Assigned by the Ministry of Agriculture, Forestry and Fisheries

Base Study on the Impact of the Population on Agriculture and Rural Environment

—REPUBLIC OF GHANA—

Focus on
Ashanti Region

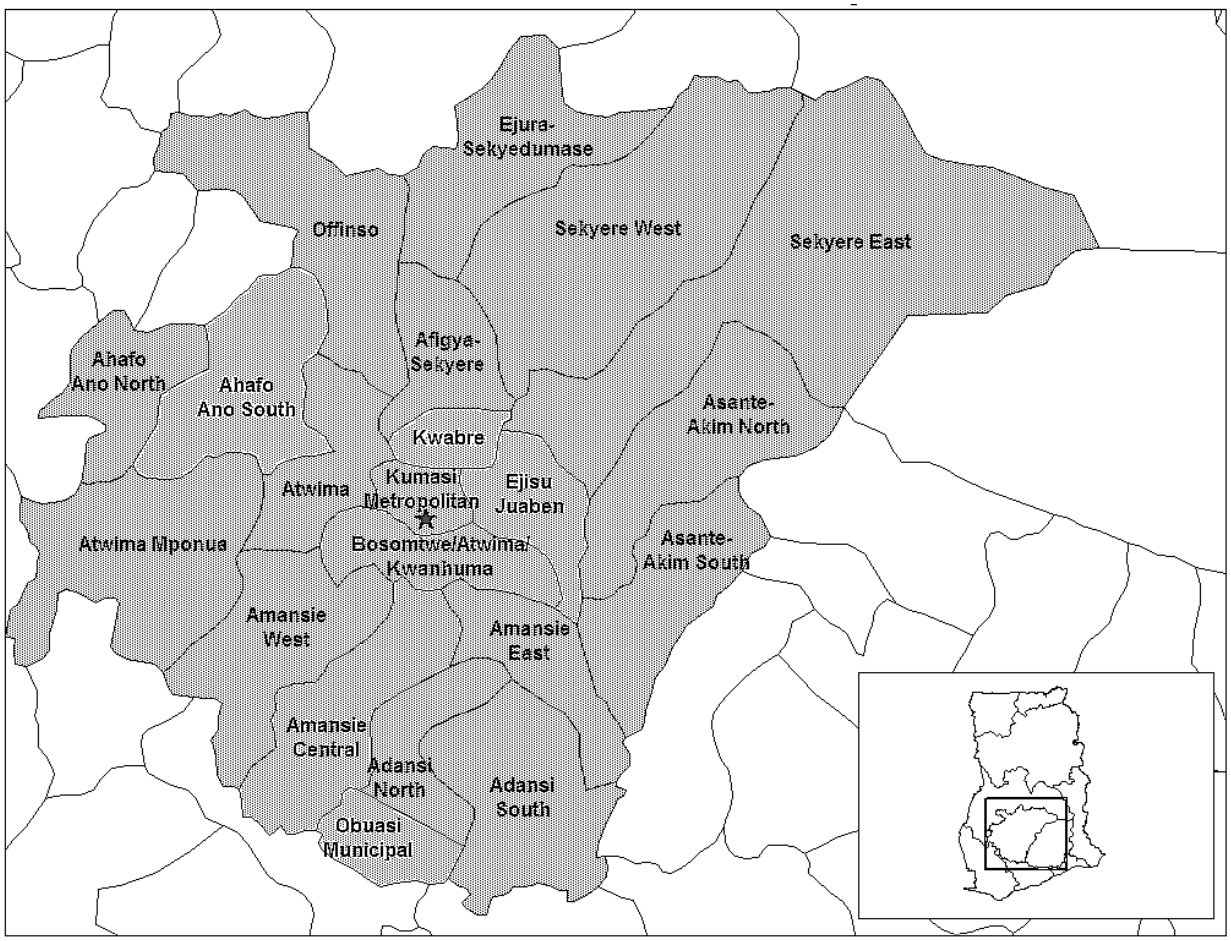
March 2009

The Asian Population and Development Association
(APDA)

Map of Ghana


Ghana
Administrative Divisions
International boundary
Region boundary
National capital
Region capital
Ghana has 10 regions.
0 30 60 Kilometers
0 30 60 Miles
Transverse Mercator Projection, CM 1 W
BURKINA FASO
BENIN
TOGO
CÔTE D'IVOIRE
UPPER WEST
UPPER EAST
Bolgatanga
Wa
NORTHERN
Tamale
BRONG-AHAFO
Sunyani
ASHANTI
Kumasi
VOLTA
Lake Volta
Ho
EASTERN
Koforidua
Volta
Lomé
Bight of Benin
GREATER ACCRA
Accra
WESTERN
CENTRAL
Cape Coast
Sekondi
Gulf of Guinea
Base 803238AI (G00183) 5-07

Map of the Survey Area (Ashanti Region)



A Map of the Surveyed Villages can be found in Figure 2.2 (page 36)

Center:
Hon. Ms. Akua Sena Dansua
Second Deputy Minority Chief Whip
(Ghanaian Parliamentarian)

From right:
Mr. Masanori TAKEMOTO Survey Member
Mr. Emmanuel Obeng
Planned Parenthood Association of Ghana
Monitoring & Evaluation Manager

From left:
Dr. Yuji MIZUKAMI Survey Member
Dr. Takeshi SAKURAI Survey Leader

UNFPA Ghana

From right:
Mr. S. Alhassan
Operations Manager

Mr. M. Bawa Amadu
Assistant Representative

JICA Ghana Office

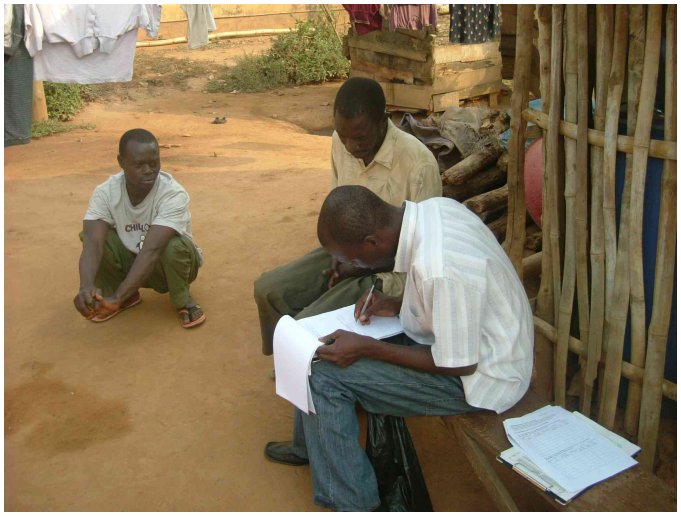
From left to right:
Ms. Megumi TSUKIZOE
Representative

Mr. Masato KUMAGAI
Senior Representative

Mr. Yukinari TANAKA
Assistant Resident Representative

Mr. Mitsuhiro KATO
Researcher(Agriculture, Rural Development)

A Cacao Tree in the Village



Household Survey in the Village

Village Rice Mill

Foreword

This report is a compilation of the results of a survey conducted in the Republic of Ghana (hereinafter "Ghana") by the Asian Population and Development Association (hereinafter "APDA") commissioned by the Ministry of Agriculture, Forestry and Fisheries for FY2008 entitled "Base Study on the Impact of the Population Problem on Agriculture and the Rural Environment." Research and coordination was mainly carried out by the Survey Review Committee which was set up by APDA, under leadership of Dr. Yonosuke Hara, Professor of the National Graduate Institute for Policy Studies.

The reduction of poverty and securing of environmental sustainability are pressing challenges of the Millennium Development Goals that require support from the international community and are positioned as priority issues in Japan's ODA Outline.

The economic climate of African countries remains in a difficult condition due to droughts, food crises and political instabilities which have been afflicting the continent since the independence of many countries in the 1960s. Concurrently, the rapid population increase that these countries are experiencing places a great burden on their national economies that are primarily founded and centered around the agricultural sector.

This project was implemented with the goal of collecting a broad range of information on the impact of population in developing countries through analyzing the correlation between population issues and problems in agriculture, rural areas and environment to understand these issues in an effort to determine the policy of future agriculture, forestry and fisheries cooperation projects, in addition to offering a concrete proposal.

In conducting the survey, local guidance and cooperation was offered by Mr. Francis Yankey, Executive Director of the Planned Parenthood Association of Ghana and Ms. Akua Sena Dansua, a Member of Ghanaian Parliament, and Mr. Tsuyoshi Shigeta, Second Secretary of the Embassy of Japan in Ghana. A great deal of consideration and cooperation was also offered by Mr. Emmanuel Obeng, Monitoring & Evaluation Manager of the Planned Parenthood Association of Ghana.

In Japan, guidance on the content of the survey and assistance in initiating the research was offered by the International Cooperation Division, the International Affairs Department and the Minister's Secretariat of the Ministry of Agriculture, Forestry and Fisheries, for which we hereby express our deepest gratitude.

It is our hope that this report will contribute to the promotion of agricultural and rural development programs in Ghana and effective assistance for such programs by the Japanese Government.

This report has been prepared under the responsibility of APDA and does not reflect any opinion or policy of the Ministry of Agriculture, Forestry and Fisheries, nor of the Japanese Government.

Mr. Yasuo FUKUDA,
Chairperson,
The Asian Population and Development Association (APDA)

Table of Contents

CHAPTER 1
Overview of Economy, Population, Agriculture and Forest Resources in Ghana

1.1 OVERVIEW OF THE GHANIAN ECONOMY

1.1.1 Characteristics and Issues of the Ghanaian Economy

Having been described as the leader and "beacon"[1] in West Africa and of African countries, Ghana has demonstrated high economic growth since 2000. The general principle of the acceleration of changes in economic growth within the economic structure appears to apply to Ghana, as the percentage of the agricultural sector's GDP is decreasing while that of the service sector, including distribution industry, is increasing. One cannot state, however, that significant changes have taken place in the structure of the economy as far as Ghana is concerned. From the macro economy viewpoint, Ghana's economic growth up to present has been excessively dependent on the export of primary products. The country has not been able to completely break out of the monoculture-oriented economic structure as hardly any growth is observed in the manufacturing industry despite the increase in percentage of the service sector. While the direct cause lies in shortage of private capital investment in the manufacturing industry, such an economic environment has been brought about by the existence of large public investment that suppresses private activities.

The enlarged public sector that inhibits the activities of the private sector is attributed to historical factors, including the country's political condition and economic policy of respective administrations after its independence. Following the declaration of independence by Nkrumah, Ghana's successive administrations actively intervened in private capital in their economic management, as characterized by active government involvement referred to as the "interventionist policy regime". The country's economy, however, fell from stagnation to decline owing to considerable political and economic confusion that occurred immediately after independence. Although Ghana had maintained economic strength comparable to Asian countries at the time of independence in 1957, the Ghanaian economy declined thereafter to the extent that it pales significantly in comparison to Asia.

1.1.2 Changes in Post-Independence Economic Policy Regime

(1) Interventionist Policy Regime and Liberal Policy Regime in Economic Policy:

In contrast to the economic policy regime that can be referred to as an "interventionist" policy regime followed by Ghana's successive administrations subsequent to its independence, the economic reform by the Rawlings Administration from 1983 onward adopted a liberal policy regime. In this sense, the Rawlings Administration was an epoch-making system of governance in the history of Ghana.[2] Such handling of the government had its

[1] World Bank (1993).

[2] This classification by dichotomy was made by Fuso and Aryeetey (2008). The viewpoint that divides the period from 1972 to 1983 and the period from 1983

origin in the administration's unique political characteristics of breaking away from the power base relied upon by previous administrations and assuming a strong populist nature. It must be mentioned that these characteristics existed at the backdrop of: 1) massive import of food becoming necessary after the most severe famine in a decade which occurred in 1983 due to drought; 2) more than 1 million Ghanaian workers that had migrated to Nigeria during the 1970s oil boom who were deported and forced to return to Ghana; 3) the reduction of an international balance of payments which occurred due to a sharp drop in cacao prices and skyrocketing oil prices.[3]

A large-scale economic reform was implemented as a result of accepting the Structural Adjustment Programme led by the World Bank and IMF in the liberalistic policy regime of the Rawlings Administration. Foreign capital has been continuously flowing into the country mainly in the form of financial assistance since the introduction of this Structural Adjustment Programme. The initial purpose of the economic stabilization policy of the Rawlings Administration – under the guidance of the World Bank and IMF – was to control inflation and reduce fiscal deficit to prevent "crowding out", i.e. exclusion of the private sector by the public sector.[4] Policies such as subsidy cutback, sale of state enterprises, reduction of public servants, expansion of object taxation, and improvement of tax gathering efficiency were introduced for this purpose.

