

The Cocoa Certification Program and Its Effect on Sustainable Cocoa Production in Ghana: A Study in Upper Denkyira West District

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Abstract

The impact of voluntary standards and certification schemes on the sustainability of cocoa production of Ghana was studied in the Upper Denkyira West District (UDW) of Ghana. Three schemes including UTZ Certified, Rainforest Alliance (RA) Certified and Conventional systems of production was used for the study. Soil chemical analyses (pH, Carbon, Organic matter, Available P and Exchangeable K) were carried out in 15 farms under each of the production system. The percent shade trees cover and economic indicators (B/C Ratio, NPV and IRR) per acre size cocoa farm were determined.

Keywords: Cocoa, certification systems, UTZ certified, Rainforest Alliance certified, conventional farms

1. Introduction

Initiatives for social responsibility are originating in different sectors and corporations, and relations between market, state and civil society are changing (Cashore *et al*., 2007; Klooster, 2010). In production, individual producers as well as whole supply chain are addressed as responsible for environmental impact of production (Carter and Carter, 1998; Vermeulen and Seuring, 2009). Initiatives to create more sustainability therefore have an increasing focus on the supply chains, which can be define to encompassing all activities associated with the flow and transformation of goods from raw material stage, through to the end user, as well as the associated information flow (Seuring and Muller, 2008). The supply chains of multinational companies and retailers have become ever-more complex, with raw materials and other product inputs being sourced from producers in every corner of the globe. At the same time, concerns about climate change, natural resource scarcity, and labor practices have made sustainability and corporate responsibility the watchwords of the day for many firms. To address the lack of innovation, low returns and perceived lack of production sustainability, voluntary standards and certification systems have emerged as a promising means for addressing sustainability and corporate responsibility in Ghana's cocoa sector in complex global market place. Certification systems typically evaluate and audit – according to environmental and/or social sustainability standards - the processes or methods by which products are produced. Sustainable certification initiatives create incentives for farms and firms to improve their environmental and socioeconomic performance (Giovannucci and Ponte, 2005; Rice and Ward, 1996). In theory, certification enables the consumer to differentiate between goods and services based on their environmental and social attributes. This improved information facilitates price premiums for certified products, and these premiums, in turn, create financial incentives for farms and firms to meet certification standards.

1. 1 Objectives

The primary objective of the study is to evaluate the impacts of voluntary standards and certification schemes on the sustainability of cocoa production in Upper Denkyira West District of Ghana. The study specifically seeks:

a. To determine the levels of soil chemical properties (soil pH, organic carbon, soil organic matter, total nitrogen, available phosphorus and exchangeable potassium) between systems of production.
b. To determine the extent of shade trees percent cover on cocoa farms.
c. To determine profitability estimates between UTZ Certified, Rainforest Alliance Certified and Conventional systems of production.

1. 2 Justification

The reputation of chocolate and confectionary companies is at risk due to the consumers' increasing concerns about social, environmental and economic issues in the cocoa chain. Cocoa is in fact, ideally suited for sustainable production and social change. The major players in the market are just a handful of transnational companies. They are well placed to act as major drivers of change and bring about a more sustainable cocoa sector. The cocoa industry invests vast sums of money at only one end of the chain: the consumers, and on one topic: branding. The industry has grossly underestimated the situation at the other end of the chain: the cocoa bean producers. Nevertheless, encouraging developments are taking place, producers, governments, industry and consumers increasingly recognize the importance of sustainable cocoa production. In the Netherlands, all the stakeholders in the chocolate sector signed an agreement, in March 2010, to source only sustainably produced cocoa for the Dutch market (ICCO, 2010a).

