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## Monitoring report 2013

### Asubima & Afrensu Brohuma Forest Reserves

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Elaborated by

Authors

Address

Telephone

Fax

Email

Website

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Reference

**Form International**

M. Tollenaar, M. Tanson and  
T. Wanders

Bevrijdingsweg 3  
8051 EN Hattem  
The Netherlands

+ 31 38 444 89 90

+ 31 38 444 89 91

[info@forminternational.nl](mailto:info@forminternational.nl)

[www.forminternational.nl](http://www.forminternational.nl)

1

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# CONTENTS

1. INTRODUCTION .....	2
1.1 Plantation monitoring .....	3
1.2 Monitoring methods .....	4
1.2.1 Extent and forest condition .....	4
1.2.2 Biological diversity .....	4
1.2.3 Forest health .....	4
1.2.4 Soil protection .....	7
1.2.5 Water protection .....	7
1.2.6 Biological diversity .....	7
1.2.7 Rainfall .....	7
1.2.8 Forest production .....	8
1.3 Economic aspects .....	8
1.4 Social benefits .....	8
1.4.1 Social evaluation .....	9
1.5 Conclusions .....	11
APPENDIX 1: FORM GHANA PLANTATION DEVELOPMENT .....	1

## 1. INTRODUCTION

Management is a continuous process. This means that the management will be adapted over time related to changes in the field. To keep track of these changes, Form Ghana applies a system of monitoring in which annually information is gathered. The process of evaluation and adaptation will lead to further fine-tuning of the management plan.

The current report informs on the various monitoring activities that have taken place the past year, and what has been learned from it. As more knowledge is gained on monitoring activities, these are further refined and the setup of the monitoring system will be adapted.

This annual monitoring report is public to allow interested persons to be informed on the progress of Form Ghana and the impact its activities have on the people and the environment in Asubima and Afrensu Brohuma Forest Reserves.

Form Ghana Ltd.

Willem Fourie

General Manager

## 1.1 Plantation monitoring

The objective of Form Ghana is to establish and manage the timber plantation in an ecologically, financially and socially sustainable manner. These management objectives are divided into criteria and for each criterion, a set of measurable indicators are determined as well as the means to verify them (Table 1).

**Table 1. Monitoring framework**

Management objectives	Criterion	Indicator	Verifier
1. Establish and manage the timber plantation in an ecologically sustainable manner with a maximum of 90% Teak and at least 10% of mixed local species with conservation of natural, riparian forest	1.1 Extent and condition of forest	1.1.1 Area planted with Teak	Map
		1.1.2 Area managed as forest plantation / buffer zone	Map
		1.1.3 Changes in planted area	Map
	1.2 Biological diversity	1.2.1 Extent of area protected	Map
		1.2.2 Fauna population and diversity in the forest reserves	Report
		1.2.3. Flora diversity in the buffer zones	PSP
		1.2.3. Existence and implementation of procedures to identify / protect endangered, rare and threatened species	Procedures
	1.3 Forest health	1.3.1 Check of the growth rate of the plantation	PSP
		1.3.2 Check of the growth rate of the Buffer zones	PSP
	1.4 Soil protection	1.4.1 Procedures to protect soil productivity and avoid erosion	Procedures
		1.4.2 Effectiveness of activities undertaken to avoid soil erosion	PSP
		1.4.3 Procedures to avoid impact from work in the forest	Procedures
	1.5 Water protection	1.5.1 Procedures to protect forest and vegetation along water courses	Procedures
		1.5.2 Checking of water quality	Sample analysis
	2. Guarantee financial and economic sustainability through the generation of income from the produced round-wood and carbon sequestration	2.1 Forest production	2.1.1 Harvest of round wood
2.1.2 Comparison of yield with yield tables			Tables
2.1.3 Calculation of current stored carbon in the plantation			Calculation
2.1.4 Calculation of current stored carbon in the buffer zones			Calculation
2.2. economic aspects		2.2.1. Cost benefit of plantation	Table
		2.2.2 Value of wood sales	Sales data
3. Provide social benefits by offering good economic conditions for	3.1 Social benefits	3.1.1 Number of people (partially) depending on the plantation for their livelihood (employees, inter croppers, out growers)	Annual report

employees and the surrounding smallholder community	3.1.2 Training and capacity building for employees, inter croppers and out growers	Table
	3.1.3 Information of the public	Website, stakeholder meetings
	3.1.4 Worker health / Accidents on work floor	Statistics