(2) Evaluation of Rawlings' Economic Policy
Many new policies that had been introduced were evaluated as follows:

Firstly, the austere policy after 1983 was highly praised among the fiscal spending reforms of the Rawlings Administration. In particular, the fact that it maintained Ghana's fiscal spending to 14% of GDP until 1992 is seen to have contributed to securing the stability of macro economy. Attention must also be given to the fact that the percentage of fiscal spending expanded rapidly after 1993 and reached 33% in 1996.

Secondly, agricultural and industrial sectors grew slowly during the structural adjustment and their share in GDP went down. This is attributed to the expansion of the service sector consisting of government, commerce and the tourism industry following the activation of consumption activities that occurred as a result of increased access to imports and inflow of funds made possible by the promotion of liberalization. In other words, the funds went primarily to consumption instead of being invested in production and flowed into urban areas where consumers were concentrated. In fact, Ghana's agricultural sector, which employs half of the country's labour force and is predominantly small in scale, faces many problems in terms of technology and capital, and is an unstable structure seeing as it is dependent on rainwater.

Thirdly, in terms of poverty in Ghana, the improvement of living standards was confirmed for the entire country, including the urban poor and rural areas during the initial stage of the Rawlings Administration. Be that as it may, benefits derived from the series of policies were not uniform when we turn consider the changes that have taken place from 1987 onward with economic

---

onward has been presented on many occasions including Aryeetey et al. (eds.) (2000).
[3] Fosu and Aryeetey (2008), p.50.
[4] Dordunoo (2000), p.91.

improvement not being observed in some parts of the urban poor, for instance.[5] In other words, the management of macro economy by the Rawlings Administration which centered around market-oriented economic reform gave rise to people that are left behind by the market and highlighted the challenges that come under close scrutiny in terms of the issue of poverty.

1.1.3 Challenges of Ghanaian Economy after the Ghana Poverty Reduction Strategy

The Kufuor Administration, which succeeded the Rawlings Administration, set out the Ghana Poverty Reduction Strategy (GPRS). GPRS II is a comprehensive policy guide for coping with the poverty issue that erupted as a result of the criticism of structural adjustment policy. In spite of this, the Kufuor Administration had to simultaneously tackle the accumulating macroeconomic challenges such as the vulnerable macroeconomic base, expansion of chronic fiscal deficit trends, and finance which was dependent on foreign capital.

The Kufuor Administration, which came into office in 2001, tightened the fiscal and monetary policy and demonstrated certain progress through stabilizing the macro economy, namely the lowering of the inflation rate, stabilization of the exchange rate and improving the foreign currency reserve. Improvement of terms in trade and additional improvement of the growth rate were also attained. In fact, real GDP has continued to grow with the annual growth rate rising up to 6.3% in 2007. Real GDP growth rate per capita rose to 4% in 2007 after slumping at approximately 2% after 2000 due to the impact of population growth – it was the highest rate in the decade.[6]

The goal of Ghana's long-term growth strategy, per contra, was to shift from the existing public sector-led growth to private sector-led growth. For this reason, it has been highlighted that the government must determine the combination of policies that would enable such a shift and formulate strategies to implement them. As for the economic issues faced by Ghana today, the points that are often raised include: 1) discipline in control of the fiscal deficit through effective public expenditure management; 2) the development of an efficient and competitive financial sector that can meet the needs of a developing private sector; 3) enhanced effectiveness of public service delivery; 4) policies to transform the agricultural sector, beginning with the land-tenure question.[7] Reasons that have been pointed out for the sluggishness of private investment included chronic fiscal deficit due to absence of fiscal discipline and the resulting inflation, as well as poor infrastructural development.[8] One of the highest priorities therefore is how to go about strengthening fiscal discipline and more efficient allocation. In reality, however, sufficient results have not been attained in this regard.

---

[5] Sarris (1993) p.221.

[6] ISSER (2008) p.7.

[7] Aryeetey and Kanbur (2008), p.2.

[8] For example, IMF (2007).

1.2 OVERVIEW OF POPULATION IN GHANA

1.2.1 The Present Condition and Challenges of the Population in Ghana

Among the African countries demonstrating high population growth rates, Ghana was one of the first countries to recognize the importance of population policies and address this problem. As a result of implementing social policies while conducting a broad range of educational activities within civil society, the country has seen a decline in the population growth rate since the mid-1980s followed by rapid changes in demographic structure. Such changes in population are exceptional among African countries, including its neighbours in West Africa. Creating awareness about the importance of population problem is still carried out today and has become the basic policy of the current national strategy.

The Growth and Poverty Reduction Strategy （GPRS II） also makes reference to population growth. It states that, although Ghana's population growth rate dropped from 3% in 1994 to 2.8% in 2000[9], the country's population growth should ideally keep pace with its economic growth and social development in the future, as that rate still exceeds the diffusion rate of social services and infrastructure development.[10]

As can be seen from the decline in the population growth rate, Ghana is going through the process of a so-called "demographic transition," which refers to a shift from high rate of birth and infant mortality to low rate of birth and infant mortality. Demographic structure changed in Ghana as a result of this fertility transition and the country entered a social phase eligible for "population bonus" where the percentage of the productive-age population (ages 15 to 64 years) increases. This, however, could become the cause of social unrest if jobs are not created due to its vulnerable domestic industry. The country will face an economic challenge of having to absorb the excess labour force that will continue to increase in the future. In this sense, utilization of the population bonus constitutes one of the key issues that Ghana is currently facing.

Moreover, it is not possible to predict how fertility transition, which has been advancing smoothly up to now, would develop in the future because regional disparities clearly exist within the declination degree of Ghana's population growth rate, in addition to the prevalence of high growth rates in rural areas. Moreover, while fertility has declined across the country as a result of rapid fertility transition, the speed of fertility decline has slowed down according to the statistics taken after 2000. Put differently, the scale of changes related to fertility is shrinking; the population growth rate in itself is still at high level despite the slowdown in population growth and may remain at that level.

The decline of the population growth rate is a phenomenon that originally started in the mid-1980s and coincides with the introduction of the structural adjustment policy in 1983 and ensuing economic growth. This is presumed to have resulted from the fact that the population policy was launched in full-scale at the same time as the structural adjustment policy. The mortality rate has been falling consistently in Ghana since the 1920s. The slowdown of the population growth rate that started in the mid-1980s is a noteworthy subject in identifying how the transition of fertility started in Ghana.

---

[9] National Development Planning Commission (2005).

[10] See Section 4.5, National Development Planning Commission (2005).

While one can assume that use of modern contraceptive methods increased with the popularization of family planning in Ghana, no popularization of modern contraceptive methods was realistically observed in Ghana.[11] The view presented that the act of childbirth and the environment surrounding fertility, as well as the social factors including proximate determinants of fertility (e.g. changes in the marital age), changed as a result of economic development and led to a decline in fertility.[12]

This suggests that that the need for family planning has not emerged among the people of Ghana today except for the social class that are benefitting from the economic development, and is corroborated by the fact that fertility rates have not changed in rural areas where no changes in economic and social factors are observed. Supplying family planning equipment to Ghana may not produce sufficient results unless the country's socioeconomic environment is improved. In particular, a large population will reach their reproductive age as a result of past population growth and gives rise to an increase in the number of women between the reproductive age of 15 to 49 years that have the ability to give birth over the next several decades.

In particular, population may increase further in poor regions that are at a disadvantage under the present situation where regional disparities are expanding in terms of advancement of fertility transition, thereby ensuing a cycle of population growth and poverty reproduction with population increasing and poverty expanding as a result. Thus the trend of the reproductive age population in Ghana shall be positioned as a noteworthy theme in considering the tasks of cooperation for Ghana.

1.2.2 Findings of the Survey

There is no dispute over the fact that rapid fertility decline has been taking place in Ghana since the mid-1980s with marked development of demographic transition. However, a recent statistical survey suggests a slowdown in the declining trend of total fertility rate (TFR) in recent years and a possibility of this rate levelling off at a certain stage. It is quite uncertain whether fertility in Ghana will continue to decline in the future resulting in several challenges concerning the method of implementing fertility decline.

Firstly, as indicated by the change in marriage trends, rise in age of first marriage for women at reproductive age since the 1960s has an effect of reducing overall childbirth. Rise in age of first marriage in rural areas suggests that marriage may be changing not only in urban areas but in rural areas as well. However, one cannot be optimistic that such changes in marriage pattern will

[11] According to GHDS, the knowledge diffusion rate of all women between ages 15 and 49 years concerning contraceptive methods was approximately 98% (2003) while utilization rate of contraceptive methods among married women remained at approximately 25% (2003). A study of the utilization rate from 1988 onward shows that the rate had been increasing from 13% (1988) to 20% (1993), 22% (1998) and 25% (2003). Despite the assertion that the use of modern contraceptive methods including condoms is increasing, their use is not increasing in reality compared to the diffusion of knowledge about such contraceptive methods. [ORC Macro (2003)]

[12] S.K. Gaisie (2007)

continue in the future as the age of first marriage has stagnated at a certain level in the recent years.

Secondly, exogenetic factors beyond the control of mothers, such as the deterioration of a hygienic environment (typified by lack of improvement in medical system related to infant health which have manifested in the form of an increase in the infant mortality rate), as well as functional decline of healthcare facilities concerning primary healthcare, have emerged in recent years. In this respect, one can hardly say that the conditions for introducing family planning, including reduction of desirable number of children in the family, are in place.

What kind of policymaking can be provided in these conditions? Implementation of health policies, including family planning and social policies, are important in stabilizing the ever-increasing population.

The real issues consist of policy priorities and the ability to implement policies. The key issues of priority will be the task of positioning and implementing the policies concerning infant mortality and diffusion of family planning. Decline in the infant mortality rate can be expected when priority is given to social policy tasks such as expansion of health facilities with the goal set on improving infant mortality. When priority is given to the diffusion of family planning, it is difficult to expect significant effects under the existing circumstances because the conditions for reducing the desired number of children have not been met in Ghana.

Since the healthcare system in Ghana is not able to develop autonomously, healthcare policies including GPRS II will most likely face enormous difficulties once the flow of capital from overseas is interrupted.

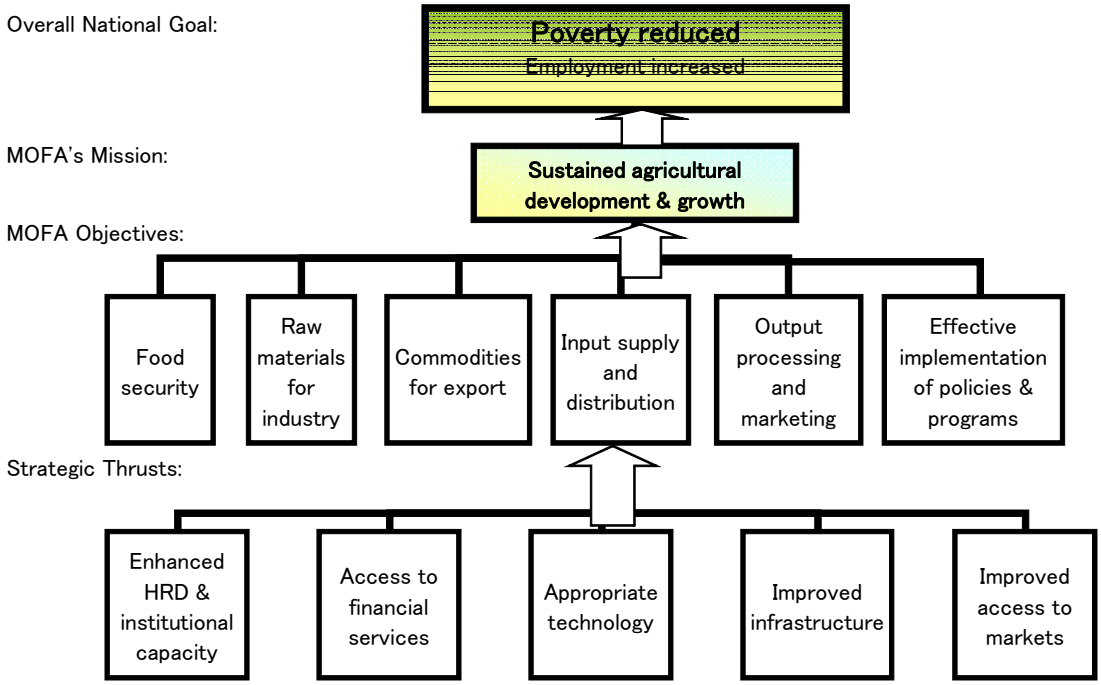
The key lies in the fact that the population cohort from the period when infant mortality declined in the mid-1980s, will be reaching their reproductive age over the next ten years, and this will result in a significant increase in the people of reproductive age. Ghana is therefore entering an extremely difficult period in which the country faces a challenge of whether or not it can maintain the declining trend of population growth rate. Population pressure on Ghana's environment will change considerably depending on the measures that will be taken during this period.