2. The Cocoa Industry in Ghana

In Ghana, cocoa has played an important role in the local economy of the country for over one century. Although the crop was believed to have been brought to the colonial Gold Coast - as Ghana was then known - from Fernando Po, (an island in the Gulf of Guinea, off the coast of Gabon), in 1879 and from Sao Tome in 1886, records show that in 1891, only twelve years after its first arrival, cocoa was being exported as a cash crop (Acquaah, 1999; Adjinah and Opoku, 2010). From the 1910/1911 season, Ghana became the leading cocoa producer in the world, a position it held until 1977, when it was overtaken by the Ivory Coast. The country went from being the number one cocoa producer to a period in the early 80s when as a result of drought, bushfires, low producer prices, diseases and general economic malaise, fell to the twelfth position and produced less than 160,000 metric tons in the 1983/1984 season (Adjinah and Opoku, 2010).

2.1 Standards and Certification Systems

Private, voluntary standards for sustainable production emerged long before a link was made to certification. In fact, standards for organic agriculture were developed as early as the 1920s. These standards represented the translation of a philosophical approach to agriculture into a set of standardized growing practices. The standards emerged from bottom-up, local standards that were developed independently around the world, led mainly by groups of farmers. Over time, these local standards were brought together, and a more unified, though not identical, interpretation of organic agriculture and the principles and criteria underlying it emerged. The International federation of Organic Agriculture Movement (IFOAM) was established in 1972 as a communications network among the various organic agriculture initiatives. Since then, many other systems have emerged, following diverse pathways. The emphasis on environmental, social, and economic/business issues in the standards varies. Social and economic issues are important in Fair-trade. Economic and business issues are highlighted in the Roundtable on Sustainable Palm Oil (RSPO) and the Round Table on Responsible Soy (RTRS), as well as schemes such as UTZ Certified. All standards pay attention in varying degrees to the environment, with some focused on health and safety issues (e.g., Global G.A.P.) and others more on conservation (e.g., the Rainforest Alliance – Sustainable Agriculture Network, or SAN-RA) (Potts *et al.*, 2007).

2.2 Rainforest Alliance / Sustainable Agriculture Network (SAN)

The Rainforest Alliance was founded in 1987 in response to the massive deforestation and extinction of many species in tropical rainforests throughout Central America in the 1980s. Its first programs, launched in 1989, focused on responsible forest management (SmartWood) and environmental education (Conservation Media Center, later the Neotropics Communications Center). The first agriculture standard (ECO-OK) for bananas came into being in 1990, followed by coffee (1995), citrus and cocoa (1997), which laid the groundwork for establishing the Conservation Agriculture Network (1998), now called the Sustainable Agriculture Network (SAN). SAN's mission is to be a global network transforming agriculture into a sustainable activity with a vision of seeing a world where agriculture contributes to the conservation of biodiversity and sustainable livelihoods (SAN, 2009).

2.3 UTZ Certified

"UTZ", means "good" in the Mayan language Quiché in Guatemala. UTZ Certified began as an initiative in 1997 under the Dutch Ahold Coffee Company, along with Guatemalan coffee producers, to create transparency along the supply chain and reward responsible coffee producers. At the time, there was a growing demand for assurance of responsibly grown coffee, and UTZ Certified recognized the need to provide roasters with the tools to do so. In 2002, UTZ Certified became an independent organization and has since expanded to other commodities (cocoa, tea, palm oil) to create an open and transparent market for agricultural products, as well as sustainable supply chains.

3. Study Area

The Upper Denkyira West District (UDW) is located at the north western part of Central region with latitude 6°09°N and longitude 2° 09°W. Temperatures are generally high throughout the year with mean monthly temperatures ranging between 26°C - 30°C and mean annual temperature of 27°C. Double maxima rainfall regime is experienced in the district. The total annual rainfall is between 1250 mm and 1750 mm. The major rains occur between April and July whilst the minor rains occur between September and December. Relative humidity is high about 80% in the raining season and 20% in the dry season. Owing to the climatic conditions experienced in the district, the vegetation is naturally semi – deciduous forest. Its economy depends largely on agriculture with about 80-90 % of the population depending directly or indirectly on Agriculture.