## 1.2 Monitoring methods

In order to check compliance with the management objectives, Form Ghana has developed a monitoring system consisting of several activities. Different monitoring methods are adopted to optimize verification of different indicators. All indicators are monitored at least once every five years. Specific indicators can be monitored annually or bi-annually.

Each indicator is described in detail in the following paragraphs.

### 1.2.1 Extent and forest condition

By the end of 2012, a total of 3,469 ha of land in Asubima and Afrensu Brohuma Forest Reserves falls under the management of Form Ghana. See Appendix 1 for the development of the plantation over time.

### 1.2.2 Biological diversity

Currently, 14% of the area consists of indigenous vegetation and is actively being restored into its former state as productive forests (Table 2).

**Table 2.** Stratification of Form Ghana plantations

Planting year	Area (ha)	Portion	Species
2001	53	2%	Teak
2008	142	4%	Teak
2009	505	15%	Teak
2010	643	19%	Teak
2011	869	25%	Teak
2012	764	22%	Teak
<i>Subtotal teak</i>	2976	86%	Teak
2008 - 2012	493	14%	Indigenous trees and buffer zones
<b>Total</b>	<b>3469</b>	<b>100%</b>	

### 1.2.3 Forest health

Analyses of forest growth and health as well as soil erosion are based on the PSP measurements taken in the plantation. Every year after planting, additional plots are created in the newly planted compartments. The number of plots will therefore increase yearly.

The basic shape of a PSP is a circular plot with a pole in the centre. GPS coordinates of the pole determine the site location. Each sample plot has a size of 800m<sup>2</sup>. This plot size does not change over time and is the size is chosen so that a plot contains a sufficient amount of trees even after subsequent thinnings.

Height and dbh (diameter at breast height) of the trees in the plots as well as overall health of the plantation is assessed annually.

The measurements taken in these plots are:

- Date of measurement
- Tree diameter at breast height (dbh): the diameter of each tree is measured at breast height with measurement tape or calliper.
- Height: The height of all trees is measured as accurately as possible with a clinometer (Suunto) or a measurement pole;
- Tree health, pests and diseases: it is recorded whether the measured trees are healthy or affected by disease.
- Soil erosion: any visual sign of erosion will be noted (rills, gullies, splash erosion, crusting);
- Undergrowth: A note is written on the amount of undergrowth and the type of undergrowth.

The data from these plots are entered in an Excel sheet, where they are further analysed. A summary of the plots for this monitoring activity is presented below in table 3.

**Table 3.** Plantation area and PSPs per forest type and plant year. Only highlighted strata were measured in 2013 with PSPs.

Forest type	Plant year	Plantation Area (ha)	PSP Area (ha)	# PSPs	Sampling density
Teak plantation	<b>2001</b>	<b>53.4</b>	<b>0.14</b>	<b>7</b>	<b>0.3%</b>
	<b>2008</b>	<b>141.9</b>	<b>1.44</b>	<b>18</b>	<b>1.0%</b>
	2009	505.4	12.16	152	2.4%
	<b>2010</b>	<b>642.7</b>	<b>6.80</b>	<b>85</b>	<b>1.1%</b>
	2011	869.2	8.00	100	0.9%
	2012	647.8			
	<b>(block 20) 2012</b>	<b>116.0</b>	<b>0.96</b>	<b>12</b>	<b>0.8%</b>
<i>Subtotal</i>		2976.4	24.80	310	0.8%
Indigenous plantation	<b>2008-2010</b>	<b>43.1</b>	<b>0.72</b>	<b>9</b>	<b>1.7%</b>
	2011	24.3	0.48	6	2.0%
	2012	78.3			
<i>Subtotal</i>		145.7	1.2	15	0.037
Buffer zone	2001-2010	183.8			
	2011-2012	163.4			
<i>Subtotal</i>		347.2			
<b>Total</b>		<b>3469.3</b>			