1.3 OVERVIEW OF AGRICULTURE IN GHANA

Ghana's key industries comprise of agriculture, forestry and fishery which accounts for around 40% of the country's GNP and 50% of exports. More than 50% of Ghana's population of 20 million still live in rural areas today. Agricultural productivity remains stagnant as farmers still rely on traditional labour-intensive farming methods. Agriculture in northern regions is essentially dependent on rainwater and is therefore highly vulnerable. On the other hand, rural farms in the forest region of the central-south region produce higher income compared to those in rural areas of the coastal region and those located in the savannah of the northern region, thanks to sufficient precipitation and fertile soil. Regional income inequalities are also widening. Thus, stagnation of agricultural modernization and expansion of regional income inequalities pose the greatest challenge for Ghana's agriculture today.

The Ministry of Food and Agriculture (MOFA), which is the regulatory authority for the agricultural sector in Ghana, formulated a comprehensive development plan for agriculture entitled the "Food and Agriculture Sector Development Policy (FASDEP)" in 2002. As shown in Figure 1.1, FASDEP has laid out systematic strategic targets consisting of food security, raw materials for industry and commodities for export.

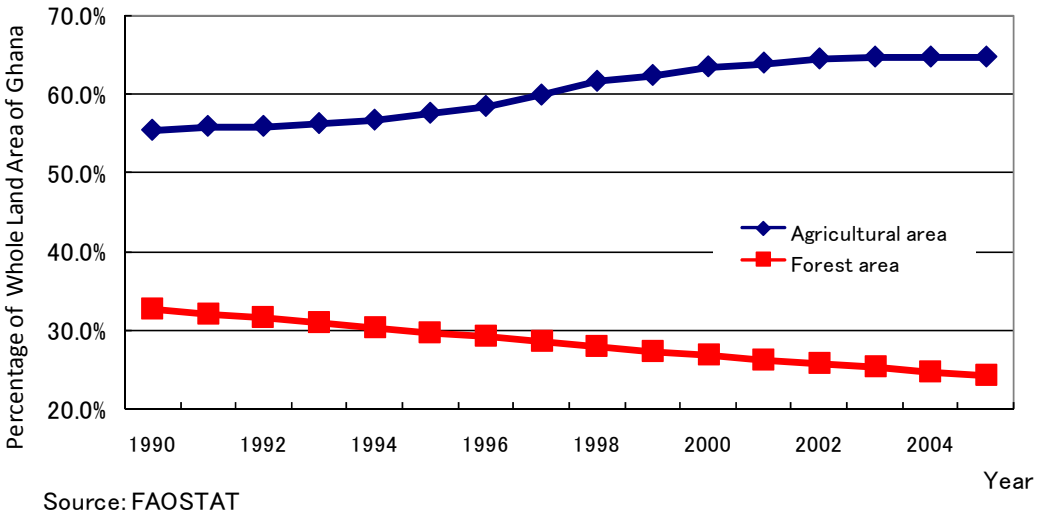
Figure 1.1: FASDEP



Source: Republic of Ghana (2002)

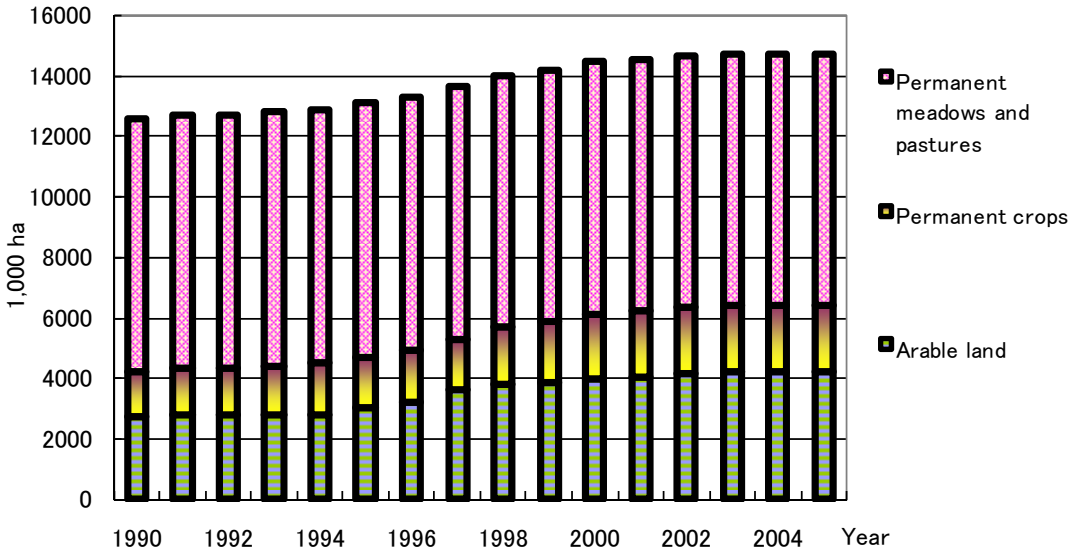
In Ghana, forests are being depleted and farms are expanding to support the country's population (Figure 1.2). Details of the expanding trends of farms are shown in Figure 1.3. The slight increasing in trend of use for permanent crops, as well as permanent meadows and pastures still being the common form of land use, can be observed.

Figure 1.2: Ratio of Agriculture and Forest Area



Source: FAOSTAT

Figure 1.3: Ratio of Agricultural Land



Source: FAOSTAT

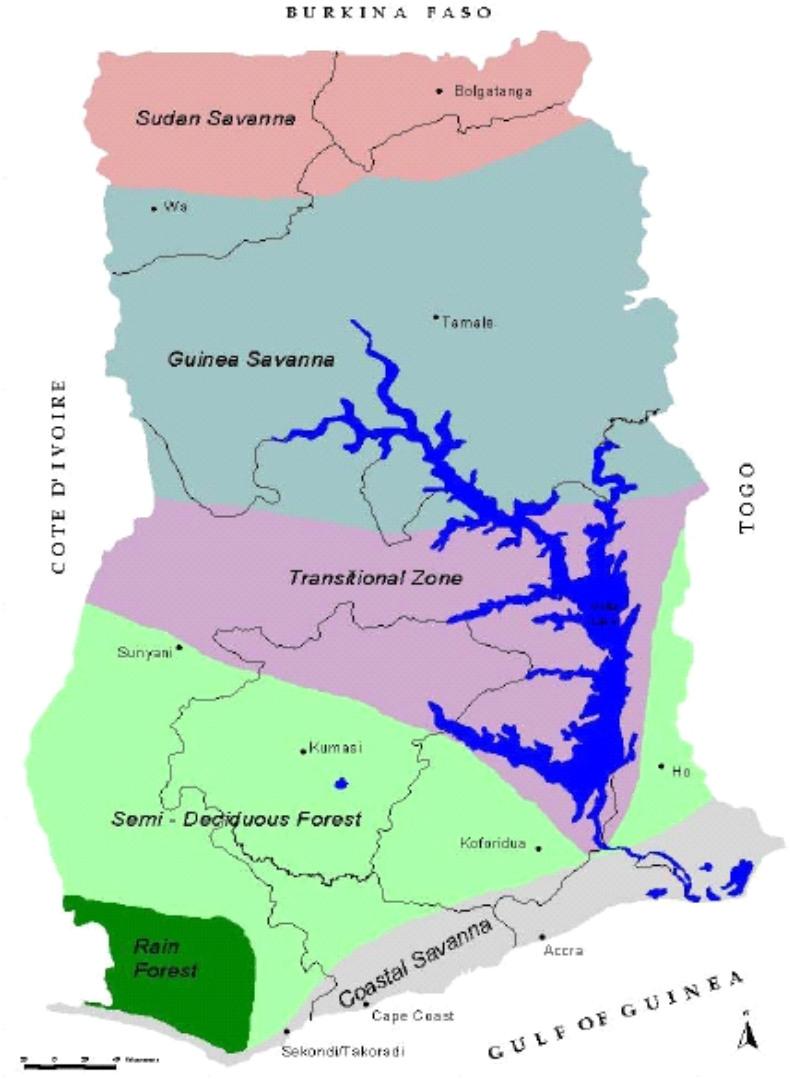
Ghana's climate is largely dominated by the movement of two types of air mass, namely the wet monsoon and dry *harmattan* and, as shown in Table 1.1 and Figure 1.4, divided into 6 agricultural ecosystems.

Table 1.1: Climates in the Agro-Ecological Zones

	Area (km^2)	Mean Annual Rainfall (mm)	Range (mm)	Major Rainy Season	Minor Rainy Season
Rain Forest	9,500	2,200	800–2,800	March–July	Sept.–Nov.
Deciduous Forest	66,000	1,500	1,200–1,600	March–July	Sept.–Nov.
Transitional Zone	8,400	1,300	1,100–1,400	March–July	Sept.–Oct.
Coastal Savannah	4,500	800	600–1,200	March–July	Sept.–Oct.
Guinea Savannah	147,900	1,000	800–1,200	May–Sept.	
Sudan Savannah	2,200	1,000		May–Sept.	

Source: FAO(2005), p.3.

Figure 1.4: Ghana's Agro-Ecological Zones



Source: Samuel Asuming-Brempong (2003)

Harvested area and production volume of major farm products in recent years are shown in Tables 1.2 and 1.3. Cacao is the most important farm product and consistently maintains an overwhelmingly large harvested area that dwarfs that of other crops. The areas for yam and cassava doubled between 1990 and 2000. Harvested areas for oilseed crops such as oil palm and ground peas have rapidly increased from 2000 onward. An increase in the production volumes of yam and cassava has been significant since the 1990s.

Table 1.2: Major Crops in the Harvested Area (ha)

	1990	2000	2005	2006	2007
Rice, Paddy	49,000	115,200	120,000	125,000	120,000
Oil Palm Fruit	100,000	115,000	325,200	333,000	300,000
Yams	119,400	261,000	310,500	300,000	299,000
Millet	124,000	208,000	185,000	200,000	185,000
Groundnuts, with shell	127,000	218,000	450,000	480,000	470,000
Plantains	129,100	244,400	290,000	299,000	302,000
Cocoyam	141,600	247,500	255,000	260,000	261,000
Sorghum	215,200	288,700	305,000	320,000	340,000
Cassava	322,800	660,100	750,000	790,000	800,000
Maize	464,800	694,700	750,000	793,000	750,000
Cocoa Beans	693,249	1,500,000	1,850,000	1,835,000	1,725,000

Source: FAOSTAT

Table 1.3: Major Crops Production (tonnes)

	1990	2000	2005	2006	2007
Rice, Paddy	80,900	248,700	287,000	250,000	242,000
Oil Palm Fruit	850,000	1,066,426	2,024,600	2,097,400	1,900,000
Yams	877,000	3,362,900	3,892,500	3,600,000	3,550,000
Millet	74,500	169,400	185,000	165,000	160,000
Groundnuts, with shell	113,000	209,000	420,000	520,000	440,000
Plantains	799,000	1,932,500	2,792,000	2,900,000	2,930,000
Cocoyam	815,000	1,625,100	1,686,000	1,660,000	1,662,000
Sorghum	135,800	279,800	305,000	315,000	350,000
Cassava	2,717,000	8,106,800	9,567,000	9,638,000	9,650,000
Maize	552,600	1,012,700	1,171,000	1,189,000	1,100,000
Cocoa Beans	293,355	436,600	740,000	734,000	690,000

Source: FAOSTAT

Regional distribution of production volume for Ghana's main food crops is shown in Table 1.4. One can see that main food crops are concentrated in the tropical rain forests of the south that enjoy the favourable natural conditions in terms of climate and soil. In contrast, grains such as rice, sorghum and pearly millet are mainly grown in the savannahs of the north.