3.1 Soil pH

Soil pH was determined in 1: 2.5 suspensions of soil and water using a pH meter. Twenty grams soil sample was weighed into 100ml polythene bottles. To this 50 ml distilled water was added and the bottle shaken for two hours. After calibrating the pH meter with buffer solutions of pH 4.0 and 7.0, the pH was read by immersing the glass electrode into the upper part of the suspension by an electrometric pH meter.

3.2 Soil Organic Carbon

Organic carbon was determined by the Walkley and Black wet combustion method (Nelson and Sommers, 1982). One gram of soil sample was weighed into a 400 ml flask and 10 ml of 1 N potassium dichromate ($K_2Cr_2O_7$) added followed by 96% concentrated sulphuric (H_2SO_4) acid. Ten (10) ml of 85% ortho-phosphoric acid (H_3PO_4) and 2 ml of barium diphenylamine indicator were added. The solution was titrated with 1.0 N ferrous sulphate ($FeSO_4$) for a colour change from blue to bright green end point. A blank titration was carried out without soil. Percentage carbon was calculated as:

$$\% \, C = \frac{1NFeSO4 \times (V1 - V2) \times 0.39}{W}$$

Where:

I*N* $FeSO_4$ = normally of $FeSO_4$ used for titration; V_1 = ml for blank titration; V_2 = ml for sample titration

W = weight of soil sample used; 0.39 = 0.001×100% ×1.3 × 3 (3 = equivalent weight of C); 1. 3= a composition factor for the incomplete combustion of the organic matter; Per cent organic matter was obtained by multiplying the per cent carbon by van Bemmelen factor of 1.724

3.3 Total Nitrogen

Total nitrogen was determined by the modified Kjeldahl digestion method (Okalebo *et al*., 1993). In this method, 10g of soil were digested with 30ml concentrated sulphuric acid, using a catalyst tablet of sodium sulphate (2), copper sulphate (1) and selenium (1). Digestion was followed by the Kjeldahl distillation process using 40% caustic soda solution (NaOH) to distil ammonia, which was received into 4% boric acid. Titration was done using 0.1 N HCl.

Calculation:

$$\% \, N = \frac{N \times (a-b) \times 14 \, mcf}{S}$$

Where:

N = Normality of the HCl use in the titration; a = volume of standard HCl used in sample titration; b = volume of standard HCl used in blank titration; S = weight of air-dry sample (g); mcf = moisture correction factor (100 + %moisture)/1001.4 = 14 ×0.001 ×100% (14 = atomic weight of nitrogen)

3.4 Available Phosphorus

The readily available acid-soluble forms of P were extracted with HCl: NH4F mixture. The Bray P1 method was used (Bray and Kurtz, 1945). Phosphorus in the extract was determined by the blue ammonium molybate method with ascorbic acid as reducing agent. Two grams soil sample was weighed into a shaking bottle (50ml) and 20ml of extracting solution of Bray-1 (0.03 *M* NH_4F and 0.025 *M*HCl) was added. The sample was shaken for one minute by hand and immediately filtered through Whatman No. 42 filter. One ml of the standard series, the blank and the extract, 2 ml boric acid and 3 ml of the colouring reagent (ammonium molybdate and antimony titrate solution) was pipette into a test tube and homogenized. The solution was allowed to stand for 15 minutes for the colour to develop to its maximum. The absorbance was measured on a spectronic 21D spectrometer at 660nm wavelength.

Calculations:

$$P \, (mg/kg) = \frac{(a-b) \times 20 \times 6 \times mcf}{S}$$

Where:

a = mg/l P in sample extract; b = mg/l P in blank; S = sample weight in (g); mcf = moisture correcting factor; 20 = ml extracting solution; 6 = ml final sample solution

