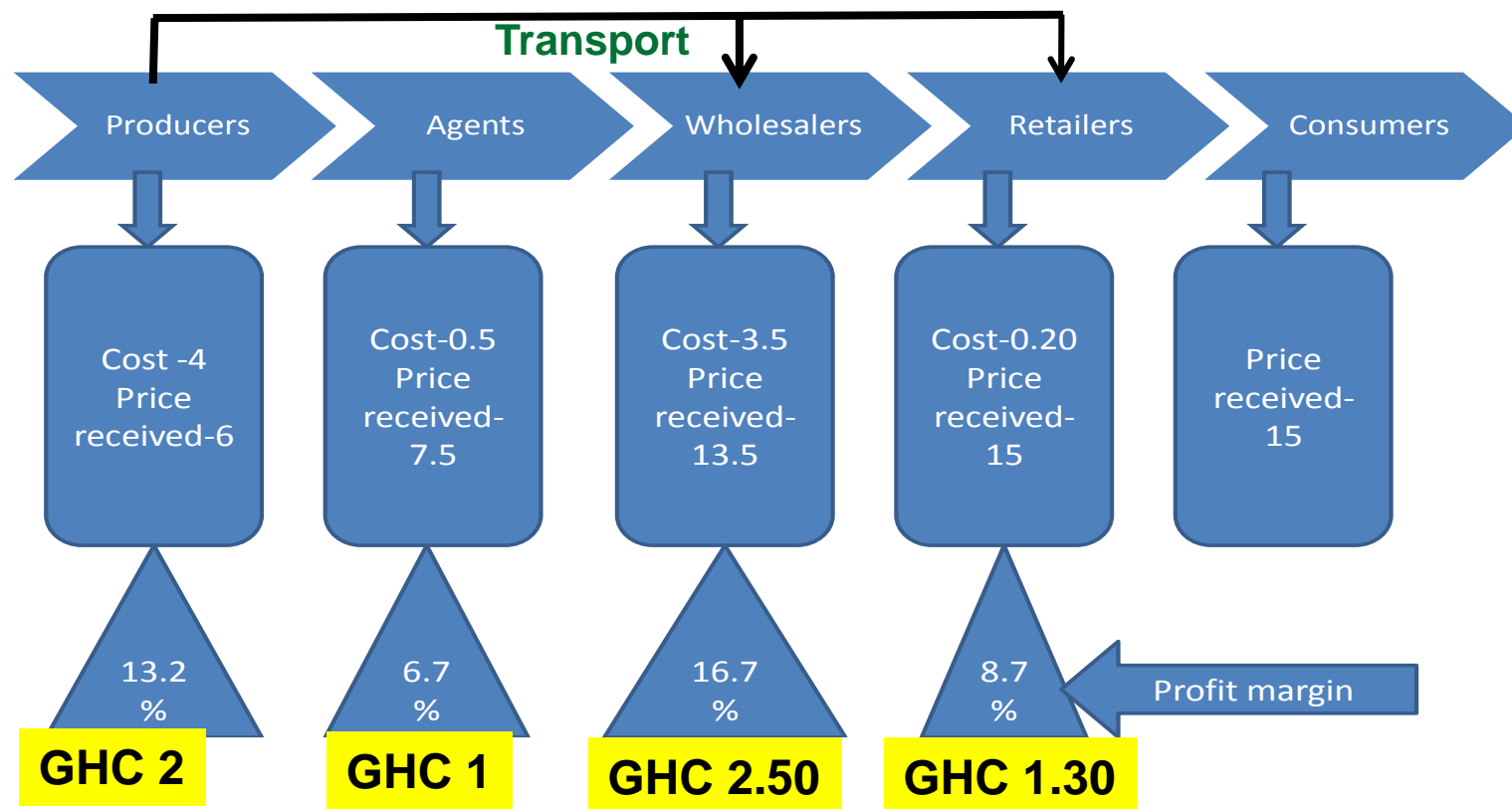


Marketing: Mangrove Wood



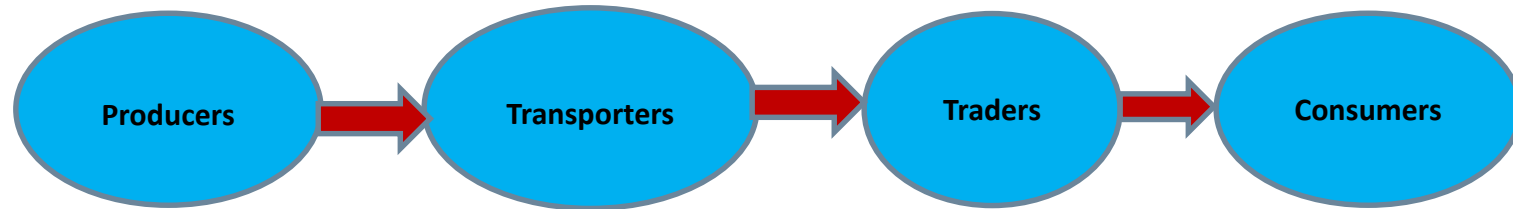
PROFITS ALONG THE CHARCOAL VALUE CHAIN

- ❖ Marginal profits per unit of bag
- ❖ Less than 1USD PER 40 KG BAG gained at each node
- ❖ Wholesaler earns highest = 16.7%



Profit along the firewood value chain

**All regions :
BUNDLE OF
FUELWOOD**



Selling price (GHC)

2.5

4.8

8

Percentage share of
selling price

15.40

35.40

49.20

Value addition (GHC)

1.50

0.80

0.70

Net profit (GHC)

1

1.5

2.5

Percentage share
of profit

20

30

50



Forestry Research Institute of Ghana



CONSTRIANTS ALONG THE CVC

1. 80% producers report decreasing feed stocks

- All year round production
- Uncoordinated inter-sectoral efforts for resource management
- Climate threat



Creaming wood for charcoal in Ghana savannah woodlands



Forestry Research Institute of Ghana

CONSTRAINTS: TECHNOLOGY

2. Inappropriate harvesting techniques leading to:

- Poor coppicing or regeneration of natural stumps



Constraints-Firewood VC

- No storage, wood left in the open to rot at marketing and consumption sites
- Poor energy content