Table 1.4: Production of Major Crops in 2007

(Figures in Metric Tons)

	Maize		Rice		Millet		Sorghum		Cassava		Yam		Cocoyam		Plantain		G'nuts	
Region	amount	share	amount	share	amount	share	amount	share	amount	share	amount	share	amount	share	amount	share	amount	share
Western	75,406	6.2%	18,744	10.1%					690,396	6.8%	97,712	2.2%	250,891	14.8%	542,742	16.8%	0	0.0%
Central	176,222	14.4%	4,586	2.5%					1,861,160	18.2%	15,063	0.3%	86,475	5.1%	129,321	4.0%		
Eastern	227,505	18.7%	18,492	10.0%					2,619,247	25.6%	642,001	14.7%	406,960	24.1%	774,253	23.9%		
Greater Accra	2,775	0.2%	2,322	1.3%					56,576	0.6%								
Volta	49,978	4.1%	36,959	19.9%			5,763	3.7%	1,048,075	10.3%	252,930	5.8%	38,909	2.3%	44,454	1.4%		
Ashanti	169,383	13.9%	9,886	5.3%					1,160,603	11.4%	374,615	8.6%	526,268	31.1%	871,141	26.9%	63,165	20.9%
Brong-Ahafo	381,435	31.3%	4,006	2.2%					2,426,982	23.8%	1,946,592	44.5%	380,600	22.5%	871,835	27.0%		
Nothern	88,037	7.2%	62,533	33.7%	40,336	35.7%	50,463	32.6%	354,890	3.5%	791,566	18.1%					68,104	22.6%
Upper West	40,104	3.3%	5,121	2.8%	43,760	38.7%	68,453	44.2%			255,512	5.8%					121,733	40.3%
Upper East	8,756	0.7%	22,692	12.2%	28,946	25.6%	30,157	19.5%									48,772	16.2%
Total	1,219,601	100.0%	185,341	100.0%	113,042	100.0%	154,834	100.0%	10,217,929	100.0%	4,375,989	100.0%	1,690,104	100.0%	3,233,745	100.0%	301,775	100.0%

Source: MOFA-SRID

Table 1.5: Price Differences of Major Crops in Average Wholesale Price in 2007

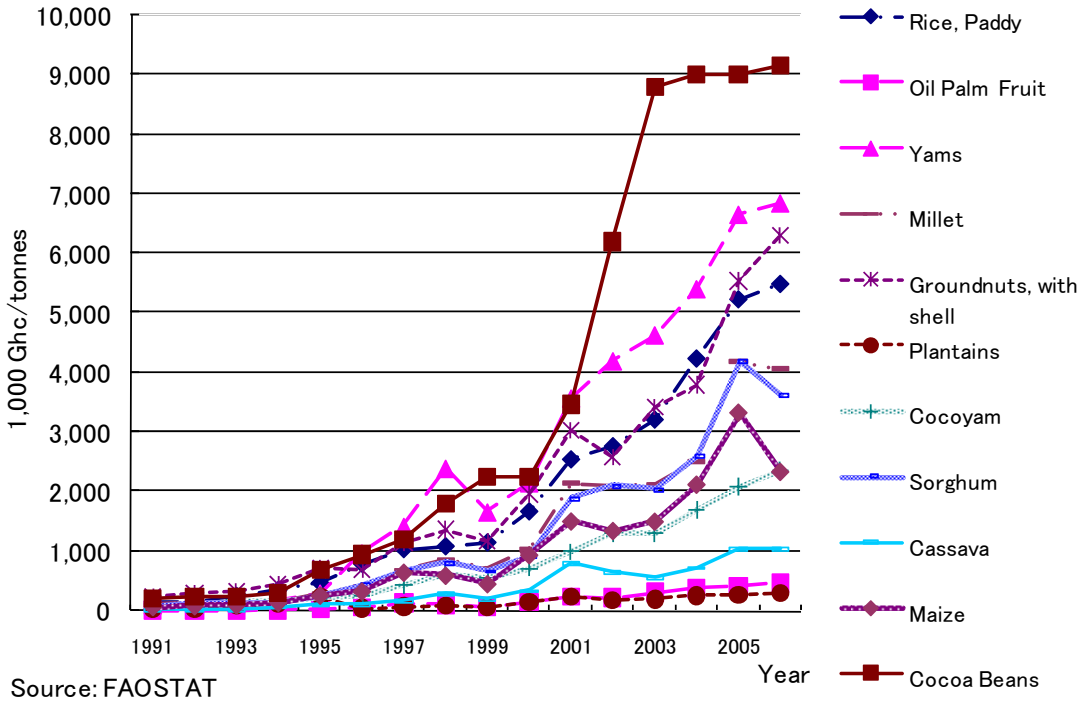
(ACCRA=100)

	Greater Accra	Central	Western	Eastern	Volta	Ashanti	Brong-Ahafo	Nothern	Upper West	Upper East
Cassava	100	60	64	42	69	32	35	59	N.A.	124
Cocoyam	100	108	90	63	104	70	60	N.A.	N.A.	N.A.
Ground Nuts	100	91	101	94	87	95	79	69	73	64
Maize	100	95	106	86	90	91	78	81	88	70
Millet	100	94	98	102	80	88	85	73	76	68
Palm Oil	100	77	80	71	127	86	81	113	104	117
Plantain	100	54	67	56	81	53	41	128	N.A.	233
Rice (Import)	100	86	83	97	93	87	94	88	85	89
Rice (Local)	100	96	104	86	94	83	77	77	95	94
Yam	100	114	137	103	109	99	96	89	88	82

Source: APDA estimate, original data MOFA-SRID

Trends of the producer price in recent years for major farm crops are shown in Figure 1.5. The producer price for rice had increased considerably for cacao as a result of rapid increase in export and rise in international prices. Rapid increase in the producer price was also observed for yam, ground nuts and rice. Meanwhile, a price slump has been continuing for edible banana and cassava due to excessive supply. Regional price difference of main farm crops is as shown in Table 1.5.

Figure 1.5: Producer Price



Source: FAOSTAT

Ghana is lagging behind in mechanization of agriculture with farm work still being performed mainly by manual labour. Status of powered farm machinery use, changes in pesticide and insecticide imports and the results of fertilizer input are listed in Tables 1.6, 1.7 and 1.8, respectively. Little progress is being made in improving Ghana's agricultural productivity owing to delay in introduction of machinery, agricultural chemicals and fertilizer (Figure 1.6). Productivity is particularly low in exported farm products such as cacao.

Table 1.6: Machinery in Use

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Agricultural Tractors	4,120	3,700	3,570	3,600	3,600	3,600	3,600	3,600	3,600
Combine Harvesters/Threshers	156	40	48	51	78	135	150	290	390

Source: FAOSTAT

Table 1.7: Import Value of Pesticides

Import Value (1,000 $)	1990	1995	2000	2001	2002	2003	2004	2005	2006
Pesticides	14,000	18,000	15,379	20,372	33,334	63,196	55,227	117,577	81,501
Insecticides	N.A.	N.A.	10,321	10,962	18,831	N.A.	N.A.	44,148	47,313
Fungicides	N.A.	N.A.	2,720	5,255	10,914	N.A.	N.A.	31,962	11,287
Herbicides	N.A.	N.A.	1,543	3,180	2,152	N.A.	N.A.	38,480	21,870
Disinfectants,etc	N.A.	N.A.	795	976	1,438	N.A.	N.A.	2,987	1,031

Source: FAOSTAT

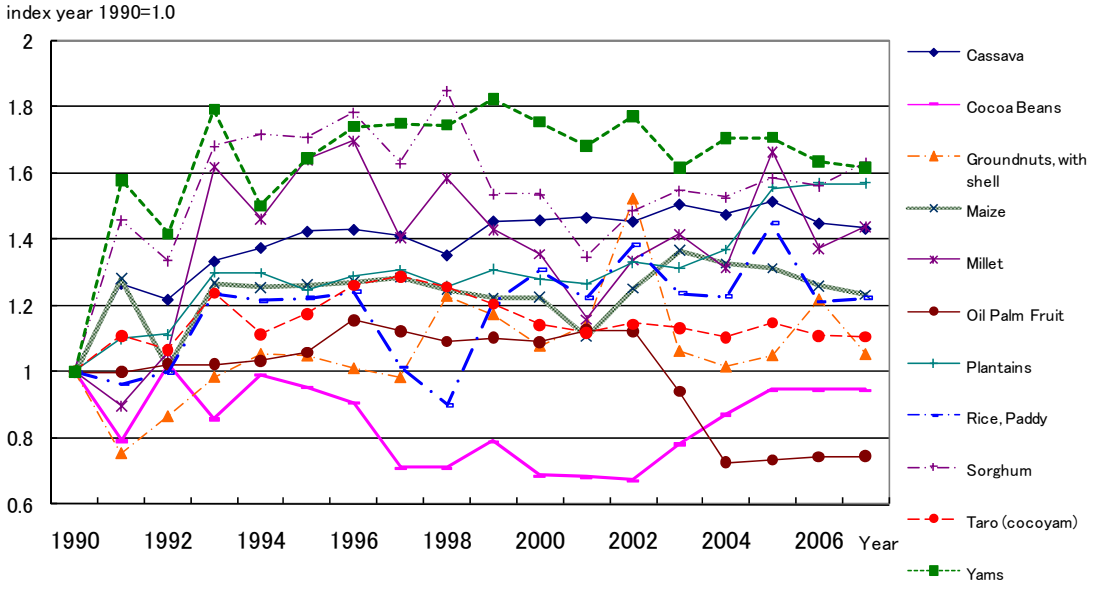
Table 1.8: Fertilizer Consumption

(tonnes)

	2002	2003	2004	2005	2006
Nitrogen	15,823	8,364	4,413	10,477	21,519
Phosphate	2,277	2,834	2,733	6,147	15,151
Potash	2,289	16,898	39,227	6,814	15,214

Source: FAOSTAT

Figure 1.6: Productivity Changes



Source: APDA estimate original data from FAOSTAT

The Council for Scientific Industrial Research (CSIR) which was established by the Ministry of Environment, Science and Technology (MEST) is responsible for agricultural experiment and research in Ghana. Fourteen laboratories are affiliated with CSIR and 8 of them are engaged in research and testing related to agriculture (Table 1.9).

Table 1.9: List of Agriculture-Related Institutes under CSIR

Institute	Background and Mandate
①Crops Research Institute : CRI	The genesis of CRI dates back to the Gold Coast where it evolved from the specialists' branch of the Gold Coast Department of Agriculture. In 1959 the Specialists' Branch and the Soil and Land Use Survey Department of Agriculture were merged to form the Scientific Services division of the Ministry of Agriculture. The Scientific Services division was transferred to the National Research Council in 1962 and then to the Ghana Academy of Sciences in 1963, and was re-named the Agricultural Research Institute (ARI. In October 1963, the Ghana Academy of Sciences re-organised the ARI into two units - Crops Research Unit (CRU) and Soil Research Unit. In 1964 the CRU became a full-fledged Institute and was renamed the Crops Research Institute (CRI). When the Academy of Sciences was re-organised in 1968 into the Ghana Academy of Arts and Sciences and the CSIR, CRI became one of the Institutes of the CSIR.
②Food Research Institute : FRI	The Government of Ghana established The Food Research Institute (FRI) in 1963. Operations of FRI started in 1965 with assistance from the United Nations Development Programme (UNDP) while the Food and Agriculture Organization (FAO) acted as the executing agency. The phase of UNDP/FAO project assistance lasted for five years, from October 1965 to September 1970. FRI has since blossomed into a full-fledged research institute and much more.
③Savanna Agricultural Research Institute : SARI	The mandate of the Savanna Agricultural Research Institute is to conduct agricultural research, particularly as it relates to food and fibre crop farming, in northern Ghana for the purpose of introducing improved technologies to enhance agricultural productivity.
④Oil Palm Research Institute : OPRI	The Oil Palm Research Institute (OPRI) was established in 1964 as a division (Plant Breeding Oil Palm) of the Crops Research Instiute (CRI), of the Council for Scientific and Industrial Research (CSIR) to take over the functions of the defunct West African Institute for Oil Palm Research (WAIFOR). It was upgraded to a center and gained autonomy from the Crops Research Institute in 1979 and became a fully fledged Institute in 1988. The center became fully fledged in 1988. Vision of OPRI is to carry out research on Oil Palm and Coconut.