3.5 Exchangeable Potassium

Potassium in the percolate was determined by flame photometry (Okalebo *et al*., 1993). A standard series of potassium was prepared by diluting 1000mg/l of potassium to 100mg/l. Portions of 0, 5, 10, 15, and 20ml of the 100ml standard solution were put into 200ml volumetric flask respectively. One hundred millilitres of 1.0 M NH_4OAcsolution was added to each flask and made to volume with distilled water. The standard series obtained were 0, 2.5, 5.0, 7.5, 10.0 ml/l for potassium. Potassium was measured directly in the percolate by flame photometry at wavelength of 766.5 nm 1.0 M KCl solution added. The bottle was capped and shaken for 2.0 hours and then filtered. Fifty millilitres (50ml) portion of the filtrate was taken with a pipette into a 250 ml Erlenmeyer flask and 2-3 drops of phenolphthalein indicator solution added. The solution was titrated with 0.1 M NaOH until the colour just turned permanently pink. A blank was included in the titration.

Calculation:

Exchangeable K $(cmol^{+}/\ kg\ soil) = \frac{(a-b) \times 250 \times mcf}{10 \times 39.1 \times S}$

Where:

a = mg/l of K in the diluted sample percolate; b = mg/l of K in the diluted blank percolate; S = air – dried sample weight of the soil in gram; mcf = moisture correcting factor; 39.1= Molar mass for potassium

3.6 Shade Trees per cent Cover per Acre

One (1) acre size farm was demarcated and number of trees counted. The processes were replicated three times and average number of shade trees per acre determined. The percent shade trees cover per acre was determined by dividing average number of trees by minimum of shade per acre (six trees per acre). The ratios were multiplied by 100 percent to estimate percent shade cover on the farm per acre.

3.7 Experimental Designs and Data Analysis

Randomized Complete Block Design (RCBD) with five blocks was used for the experiment. It was replicated five times. All soil chemical analysis data collected were subjected to Analysis of Variance (ANOVA) and LSD at 5% by GENSTAT was used to compare the significance difference among the means. The profitability indicators estimated were benefit-cost ratios (BCR), net present values (NPV) and internal rates of return (IRR). A 10% discount rate was used in assessing the profitability of the technology (Gittinger, 1982). The IRR determines the discount rate that makes the net present worth of the incremental net benefit stream or incremental cash flow equal zero. The formal selection criterion for the net present value is to accept investments with NPV greater than zero. An investment is technically and economically feasible if the NPV is positive. The decision rule for BCR is that for any project to be economically viable, the ratio must be greater than unity.

Table 1: Economic indicators used for profitability assessment

Profitability Indicator	Formula	Decision Criteria
BCR	$\frac{\sum Bt}{(1+r)^t} \div \frac{\sum Ct}{(1+r)^t}$	BCR ≥ 1.0
NPV	$\sum_{t=0}^{t=n} \frac{(Bt-Ct)}{(1+r)^t}$	NPV≥ 0
IRR	$\sum_{t=0}^{t=n} \frac{(Bt-Ct)}{(1+r)^t} = 0$	IRR ≥ r

B = benefit, C = cost, t = time in years/production period, r = discount rate, n = rotation length in year

4. Soil Chemical Properties

The soil chemical analysis used for the study were soil pH, soil carbon (C), soil organic matter, (OM), per cent total nitrogen (N), available phosphorus, (P) and exchangeable potassium (K).

Table 2: Levels of soil chemical properties in UTZ Certified, RA Certified and conventional farms

Treatments	pH	C %	OM %	N %	Avail. P mg/g	Exc. K $cmol^+/kg$
UTZ Certified 1	6.01	2.028**a**	3.524	0.196	7.520	0.540
UTZ Certified 2	5.26	2.214	3.446	0.24	7.540	0.440**b**
UTZ Certified 3	6.55	2.413	3.452	0.238	11.05	0.436**b**
Average	**5.94**	**2.218**	**3.474**	**0.225**	**8.703**	**0.472**
Rainforest Alliance 1	6.15	2.472	3.556	0.248	8.440	0.708**b**
Rainforest Alliance 2	5.54	2.650	3.198	0.222	8.630	0.574
Rainforest Alliance 3	6.07	3.830**a**	3.578	0.22	7.590	0.591
Average	**5.92**	**2.984**	**3.444**	**0.230**	**8.220**	**0.624**
Conventional 1	5.67	0.988	1.098	0.196	2.890	0.142
Conventional 2	6.20	0.911	1.140	0.224	2.590	0.104
Conventional 3	6.02	1.092	1.016	0.238	2.150	0.164
Average	**5.96**	**0.997**	**1.085**	**0.219**	**2.543**	**0.137**
Significant level	n.s	*	*	n.s	**	*
LSD (0.05)		0.692	0.437		4.801	0.228
CV (%)		10.3	2.7		40.8	26.1