In the graph below the average height is compared to the height at various plantation ages taken from the yield table. This allows a comparison of growth speed. It must be noted that the height growth as presented in the yield table is a top height (highest trees from a plantation). This makes the comparison with averages difficult. The contents of table four are discussed in the sections below.

**Table 4. Basic growth statistics**

Plant year	(N/ha) +-		Survival (%) <sup>1</sup>	H (dom) (m) +-		dbh (cm) +-		V (m <sup>3</sup> /ha) <sup>2</sup> +-		G (m <sup>3</sup> /ha) +-	
2001	395	72	-	20.6	1.8	19.9	2.0	81.7	19.7	12.7	2.5
2008	1044	264	-	9.1	1.6	6.3	1.9	11.6	10.5	4.3	2.9
2010	728	217	66%	7.1	1.4	4.1	1.5	2.6	2.7	1.2	1
Block 20 <sup>3</sup>	330	101	-	13.1	3.5	14.7	4.6	26.7	19.9	6.0	4

1: Not calculated because of thinning

2: V is calculated as  $V=N*H_{avg}*G*formfactor$ . Form factors are based on the adapted Ivory Coast yield tables (0.36 for plant years 2008-2011) and on section analysis done in the 2001 plantation (0.36 for plant year 2001) See chapter 4.7

3: Is based only on farmer's teak already present. Teak planted in 2012 by FG is excluded from this analysis.

### Stocking

Most plots of the 2010 plant year represent stocking between 700 and 900 trees per hectare. The average N for 2010 is 728 tree/ha. This is quite low and is about 150 trees per hectare less than last year. More than half of the trees were still smaller than 1.3m high in 2012, compared to 10% this year. Mortality has probably taken mostly place in this tree class. A change from mechanical to chemical weeding could also cause mortality in especially the smaller trees.

With the data available for plant years 2001 and 2008-2011 it is possible to calculate height growth projections over time for the teak stands. The mean Akumadan height growth curve can be compared with the curves of the yield tables. The mean growth curve for Akumadan is currently between yield classes 2 and 3.

### Height

Average dominant tree height as measured from 2009-2013 increases with increasing plantation age. The 2001 plantation has increased with 2.4m as compared to last year's measurement which was, however, considered unreliable. The current dominant height corresponds with a yield class between 1 and 2 of the Ivory Coast Yield tables.

Stands of plant year 2008 and 2010 have grown on average 0.4m<sup>3</sup> and 2.5m<sup>3</sup>. The low figure of 2008 could partly be explained by the fact that most monitoring was done last year in June and time between monitoring moments is relatively short, but it nonetheless still seems only small increase. The dominant height of 2010 planting after three years is relatively high when compared to the 2009 and 2008 planting.

### DBH

The diameter of 2001 has increased between 2011 and 2012. However between 2012 and 2013 the increase was only 0.1 cm which is possibly due to high thinning in which both smaller and larger badly formed stems and trees with bad crowns were taken out. The poorly formed trunks often have a larger dbh than the straight trunks. A commercial high thinning was done in March 2012, but the expected response cannot be seen yet in the monitoring data of 2013. A response in diameter growth is expected during next monitoring in 2014.