Cont.

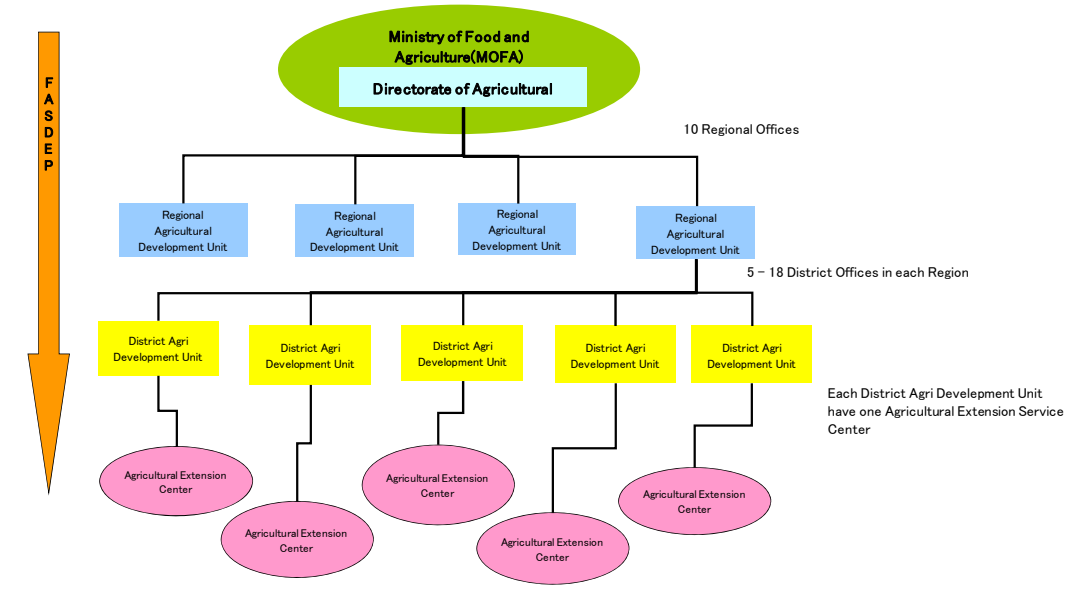
Table 1.9: List of Agriculture-Related Institutes under CSIR (Cont.)

⑤Animal Research Institute : ARI	Animal Reserach Institute (ARI) was establish in 1964,to undertake research aimed at providing solutions to problems relevant to the livestock industry in Ghana, and to advise government through the CSIR on livestock production policy matters. The Institute's objectives are to help the country to become self-sufficient and achieve food security in animal protein supply. A short-term objective is: to provide support for the National Livestock Services Project (NLSP).
⑥Soil Research Institute : SRI	The Soil Reserach Insitute was established as one division of CRI.The mandate of Soil Research Institute is to take inventory of the soil resources of the country, carry out research and provide advice on maintaining soil fertility for agricultural production and sustainability of the environment.
⑦Forestry Research Institute of Ghana : FORIG	The Forestry Research Institute of Ghana was established as a research institute and named FOREST PRODUCTS RESEARCH INSTITUTE (FPRI) under the then Ghana Academy of Sciences in 1964 and in 1968 placed under the CSIR. In 1991, the name of the Institute was changed to Forestry Research Institute of Ghana (FORIG) to reflect the widening scope of its research activities. The Mandate of FORIG is to undertake forest and forest-products research to ensure sustainable management and utilization of Ghana's forest resources and to engage in the commercialization of the research results and services.
⑧Plant Genetic Research Center : PGRC	The PGRRI was established in 1964 as a section of the Crop Research Institute of the CSIR under the name Plant Introduction and Exploration (PIE). Its function was to introduce exotic tropical species for trials in Ghana, and evaluate their economic potential, as well as to assemble and maintain the germplasm of plants in Ghana. In 1985, its name was changed to Plant Genetic Resources Unit (PGRU) to reflect the scope of its activities and to conform to international designation of similar institutions. In August 1994 the Unit's mandate was expanded and its status elevated to that of a Center within the CSIR. In August 2005 the Center was elevated to a full fledged Institute with the name Plant Genetic Resource Research Institute (PGRRI). The mandate of the PGRC is to collect and conserve the germplasm of plant genetic resources of Ghana.

Source: CSIR webstime(URL http://www.csir.org.gh/)

As for agricultural extension services, a method of extension called the Training and Visit System is used by the Directorate of Agricultural Extension Services (DAES) within MOFA. The organizational structure for extension is shown in Figure 1.7.

Figure 1.7: DAES Organizational Chart

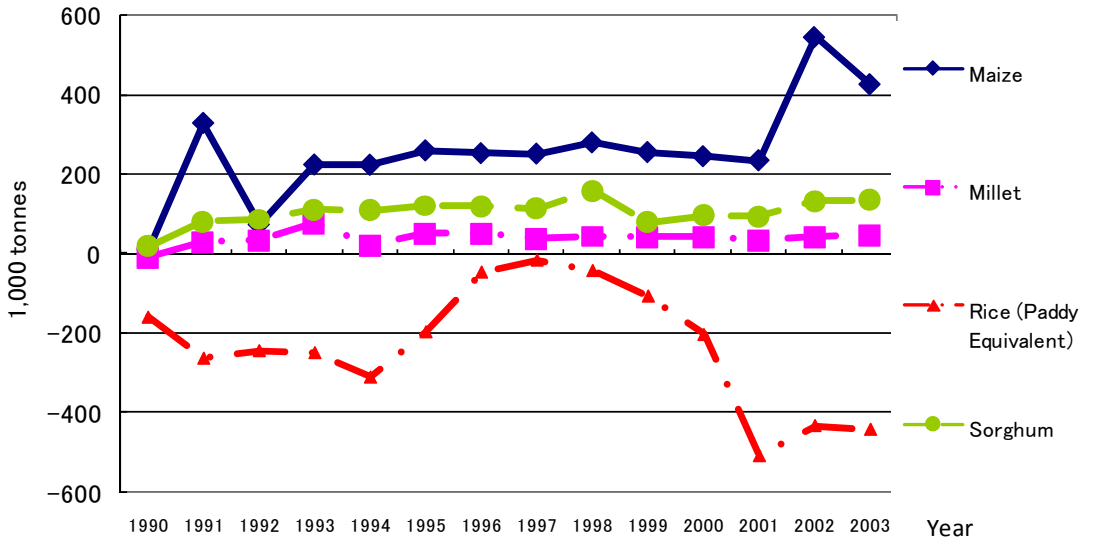


Source: MOFA website

- Cooperatives in Ghana are characterized by their small scale and more than 1,000 cooperatives exist even when only those that are registered are counted.
- Formal agricultural financial institutions in Ghana include the Rural and Community Bank (RCB) and the Agricultural Development Bank (ADB).
- Farms that cannot use formal financial institutions are using informal financial institutions called "*susu*."
- Ghana's agricultural financial institutions are still insufficient in both quality and quantity for formal and informal financial institutions including RCB, ADB and *susu*.

Figure 1.8 shows a gap between grain production and grain consumption. Among grains, consumption of maize has remained stable since 1990. Equilibrium has been maintained for both sorghum and millet with stable consumption and production. Ghana does not produce wheat so the country is completely dependent on importing wheat. Fluctuations in rice demand and supply gap is most severe, having marked a substantial over-consumption of 400,000 tons in recent years.

Figure 1.8: Cereal Supply and Demand Gap

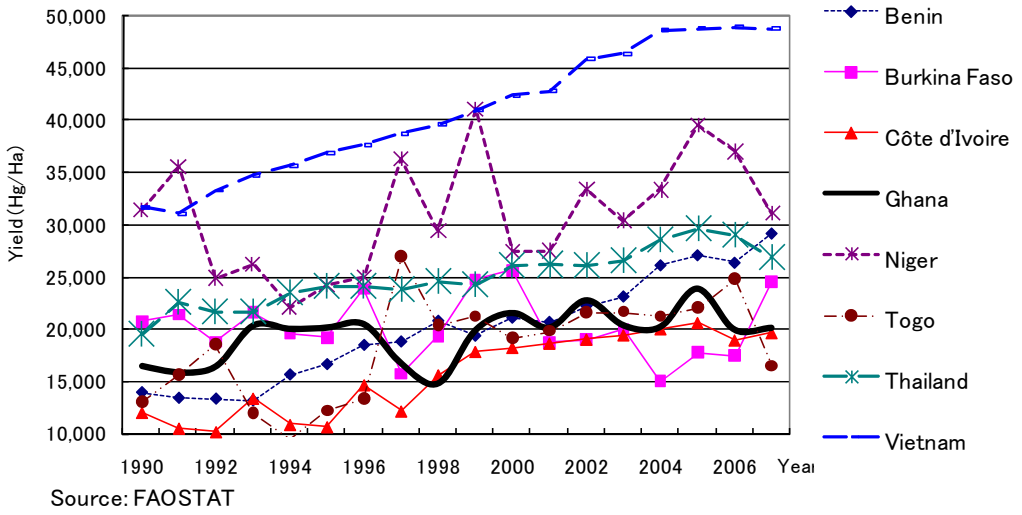


Source: APDA estimate original data from FAOSTAT

As shown in Table 1.5, major rice growing centers consist of the savannah in the Northern Region, the Upper East Region and the Volta Region in the southern part of the country. The Northern Region in particular is the center of rice cropping where lowland and upland rice are grown on rain-fed paddies in river basins. While paddies are irrigated in some areas, extensive farming of lowland and upland rice is practiced in general.

The productivity of rice in Ghana is compared with its neighbouring countries and with Southeast Asia in Figure 1.9. Ghana's productivity always exceeds that of its neighbours such as Côte d'Ivoire and Togo but lost its lead to its northern neighbour Burkina Faso in 2007.

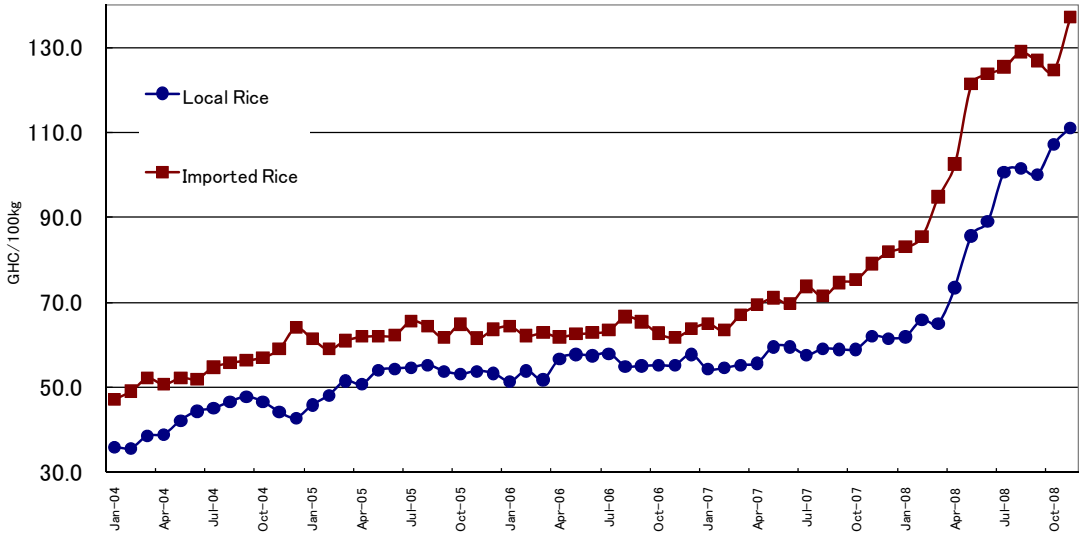
Figure 1.9: Rice Productivity



Source: FAOSTAT

Changes in average wholesale rice price in Ghana were compared between local rice and imported rice in Figure 1.10. While extremely diverse varieties of rice, ranging from high to low quality are imported, intermediate quality imported rice is of higher quality and higher price compared to local rice. Quality and price of local rice are almost equal to those ranked at the bottom range of imported rice. The price of local rice is kept low as it is less popular compared to standard imported rice because of its low quality owing to milling-related problems.