n. s - no significant * - significant P<0.001 ** - significant P<0.005, a and b - significant between UTZ Certified and RA Certified

The level of percent C was significantly (P<0.001) higher in Rainforest Alliance Certified (2.984%), followed by UTZ Certified (2.218%) than the conventional farms (0.997%). The percent OM content was significantly (P<0.001) higher in UTZ Certified (3.474%), followed by Rainforest Alliance Certified farms (3.444%) than Conventional farms (1.085%). Also, the exchangeable K was significantly (P<0.001) higher in Rainforest Alliance Certified farms (0.624 $cmol^+/kg$), followed by UTZ Certified (0.472 $cmol^+/kg$) than Conventional farms (0.137 $cmol^+/kg$). However, available P was significantly (P<0.005) higher in UTZ Certified (8.703 mg/g) followed by Rainforest Alliance farms (8.220 mg/g) than the Conventional counterpart (2.543 mg/g). With the exception of the Rainforest Alliance Certified 3, percent C was significantly (P<0.001) higher than UTZ Certified 1 (3.830% and 2.028%) respectively. The exchangeable K of Rainforest Alliance Certified 1 was also significantly (P<0.001) higher (0.708$cmol^+/kg$) than UTZ Certified 2 (0.440 $cmol^+/kg$) and UTZ Certified 3 (0.436 $cmol^+/kg$). All soil chemical properties analyzed for the study were not significantly different for UTZ Certified and Rainforest Alliance Certified farms. The pH and total N content were not significantly different for in all the systems of production.

4.2 Shade Tree Percentage on the Farm

Table 3: Percent of shade tree cover on cocoa farms per acre

Respondents status	Average number of Trees per acre	Average shade tree cover/acre %
UTZ Certified	1.54	25.67
Rainforest Alliance	1.60	26.67
Conventional	1.37	22.83

The minimum biodiversity management scores for shade trees cover on the cocoa farm is 40% (or 6-9 trees per acre) shade cover. In table 3, all systems of production recorded below the 40% shade tree cover on the cocoa farm per acre. The percent score of Rainforest Alliance (26.67%) was higher than UTZ Certified (25.67%) and conventional farms (22.83%). The little variation between conventional and RA Certified and UTZ Certified farms overall, pointing to the likelihood that, for early periods of certification, there is usually little or no effect on these measures. As such, biodiversity scores within study were a function of both the number of trees per acre and the variety of tree species present on the farm. The results of low shade tree cover in cocoa plantations in the studied were due to results from several studies at Cocoa Research Institute of Ghana (CRIG) in which shade and fertilizer levels were varied which led to extension recommendations to reduce or entirely eliminate shade trees and apply fertilizer (Ahenkorah *et al*., 1974; Ahenkorah *et al*., 1987). This low shade recommendation was widely followed in the rapid expansion of the sector in the 1980s and 1990s. However, fertilizer recommendations have largely been ignored due to a combination of underdeveloped fertilizer and credit markets in Ghana (Gockowski and Sonwa, 2008).