### *1.2.4 Soil protection*

On sloped terrain erosion can be a problem, especially on the more sandy soils of Asubima. For this reason we pay special attention to erosions on our roads and in the plantation. Especially in older plantations, erosion can become a problem as the dense crowns can create shade that few understory plants can survive in. By regular and timely thinning this erosion can be kept in check as it stimulates undergrowth.

In the permanent sample plots erosion is checked every time the plot is measured. No erosion was found during PSP monitoring in 2013.

### *1.2.5 Water protection*

Water samples in 2008 showed that all water was polluted to a certain extent with silt and pesticides. Now that all agricultural pesticides except round-up are banned and the vegetation restored this situation was expected to change.

The water quality in Asubima FR was assessed again in 2011 at strategic points where streams enter and leave the plantation. The data showed that the water in the streams is of drinking quality (according to WHO standards) for all factors except iron, colour and turbidity. It shows that the contamination of the water is minimal.

Measurements of hydrological characteristics in streams in Afrensu Brohuma FR in 2013 show that nearly all streams are polluted quite severely. The restoration of the 30 meter buffer zones along the water courses is expected to reduce erosion and prevent chemicals from entering the water, as was observed in Asubima FR.

### *1.2.6 Biological diversity*

The monitoring of biological diversity has started in 2008. In 2011 research on birds, small mammals, butterflies and vegetation in the buffer zones was done. The results of this study are reported in a specific report available on the Form Ghana [website](#).

It is not expected that significant change can be measured on a yearly basis and therefore monitoring of biological diversity was not done in 2013. The next measurements are expected in 2016.

### *1.2.7 Rainfall*

The precipitation in the area was this year measured at 4 points:

- In the nursery
- At fire tower # 1 in the West of the Asubima plantation
- At fire tower # 2 in the Eastern corner of the Asubima plantation.
- At fire tower # 3 in the Afrensu Brohuma plantation

The averages of the four points are shown in

*Table 5.*

The data shows that the rainfall fluctuates around 1100 mm, with a peak in 2010 and low levels in 2009 and 2011. Rainfall in 2013 has increased since 2012.

**Table 5.** Average rainfall in Akumadan.

Month	2009	2010	2011	2012	2013
January	?	0	9	0	0
February	?	54	34	39	77
March	43	50	30	77	131
April	110	184	66	125	107
May	125	119	119	190	168
June	222	162	267	135	63
July	138	309	73	94	155
August	25	63	71	4	15
September	112	106	248	36	239
October	125	258	269	205	99
November	64	28	0	79	63
December	0	27	0	0	0
<b>Total</b>	<b>964</b>	<b>1390</b>	<b>1185</b>	<b>984</b>	<b>1118</b>

### 1.2.8 Forest production

The annual cut is determined by the yield models that have been developed for Form Ghana. To monitor whether thinning and harvesting go according to plan, every year a comparison is made between the planned volumes for commercial thinning and final felling and the realised volumes.

Due to constraints after the initial planting in 2001 of the first pilot piece of plantation, the first thinning which was due in 2004-2005 did not take place. The plantation has continued to grow and trees that could not support the stiff competition have died naturally. The density of the plantation went down from 1111 to a mean density of 790 trees per hectare. In 2012 a catch-up thinning has taken place to reduce the stem density to about 450 - 550 trees per hectare in the higher growth areas. An approximate average of 4.8 m<sup>3</sup> per hectare was thinned.

The expected response cannot be seen yet in the monitoring data of 2013, possibly due to high thinning in which both smaller and larger badly formed stems and trees with bad crowns were taken out. A response in diameter growth is expected during next monitoring in 2014.

## 1.3 Economic aspects

In 2012 commercial thinning has taken place in the 2001 pilot plantation and 4184 billets are sold with an approximate volume of 257 m<sup>3</sup>. 10 % of the standing tree value (STV) has been paid to the Forestry Commission and traditional landowners according to the benefit sharing agreement.