Figure 1.10: Local and Imported Rice Prices



*Previous data from June 2006 data was multipled by 10000, ajusted as redenomination.
** Wholesale price of imported rice estimated as double of standard unit 50kg's price.

Source: APDA estimate ,original data from MOFA-SRID.

District-level harvested area, production, and yield/productivity for the Ashanti Region, where this survey was conducted, are listed in Table 1.10. As we can see, there is hardly any correlation between the area of the district and the harvested area, production and yield/productivity. However, a tendency of productivity being lower in proportion to large production can be observed in areas located southeast of the Kumasi Metropolitan Area, while productivity is slightly higher in areas located northwest of Kumasi.

Table 1.10 Rice Cultivation Status in Ashanti Region (2007)

DISTRICT	Figures in Hectares	Figures in Metric Tons	Figures in Mt/Ha
Amansie East	360	353	0.98
Amansie Central	30	30	1.00
Amansie West	101	112	1.11
Ejura Sekyedumase	185	268	1.45
Sekyere West	26	33	1.25
Sekyere East	161	203	1.26
Afigya Sekyere	187	187	1.00
Ahafo Ano North	204	267	1.31
Ahafo Ano South	535	829	1.55
Atwima Mponua	739	998	1.35
Atwima Nwabiagya	1,001	1,351	1.35
Ejusu Juaben	494	716	1.45
Kwanwoma	494	519	1.05
Kwabre	135	128	0.95
Offinso	297	312	1.05
Adansi North	256	236	0.92
Obuasi (Adansi West)	76	72	0.95
Adansi South (East)	1,400	1,610	1.15
Asante Akim North	1,480	1,332	0.90
Asante Akim South	351	316	0.90
K. M. A.	12	14	1.20
TOTAL	**8,524**	**9,886**	**1.16**

Source: MOFA-SRID

1.4 GHANA'S FOREST RESOURCE MANAGEMENT POLICY AND OVERVIEW OF FORESTRY

Since forest resources are abundant, Ghana has been promoting its industries by positioning its lumber industry as a major export industry along with cacao. Forests outside the forest reserve were logged one after another with the growth of the timber industry, and were systematically converted into farmland to support the increasing population. There is an urgent need to develop a system to adequately protect the forests and utilize timber and charcoal in a sustainable manner before the rapidly diminishing resources of the forest are depleted.

The history of major laws and policies put in place in connection with the forest sector is listed in Table 1.11. Forest management in Ghana started with regulation of commercial logging through the promulgation of the Timber Protection Ordinance 1907. After World War II in 1948, Forestry Policy, which became the foundation of post-war forest administration, was formulated and put into effect. Its basic policy was to allow logging outside of forest reserves and foster the logging industry as an export industry in exchange for protection of forests inside a forest reserve.

Table 1.11: Policies for Forestry Protection and Management

1907	**Timber Protection Ordinace,1907** was the first timber regulation for commercial logging.
1909	**Establishment of the Forestry Department** to spearhead the reservation effort and regulate the emerging timber industry
1927	**An Ordinance for the Protection of Forests and for the Constitution and Protection of Forest Reserves 1927, (Forests Ordinance)** attempts to categorize forest reserve.
1939	**Concessions Ordinance 1939**, and earlier similar legislation, provided for a system of grants of timber harvesting rights and the determination and collection of revenue over both reserve and off-reserve forest by the traditional land and forest holding authorities.
1948	**1st Natural Forest Policy:** Salvage felling in off-reserve areas without replacement introduced; increase in control by the forest service to ensure adequate and stable supplies of timber to support war effort.
1949	**Tree and Timber Ordinance, No .20 of 1949** sought to regulate and control the timber trade through the registration and issuing of Property Marks to concession holders and the issuing of licenses and permits for the felling of forest trees.
1960	**Forest Improvement Fund Act 1960**. All links between the FC's management of FR and accountability to landowners served.
1962	**Concessions Act and Administration of Lands Act 1962 –** all timber resources and land vested in and managed by the State. Farmers lose all rights to utilize trees left standing on their farms.
1974	**Trees and Timber Decree, 1974 (NRCD 243)** continued the operation of the system of property marks and made it a criminal offence for a person to fell timber for export without a valid property mark.
1974	**Forest Protection Decree, 1974 (NRCD 243)** attempts to protect the integrity of forest reserves by prohibiting virtually any activity therein if done without prior written permission from the Forestry Department.
1983	**Trees and Timber (Amendment) Law, 1983 (PNDCL 70)** imposed harsher penalties for violation of the Trees and Timber Decree.
1983	**Control of Bush Fires Law, 1983 (PNDCL 46)** sought to control the setting up of bushfires during one of he worst periods of rampant fires, by criminalizing the intentional, reckless, negligent causing of such fires and holding the offender liable for all the consequences of the fire.
1983	**Forest Protection (Amendment) Law, 1986 (PNDCL 142)** imposed stiffer penalties for violation of the Forest Protection Decree.
1986	**Article 269 of the 1992 Constitution** provides for the establishment, composition and functions of the present Forestry Commission.
1990	**Forestry Commission Act, 1993 (Act 453)** established the present Forestry Commission.

Table 1.11: Policies for Forestry Protection and Management (Cont.)

1990	**Control and Prevention of Bushfires Law, 1990 (PNDCL 192)** shifted the emphasis in the fight against bushfires from punishment for criminal offenders to regulation and prevention through educational programmes and organization of early farm burning by district assemblies.
1991	**Trees and Timber-Chain Saw Operations-Regulations, 1991 (Legal Instrument 1518)** established the legal recognition of chainsawing. FC and district administrations regulate and supervise chainsaw operations.
1993	**Trees and Timber Amendment Act, 1994 (Act 493)** makes provisions for the biannual renewal of property marks and the use of levies and other forest fees in the regulation of the timber trade. Under this Act, levies have been imposed on the export of logs and the fee for the renewal of property marks substantially increased.
1994	**Forest and Wildlife Policy, 1994**. The present formal policy on forest and wildlife aims at conservation and sustainable development of the resources for maintenance of environmental quality and perpetual flow of optimum benefits for all segments of society.
1994	**Interim Measures** to control illegal timber harvesting outside of the forest reserves. This introduced a new system for the harvesting of off-reserve timber introducing the farmer's right of veto and payment of compensation for crop damage.
1995	**Master Plan for the Development of the Forestry Sector**, prepared by the Ministry of Land and Forestry, is a comprehensive plan with strategies, proposed actions, inputs, outputs and time frames for implementing the Forest and Wildlife Policy.
1996	**Timber Resources Management Act 1997** introduces Timber Utilization Contracts for any timber harvesting and enhanced rights for landowners and farmers over harvesting of trees on their land.
1998	**Timber Resources Management Regulations (Legal Instrument 1649)** makes chainsawing prohibited. Relevant provisions of the law that recognized the activity (Legal Instrument1518 of 1991) are repealed.
1999	**Forestry Commission Act, 1999 (Act 571)** was implemented to re-establish the Forestry Commission in order to bring under the Commission the main public bodies and agencies implementing the functions of protection, development, management and regulation of forests and wildlife resources, and to provide related matters.
1999	**Natural Resource Management Programme,** was designed as the major instrument for implementing the 1994 Forest and Wildlife Policy and Forest Development Master Plan.
2000	**Forestry Act**. This Act aims at consolidation and replacement of all existing forestry legislation. It indicates clear identification of land and forest-holding communities as the primary clients of a proposed Forest Service, which will pursue sustainable forest management.
2001	**National Forest Plantation Development Programme** was introduced by President Kufor.
2002	**The Timber Resource Management Act (Amendment)** provide incentives to encourage private sector participation in plantation development.
2003	**Timber Resource Management Regulation (Amendment)**. Introduced competitive bidding for the allocation of timber right as well as a binding social responsibility agreement.

Source: Environmental Protection Agency (2005), Odoom(2005), Varmola (eds.) (2002), FAO,FC's Website(URL: http://www.fcghana.com/)

An attempt was made to shift the policy in the direction of protecting forest resources outside a forest reserve in response to rapid destruction of forests and resulted in promulgation of the Forests and Wildlife Policy as the new basic policy for forests and forestry in 1994. The policy is aimed at realizing conservation and sustainable use of forest and wildlife resources (Table 1.12). The policy is unique in that it regarded understanding and cooperation of local residents as an essential aspect of forest conservation and actively sought their participation. The Forestry Development Master Plan 1996-2020 (MP) was formulated based on the Forests and Wildlife Policy.

Table 1.12: Forest and Wildlife Policy 1994 Objectives

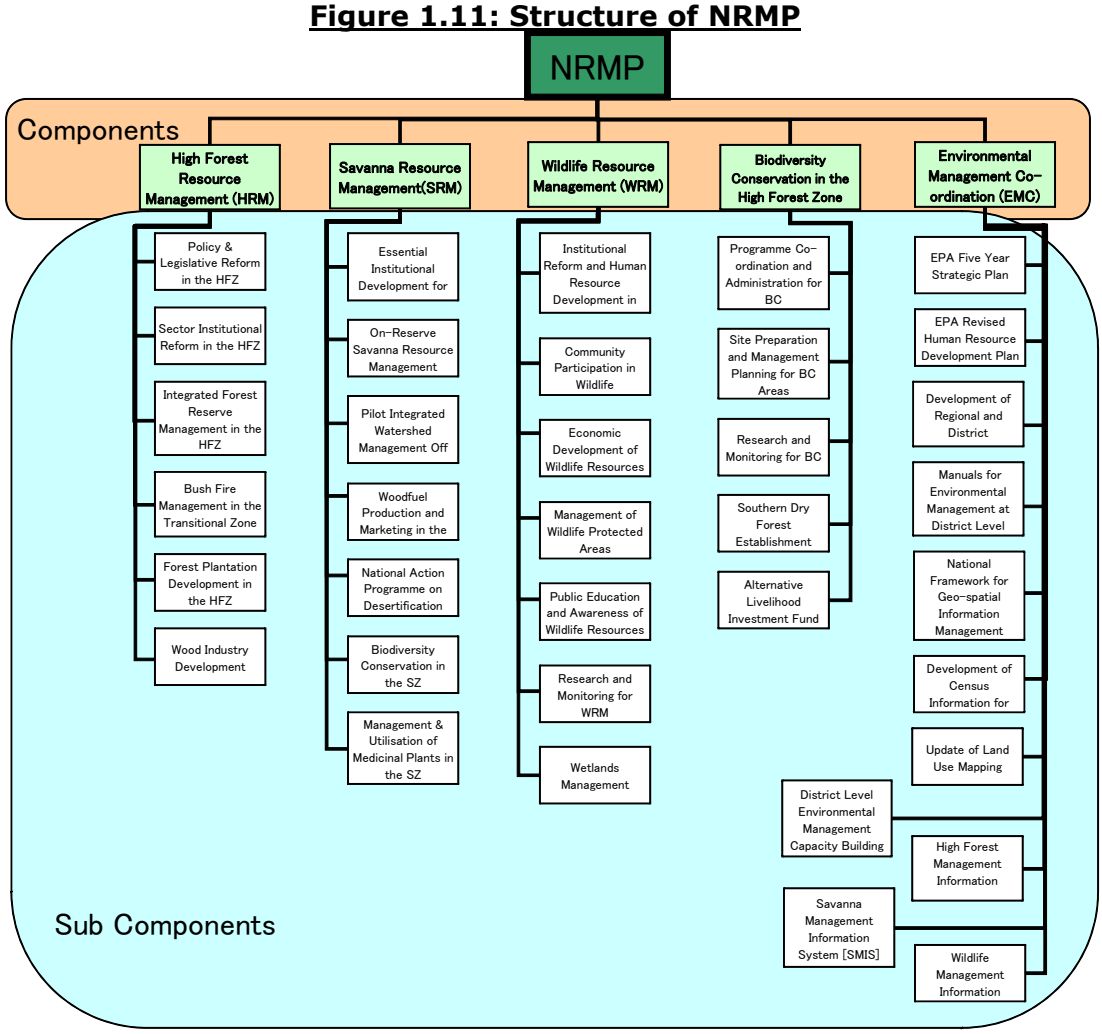
Management and enhancement of Ghana's permanent estate of forest and wildlife resources;
Promotion of viable and efficient forest-based industries, particularly in the secondary and tertiary processing;
Promotion of public awareness and involvement of rural people in forestry and wildlife conservation;
Promotion of research-based and technology-led forestry and wildlife management, utilization and development, and;
Development of effective capability at national, regional and district levels for sustainable management of forest and wildlife resources.