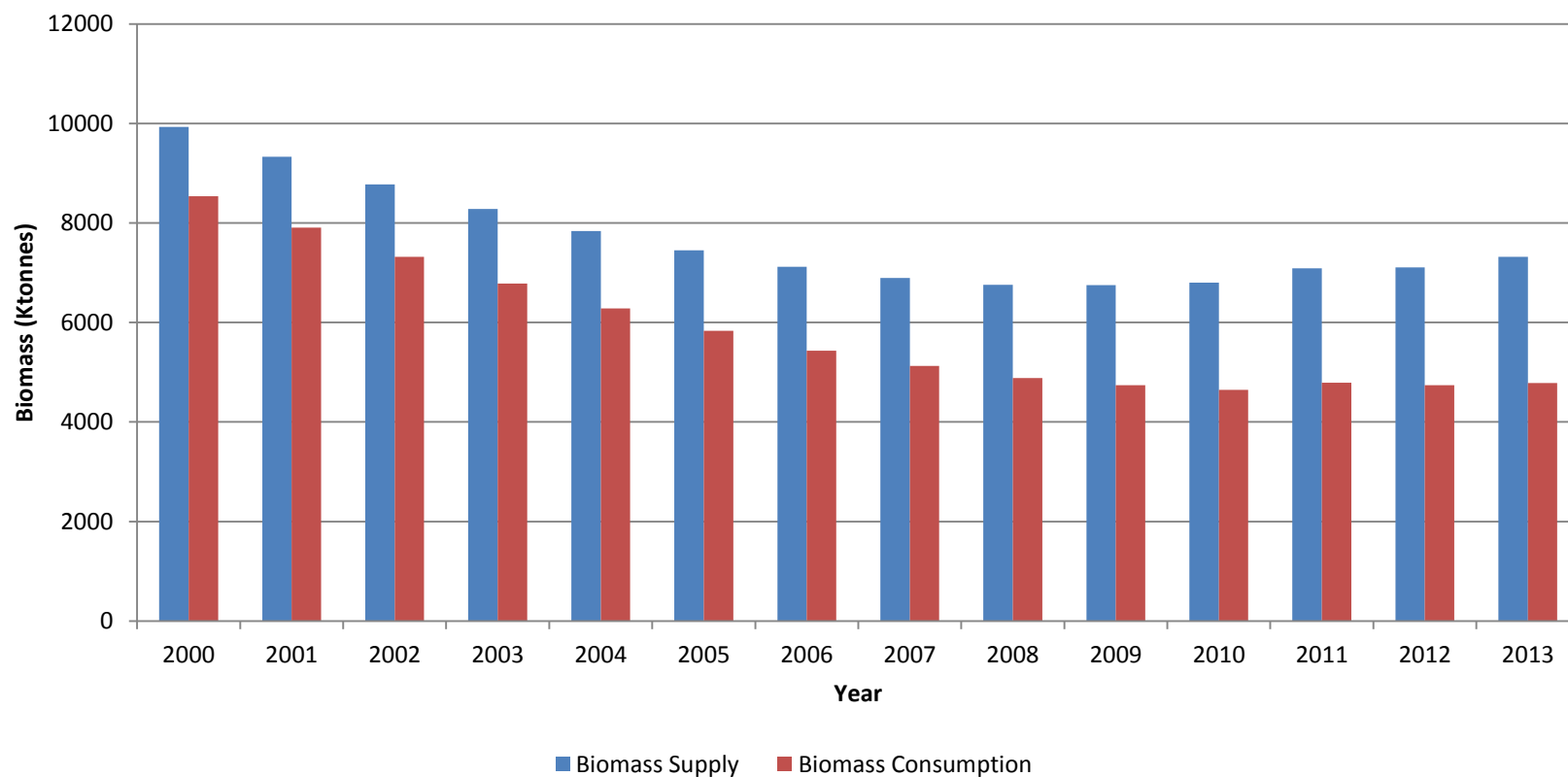


Forestry Research Institute of Ghana

Constraint-Production & Consumption

❖ Supply-demand Surplus

➤ **Surplus may include waste**



Forestry Research Institute of Ghana

3. RUDIMENTARY PROCESSING TECHNOLOGY

90% producers report drudgery and health hazards

- Smoke, heat and dust from traditional earth mound charcoal production
- ❖ **95% producers lack knowledge on improved kilns**



4. Constraints -Transportation

- 75% Poor road network –road accidents
- 60% high transport cost



5. Constraint marketing and utilization

- **98% traders report Poor Quality charcoal and packaging produces** charcoal dust on markets



- **90% consumers report poor quality, burns quickly with lots of ash**
 - Species of low calorific wood values being burnt for charcoal due to **scarcity of suitable hard wood species**



Forestry Research Institute of Ghana



CONCLUDING REMARKS

- Charcoal production is viable with available technology based on NPV values
- Commodity chain is well established **BUT:**
 - ❖ Process is very labour intensive and has health risks
 - ❖ Profit margin per unit is less than a dollar. Hence, several mounds set to burn wood from wide range of species escalating deforestation
 - ❖ Improved processing technologies may reduce health risks and are more profitable but:
 - Improved kiln is expensive compared with earth mound
 - Raw material must be guaranteed
- Possibility of briquette production from charcoal dust



CONCLUDING REMARKS

● **Need for plantation wood to sustain charcoal and firewood industry is imperative as suitable species are declining in natural stands**

■ **Charcoal firewood production from woodlot is viable** But:

- Sufficient land resources required if production is to be sustainable throughout the year
- Species used must be fast growing at least 3-5 year rotation and of comparable energy values to preferred species
- Attention paid to soil and rainfall regimes

(Obiri et al., 2014 and 2018)



Forestry Research Institute of Ghana



Dedicated Bamboo plantations for carbonization into charcoal and briquette

- Commercial plantations
- Hectare and production scales unknown



Dedicated plantations for energy: **Miro project**

- Located in Ahanti Region
- Production of biomass and charcoal for domestic and international market
- Better packaging



Dedicated plantations for energy: **Neem woodlot**

- Located in Ashanti Region
- Producing charcoal from Neem using Japanese retort kiln



Neem plantation



Neem wood packed in a kiln prior to carbonization

Dedicated plantations for energy-**APSD-Project**

- ❖ Located in Atebubu in BA
- ❖ Plans of 21,000 ha of energy plantations
- ❖ 9,000 planted