## 1.4 Social benefits

Workers and management of Form Ghana have been trained on various subjects such as the use of phytosanitary products, the application of first aid, fire fighting, nursery techniques, plantation techniques, use of the chain saw, monitoring, GIS mapping and FSC. The number of people in permanent employment has risen from 127 in 2010 to 288 in 2013 (see table 6).

**Table 6.** Employees hired by Form Ghana

Contract	2010	2011	2012	2013
Permanent	127	173	182	288
Casual	300	400	224	289
<b>Total</b>	<b>427</b>	<b>573</b>	<b>406</b>	<b>577</b>

The local population and other interested parties have been kept up to date through the organisation of stakeholder meetings (2 times). Form Ghana has signed an intercropping agreement with 101 people in 2012, which is less than the 131 in 2011. This could be because the area of the cleared and planted land by Form Ghana was smaller than in 2011.

Form Ghana has an agreement with the national Health Insurance Company of Ghana, insuring all permanent workers of free access to medical care. An onsite professional nurse assists people not feeling well or injured in the plantation. The nurse can assess the persons, treat them if it is a simple problem or forward them to the hospital in Akumadan or Techiman. The nurse is also responsible for the renewal of the first aid training and for checking the contents of the first aid boxes.

During 2013, medical treatment has been issued 971 times in Akumadan, which is less than the 1192 times in 2012 and 1352 times in 2010. In Berekum, 1126 medical treatments were given out in 2013. The main disease encountered on both locations is malaria. After malaria, most treatments were given to people with musculoskeletal pain.

#### 1.4.1 Social evaluation

In 2012 a social and environmental impact assessment (SEIA) was done in Afrensu Brohuma. Form Ghana intends to plant at least 90% of the area with teak (*Tectona grandis*). Approximately 10% of the total amount of trees planted will be indigenous. These indigenous trees will be planted throughout the plantation and in the buffer zones bordering the waterways. Considering the highly degraded current state of the forest reserve, the consultants and relevant stakeholders concluded that these efforts are likely to have a positive impact on the environment as well as on the local society.

The intended forest cover has the potential to enhance water, soil, forest and general ecological integrity (biodiversity), and provide a sustainable source of income and other goods and services for local communities. The report and results can be found on the Form Ghana [website](#).

Elders of the communities remember the original forest to be rich, with a large wildlife population even in the forest outside the reserve. However, illegal logging, hunting, farming in the forest reserve and wildfires have totally degraded the forest.

Therefore, fire education was given in and around the Form Ghana areas. As the use of fire has become part of their lifestyle, all communities were advised to use fire with great caution. Loss of soil fertility due to fire is widespread as farmers are compelled to use chemical fertilizer to augment crop yields. Community members were advised not to leave any fire unattended to, even before leaving farms for their homes. Recalcitrant members are to be reported to the appropriate authorities for sanctioning and redress. Farmers can ask for free assistance of Form Ghana on fire issues when needed during land preparation.

In general, the communities expressed great appreciation for the collaboration during the yearly fire education program in the communities and also promised to keep fire out of the communities and the forests.

## 1.5 Conclusions

- The planting of Asubima & Afrensu Brohuma has gone quicker than initially planned and all the terrain allocated to Form Ghana has been planted. The area under natural vegetation or indigenous plantation has grown to 493 hectares (14%).
- The annual rainfall was highest (1390 mm) in 2010, decreased in 2011 and decreased again (984mm) in 2012. In 2013, rainfall increased again to 1118mm, which is about average for the area.
- Growth is better than was expected in some of the areas. However, some of the plots also fall in areas with lower performance than expected. The plantation is in this stage still too young to make conclusions on growth expectations.
- The activities of Form Ghana have a positive effect on the availability of paid employment in the region. It is perceived as aiding significantly to the restoration of the forest and it's various services.
- The mean growth curve for Akumadan is currently between yield classes 2 and 3.

# APPENDIX 1: FORM GHANA PLANTATION DEVELOPMENT