Source: Minister of Lands and Forestry(1994)Forest and Wildlife Policy

The Natural Resources Management Programme (NRMP), which was a structural reform program involving the entire forestry and wildlife administration of Ghana, was formulated in 1999 by replacing the Forestry Development Master Plan 1996-2020. The objective of the MP was to increase the income of regions possessing natural resources in a sustainable manner by protecting and restoring the national land, forests and wildlife resources, and managing these resources in a sustainable manner. Activity components of NRMP are as shown in Figure 1.11.

The National Forest Plantation Development Programme (NFPDP) was launched in September 2001 in response to a proposal by President John Agyekum Kufuor. NFPDP was a program to promote tree planting outside forest reserves with the goal to plant trees on 20,000 hectares of land every year, starting in 2002. NFPDP promoted tree planting using the improved Taungya system. It was a system in which farmers were required to look after the trees by performing weeding and other work after cultivation is completed and receive some income and timber as compensation for their work.

Figure 1.11: Structure of NRMP

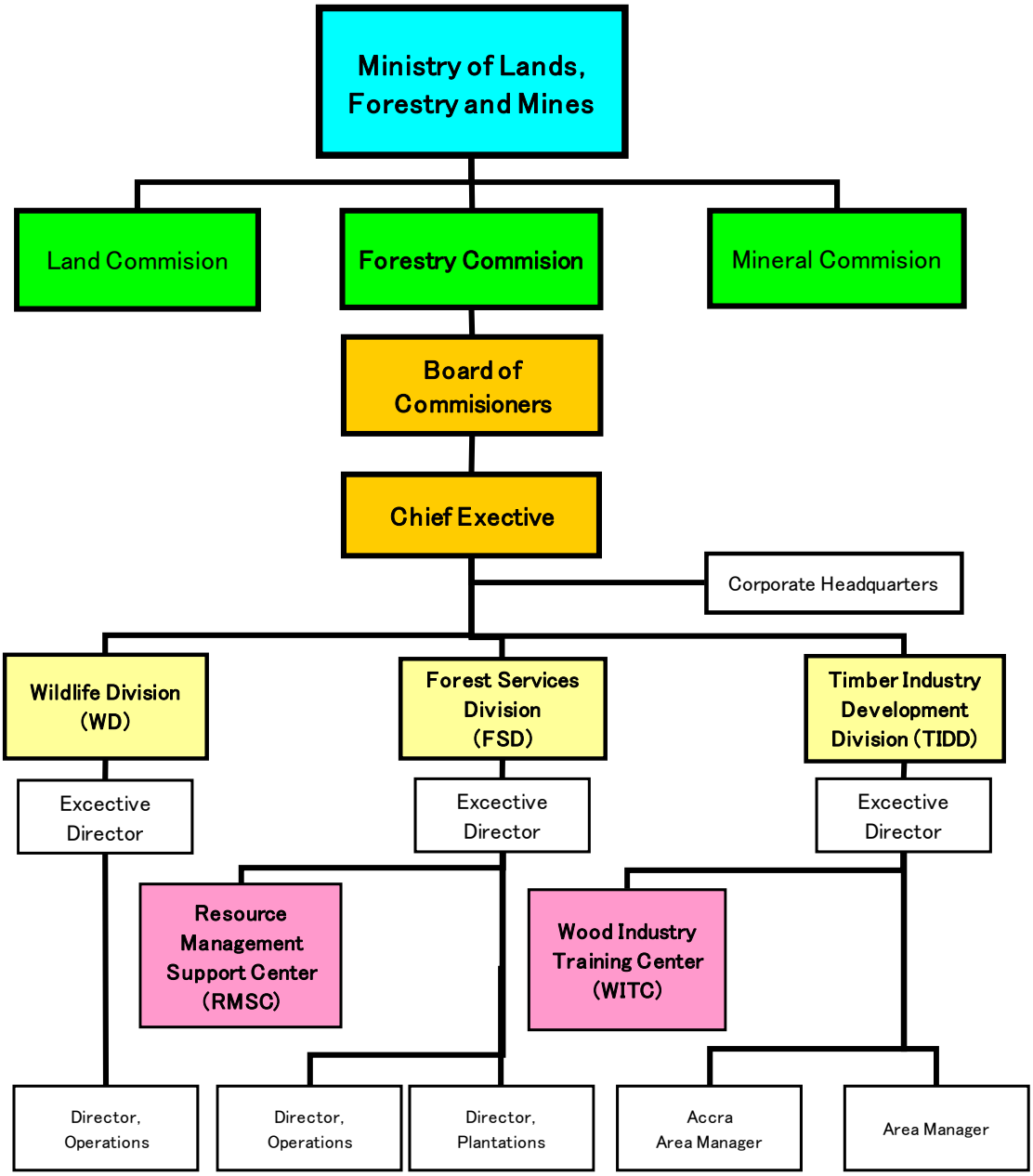


Source: Natural Resources Management Programme

While the Ministry of Land, Forestry and Mines (MLFM) is the administrative control agency responsible for forest resources, the Forestry Commission (FC) is virtually at the center of forestry administration. The organizational system of FC is as shown in Figure 1.12.

The main functions of FC include: 1) regulation of forest and timber resources; 2) management of forest reserves and protected areas; 3) support for the management of various private organizations in accordance with the Forest and Wildlife Policy; 4) reforestation of blighted forests; 5) reforestation aiming for an increase of industrial roundwood.

Figure 1.12: Forestry Commission Organizational Chart



Source: Information based on Forestry Commission's website

FSD is a core organization affiliated with FC. Main activities of FSD include: 1) management and development of forest reserves ; 2) monitoring of forest resources ; 3) advice concerning forest policies; 4) regulation of forest resources. FSD is responsible for forest management and has the authority concerning concession for logging.

The Wildlife Division (WD) is a department which has the authority concerning all wildlife in Ghana. WD exercises control over a total of 13,389 km^2 consisting of national parks, resource reserves, wildlife sanctuaries and strict nature reserves which cover an area corresponding to 5.62% of Ghana's national land (Figure 1.13, Table1.13).

Figure 1.13 Protected Areas and Ramsar Sites in Ghana

Source:EPA(2005)

Table1.13: Wildlife Protected Area and its Percentage

Name of Park/Reserve/Sanctuary	Total Area in km²	% of Area as Total of Ghana
Mole National Park	4,840	2.030
Kakum National Park and Assin Attandanso Resource	360	0.150
Digya National Park	3,478	1.460
Bui Nanalonal Park	1,821	0.760
Bia National Park and Resource Reserve	306	0.130
Nini Suhien National Park and Ankasa Resource Reserve	503	0.210
Kyabobo National Park	360	0.150
Owabi Wildlife Sanctuary	13	0.005
Agumatsa Wildlife Sanctuary	3	0.001
Boaben-Fiema Monkey Sanctuary	4	0.018
Tafi Atome Monkey Sanctuary	329	0.140
Shai Hills Resource Reserve	49	0.021
Kalakpa Resource Reserve	320	0.130
Gbele Resource Reserve	565	0.240
Kogyae Strict Nature Reserve	386	0.160
Bomfobiri Wildlife Sanctuary	53	0.022
Total	13,390	5.627

Source EPA(2005)

The Timber Industry Development Division (TIDD) is a new division created in 2002 through amalgamation of the former Timber Export Development Division and the former Forest Product Inspection Division in 2002. Main activities of TIDD include provision of information to promote export of timber and wood products, product development, quality control such as grading of timber and supervision of exporters.

Trends of Ghana's timber production, trade and consumption in recent years were compiled according to editions of FAO's *State of the World's Forests* for respective years (Table 1.14). Production and consumption of fuelwood declined from 1996 to 1998 and levelled off until 2004. Production and consumption of industrial roundwood increased in 2004, after dropping between 1996 and 2000. Production of sawnwood declined from 1996 to 2000.

Table 1.14: Production, Trade and Consumption of Forest Products

		1996	1998	2000	2002	2004
Woodfuel (1,000m³)	Production	25,190	20,678	20,678	20,678	20,678
	Imports	n.a.	n.a.	n.a.	n.a.	n.a.
	Exports	n.a.	n.a.	n.a.	n.a.	n.a.
	Consumption	25,190	20 678	20,678	20,678	20,678
Industrial Roundwood (1,000m³)	Production	1,255	1,227	1,087	1,104	1,350
	Imports	0	0	0	0	3
	Exports	150	0	0	0	1
	Consumption	1,105	1,227	1,087	1,104	1,351
Sawnwood (1,000m³)	Production	604	590	243	461	480
	Imports	0	1	0	0	0
	Exports	240	254	244	207	211
	Consumption	364	336	0	254	270
Wood-based Panels (1,000m³)	Production	105	159	166	391	435
	Imports	0	1	0	0	1
	Exports	73	96	157	192	178
	Consumption	33	64	9	199	258
Pulp for Paper (1,000tonnes)	Production	n.a.	n.a.	n.a.	n.a.	n.a.
	Imports	0	0	0	0	0
	Exports	0	0	0	0	0
	Consumption	0	0	0	0	0
Paper and Paperboard (1,000tonnes)	Production	n.a.	n.a.	n.a.	n.a.	n.a.
	Imports	13	22	36	45	141
	Exports	0	0	0	0	0
	Consumption	13	22	36	45	141

Source: FAO, *State of the World's Forests* (various issues)

As shown in Tables 1.15 and 1.16, timber prices have seen a substantial rise in recent years, as a result of rising trend in international timber prices and an increase in demand for commercial timber at home originating from ongoing economic growth. The number of workers employed in the forestry sector and timber industry amounted to around 130,000 at the time of the Population and Housing Census 2000. As for regional distribution, forestry and logging workers were found in large numbers in regions with abundant forest resources such as in Ashanti, Brong Ahafo and Northern, while wood product workers were common in the Upper East and Accra (Figure 1.14).