4.3 Farm Profitability Estimates - Cost and Benefit Analysis

Table 4: Summary of profitability estimates for three cocoa production systems at 24% discount rate

Economic Indicator	Conventional	Rainforest Alliance	UTZ
B/C Ratio	1.18	1.34	1.26
Max NPV (GH¢)	139.8	184.11	163.27
IRR	30.50%	54%	52%

Economic indicators estimated are the B/C ratio, NPV and IRR. The discounted cash flow results presented in Table 4 show that cocoa production is, in general, profitable at 24% discount rate. However, the conventional system is the least profitable although it has the longest rotation. The certification effect decreased the BCR, NPV and IRR with 1.34, GH¢184.11, and 54% respectively in the Rainforest Alliance system to 1.26, GH¢163.27, and 52% respectively in the UTZ system, although both systems exhibit greatly improved financial performance compared to the conventional system of 1.18 (BCR), GH¢139.8 (NPV) and 30.5% (IRR). Duguma *et al*. (2001) reported that, even with no value assigned to the tree species, cocoa production in smallholder systems in Cameroon was profitable, with production being more profitable with planted shade trees. Many certification systems require environmental management techniques that sometimes reduce yield. In some cases, the cost savings and any premium earned (even through guaranteed-premium systems like Fairtrade) might not make up for that loss in yield. Overall, the effects of standards on yield and quality are variable and difficult to attribute to the standard per se, since most study designs are confounded by possible differences in pre-existing conditions.

5. Conclusion

The study established that the impact of voluntary sustainability initiatives (VSIs) on soil chemicals properties (C, OM, P and K) were significantly higher in UTZ and RA farms, however, soil pH and N had no significant impact among the treatments. The study also established that there was little evidence that certification on the observed farms had a significant effect on key indicators such as biodiversity and shade trees coverage. On the economic frontier, the study concludes that, with conventional cocoa farms, cocoa production is profitable. The introduction of cocoa certification greatly enhances profitability. To increase the value of the certification process on sustainable cocoa production in Ghana, several actions need to be undertaken: the generation of an internal and on-going measurement system among farmer groups in collaboration with local institutions; the development of an open access database on sustainability initiatives for policy-makers and producers in order to enable more strategic business, risk and quality management in the adoption of sustainable practices. Nursery centers for recommended shade trees must be established in all cocoa districts by appropriate institutions such as Forestry Commission, Forest Research Institute of Ghana and other stakeholders in the supply chain to be distributed to farmer to increase shade tree cover on their cocoa farms.

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Appendix A. Analysis of Variance (ANOVA) Table – Soil Chemical Analysis

Variate: %O_M

Source of variation	d.f.	s.s.	m.s.	v.r	F pr.
Block stratum	4	0.1810	0.0452	0.39	
Treatment	8	56.8950	7.1119	61.76	<0.001
Residual	32	3.6846	0.1151		
Total	44	60.7606			

l.s.d. (0.05) = 0.437 CV (%) = 2.7

Variate: %_O_C

Source of variation	d.f.	s.s.	m.s.	v.r	F pr.
Block stratum	4	1.3828	0.3457	1.20	
Treatment	8	19.7983	2.4748	8.59	<0.001
Residual	32	9.2215	0.2882		
Total	44	30.4025			

l.s.d. (0.05) = 0.692 CV (%) = 10.3

Variate: %_TOTAL_N

Source of variation	d.f.	s.s.	m.s.	v.r	F pr.
Block stratum	4	0.041458	0.01036	3.24	
Treatment	8	0.014391	0.00160	0.56	<0.800
Residual	32	0.102342	0.00320		
Total	44	0.158191			

l.s.d. (0.05) = 0.07285 CV (%) = 15.5

Variate: Avail P mg/kg

Source of variation	d.f.	s.s.	m.s.	v.r	F pr.
Block stratum	4	252.75	63.19	4.55	
Treatment	8	397.37	49.67	3.58	<0.005
Residual	32	444.42	13.89		
Total	44	1094.54			

l.s.d. (0.05) = 4.801 CV (%) = 40.8

Variate: K_cmol$^+$/kg

Source of variation	d.f.	s.s.	m.s.	v.r	F pr.
Block stratum	4	0.4146	0.1037	3.30	
Treatment	8	1.9627	0.2453	7.82	<0.001
Residual	32	1.0042	0.0314		
Total	44	3.3815			