APSD tree nursery



APSD Eucalyptus plantation



Forestry Research Institute of Ghana

Dedicated plantations for energy: **Cassia and Neem for charcoal and food**

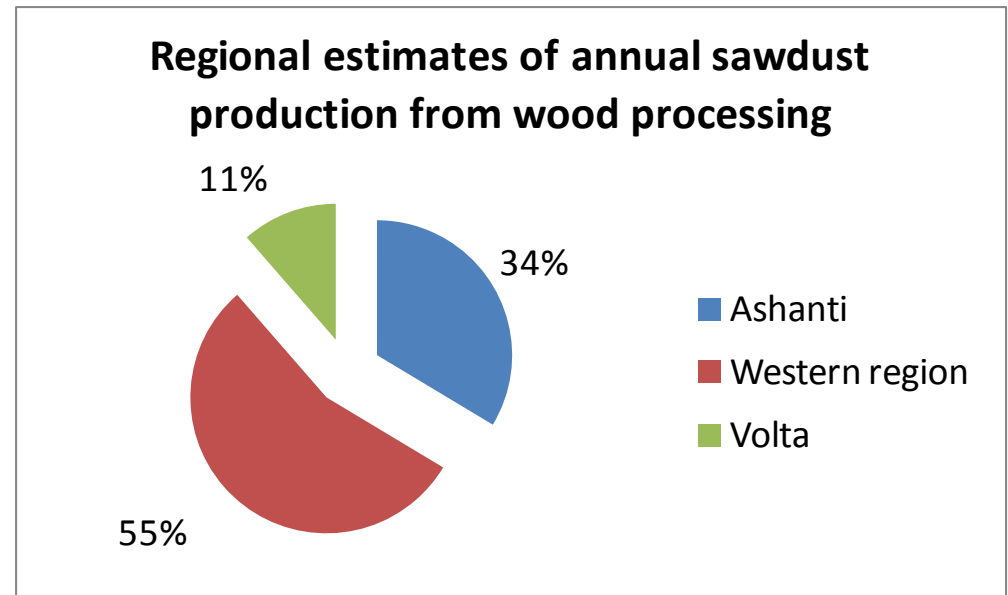
- Located in Volta Region
- 60 acre land for crops and wood
- Charcoal production using brick kiln



Forestry Research Institute of Ghana

Sawdust for co-generation to heat and electricity

- In use by large scale sawmills
- Obsolete and inefficient Machinery
- 60% sawdust not used may be burnt causing pollution



Essential Gaps

- Empirical information on volumes of wood energy resources and flows
- Economics
- Strategic management of resources-models
- Efficient technology research & deployment
- Efficient use of waste and residues
- Policy – Practice linkages
- ETC

ACKNOWLEDGEMENT

1. Funds

1. Danida-PEN -2007-2011 (Economics of rural forest dependency)
2. Inbar-China-2011 (Market chain analysis-Bamboo for fuel in Ghana)
3. CSIR-FORIG-Ghana government-2012-(Emerging woodfuel spp.)
4. EU & Tropenbos Ghana-2012-2014-(Charcoal value chain)
5. SNV-Ghana -2015 (Fuelwood value chain)
6. International tropical timber organization (ITTO), Japan-2013-201
7. **FAO-training in rapid appraisal of Bio-energy systems-2017**
8. German Research and Education Ministry-2018-2019 -**RE PILOT**

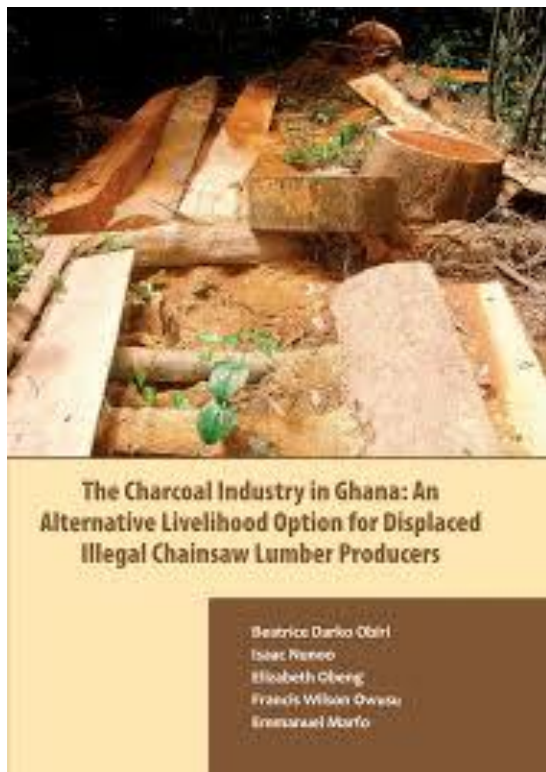
- ❖ Respondents in study areas for information
- ❖ Colleagues researchers-CSIR, FSD, Energy Commission, SNV, KNUST, UNER



Forestry Research Institute of Ghana



Publication



Darko Obiri. B, Owusu-Afriyie, K., Kwarteng E,, Nutakor E, (2015). Fuel Wood Value Chain Report. The USAID/Ghana Sustainable Fisheries Management Project (SFMP). Narragansett, RI: Coastal Resources Center, Graduate School of Oceanography, University of Rhode Island and SNV Netherlands Development Organization. GH2014_SCI011_SNV. 157 pp.



Forestry Research Institute of Ghana

THANKS



Forestry Research Institute of Ghana