l.s.d. (0.05) = 0.2282 CV (%) = 26.1

Variate pH

Source of variation	d.f.	s.s.	m.s.	v.r	F pr.
Block stratum	4	4.4375	1.1094	2.03	
Treatment	8	3.6885	0.4611	0.84	<0.572
Residual	32	17.4796	0.5462		
Total	44	25.6056			

l.s.d. (0.05) = 0.865 CV (%) = 1.4

Appendix B: Study Area

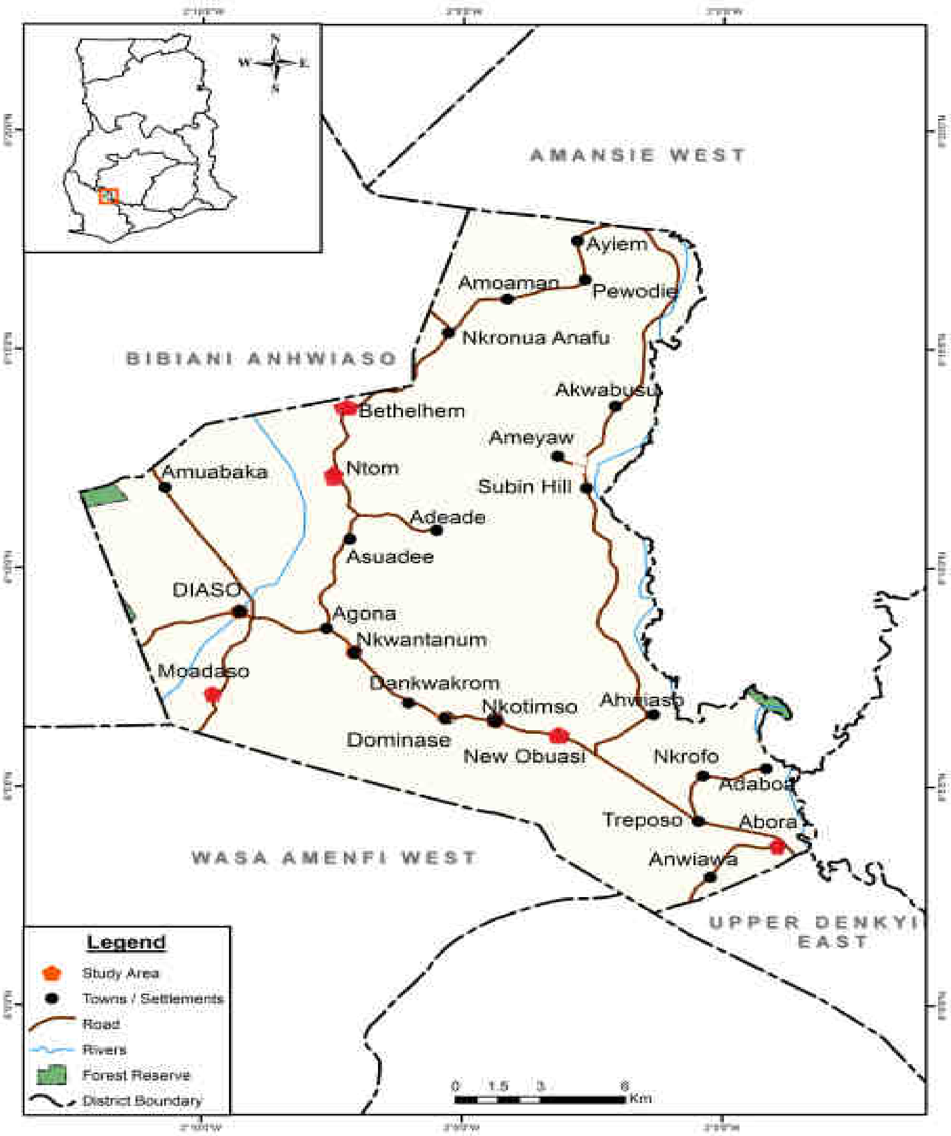

Figure 1: The District map of Upper Denkyira West, Source: Geography Department, UCC