Table 1.15: Ghana Domestic Log Prices (US$/m^3)

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Wawa	Lowest	29	29	28	24	32	36	36	57	90	100
	Highest	37	36	35	37	38	44	44	70	105	115
Odum Grade A	Lowest	N.A.	N.A.	28	73	35	77	89	150	160	160
	Highest	N.A.	N.A.	167	152	175	175	175	160	170	170
Ceiba	Lowest	21	26	19	20	27	31	31	53	75	90
	Highest	24	29	24	24	53	53	53	75	90	100
Chenchen	Lowest	23	17	35	21	29	33	44	49	55	60
	Highest	29	29	42	40	57	88	88	70	80	90
Khaya/Mahogany (Veneer Qual.)	Lowest	29	43	69	61	47	40	40	65	70	70
	Highest	57	87	90	134	160	91	91	80	90	90
Sapele Gradea A	Lowest	57	72	28	37	47	55	55	125	130	130
	Highest	86	87	56	122	140	154	154	140	150	150
Makore (Veneer Qual.) Grade A	Lowest	57	53	69	40	47	54	55	125	125	125
	Highest	129	76	90	133	140	154	154	135	135	135

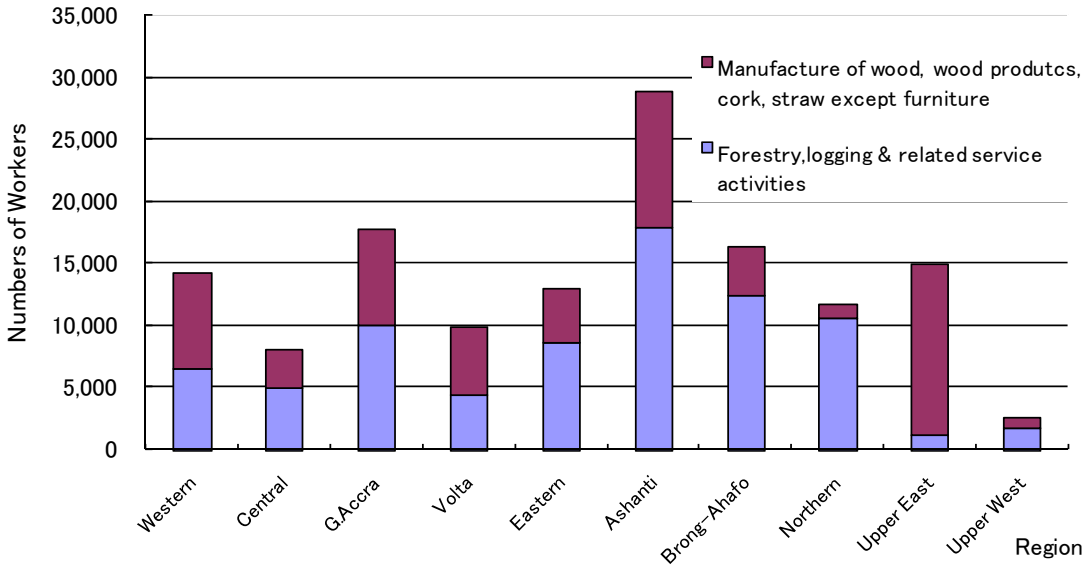
Source: ITTO, *Tropical Timber Market Report* (Various Issues)

Table 1.16: Ghana Sawnwood, Domestic (US$/m^3)

Sawnwood	Unit	Jan-05	Jan-06	Jan-07	Jan-08	Jan-09
Wawa	25x300x4.2m	73	108	134	225	255
Emeri	25x300x4.2m	70	260	233	305	345
Ceiba	25x300x4.2m	53	106	122	166	210
Dahoma	50x150x4.2m	138	138	274	306	318
Redwood	50x75x4.2m	122	122	208	230	280
Ofram	25x225x4.2m	136	146	194	280	330

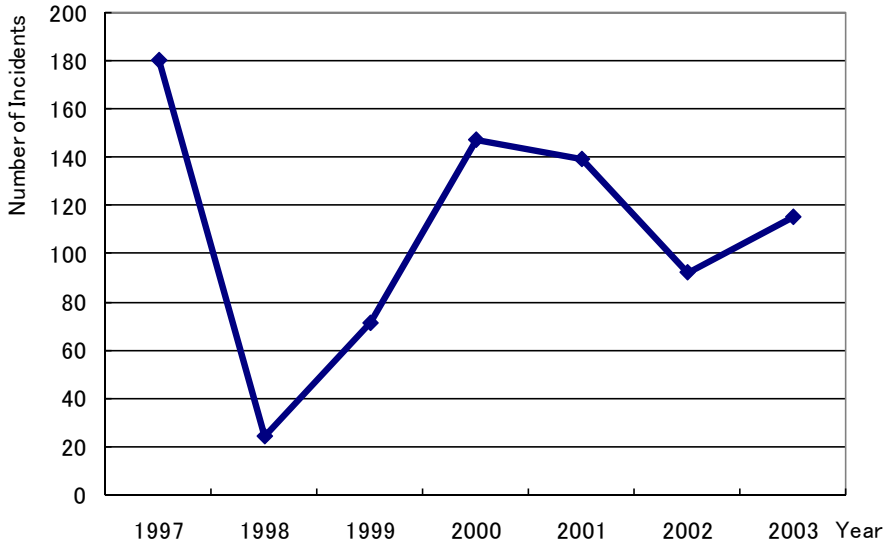
Source: ITTO, *Tropical Timber Market Report* (various issues)

Figure 1.14: Number of Workers in the Forestry and Wood Industry



Forest and bush fires are directly responsible for forest degradation and deforestation. Common causes of forest and bush fires include accidental fires including mishandling of fire used in slash-and-burn and bonfires, illegal creation of fields and pastures using the slash-and-burn method, and starting fires to capture wild animals such as giant rats. Occurrences of fires in Ghana in recent years are shown in Figure 1.15.

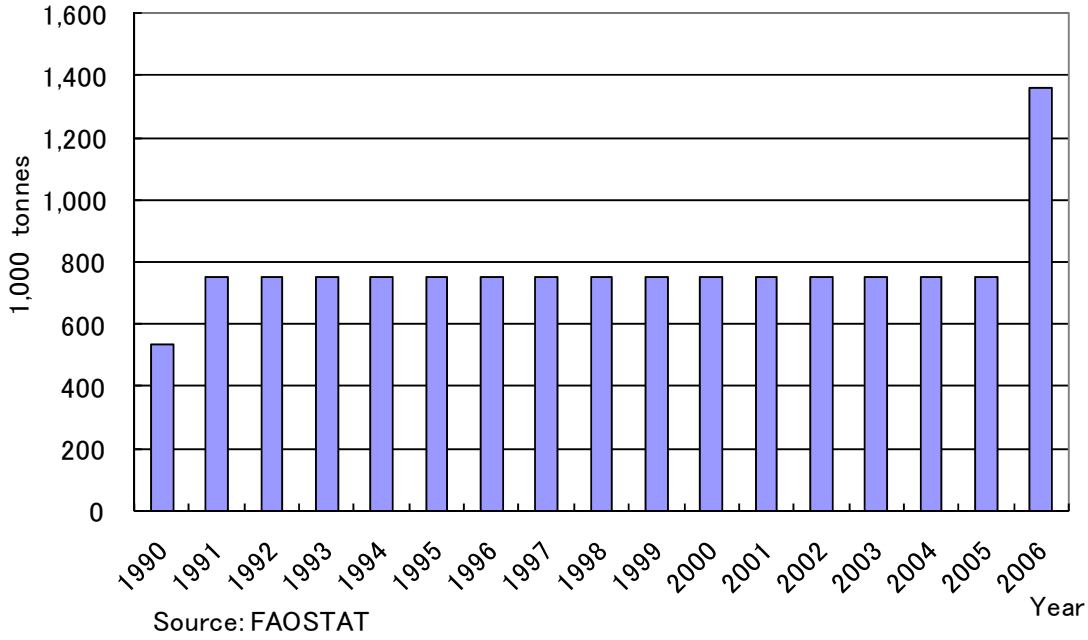
Figure 1.15: Forest and Bush Fires in Ghana, 1997-2003



Source: Forest Service Division Annual Report

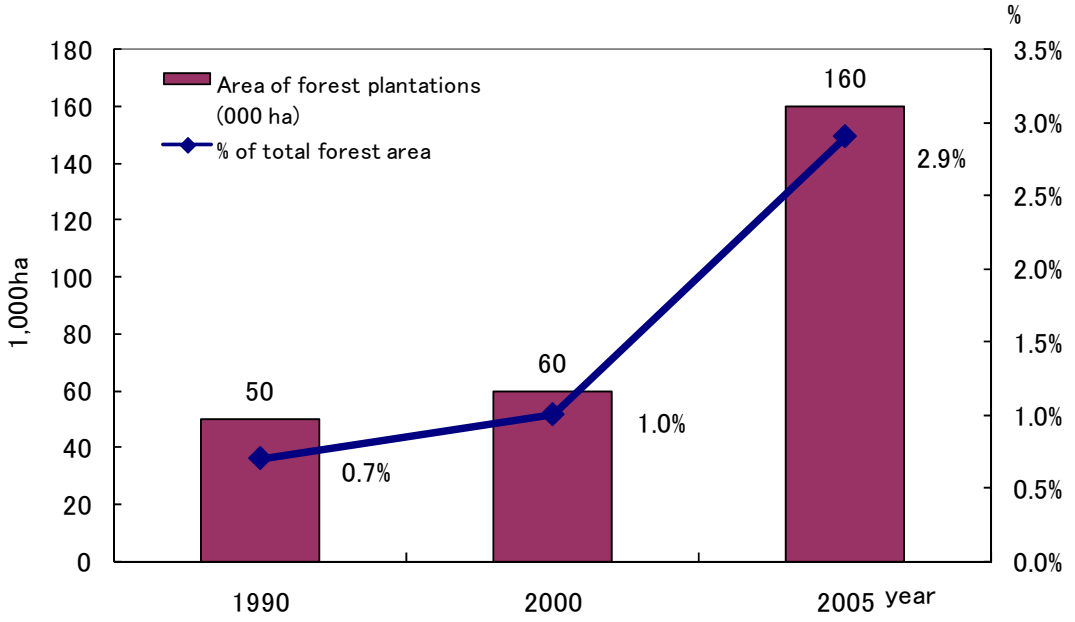
Production of charcoal soared in 2006 to 1,400 tonnes after having remained constant. Its burden on the environment poses a concern. Approximately 70% of demand for environmentally controversial fuelwood comes from homes and the industrial sector is responsible for the remaining 25% (Figure 1.16, Table 1.17).

Figure 1.16: Wood Charcoal Production



Source: FAOSTAT

Figure 1.17: Forest Plantation Change



Source: FAO, *State of the World's Forests*

Table 1.18 calculates the theoretical gap between annual timber demand and supply capacity based on existing forest resources. A total of 1,255,500 hectares will have to be planted every year if the shortage of trees were to be covered by tree planting. The actual results of tree planting to date are shown in Figure 1.17.

Table 1.18: Theoretical Plantation Area Calculations

End-Use	Estimated annual requirement (m^3 round)	Supply from existing forests (m^3 round)	Balance (m^3 round)	Plantation area required (ha)
Industry*	4,000,000	750,000*****	3,250,000	325,000
Fuelwood***	16,400,000	8,000,000	8,400,000	840,000
Poles***	30,000	15,000	15,000	1,500
Local lumber**	1,140,000	250,000****	890,000	89,000
Total	**21,570,000**	**9,015,000**	**12,555,000**	**1,255,500**

*Sawmill, bushmill, veneer and plymill. Exclude chainsaw **Include chainsaw

*** 50% Assumed from the forests **** 25% of AAC of 1,000,000 m^3/yr. ***** 75% of AAC of 1,000,000

Source: M.Varmola eds (2002)

The Energy Commission forecasts the future demand for fuelwood based on 3 scenarios (Table 1.19). Forest resources inside and outside forest reserves in Ghana will be depleted in the near future, if the consumption of resources continues at the present rate.

Table 1.19: Future Demand Scenario

	(million tonnes)	2008	2012	2015	2020
GPRS High Economic growth scenarion	Wood for use as firewood	17.5	20.8	23.7	29.4
	Wood required for charcoal	15.7-23.6	16.9-25.4	19.3-29.0	24.1-36.1
	Toral wood required	33.4-41.2	37.9-46.4	43.2-52.9	53.7-65.7
Moderately High Economic growth scenarion	Wood for use as firewood	13.9	16.4	18.6	22.8
	Wood required for charcoal	11.3-16.9	12.4-18.7	14.1-21.2	17.5-26.2
	Toral wood required	25.2-30.8	28.8-35.0	32.7-39.8	40.2-49.0
Business-as-usual economic growth scenarion	Wood for use as firewood	10.3	12.0	13.4	16.2
	Wood required for charcoal	6.8-10.2	8.0-12.0	8.6-12.9	10.8-16.3
	Toral wood required	17.2-20.6	20.0-24.0	21.6-26.0	27.2-32.6

Source: Energy Commission(2006)

References

Aryeetey, E. and Harrigan, J. and Nissanke, M. (eds.) (2000) *Economic Reforms in Ghana: The Miracle and the Mirage*.

Aryeetey, E. and Kanbur, R.(eds.) (2008）*The Economy of Ghana: Analytical Perspectives on Stability, Growth and Poverty,* James Currey, Woeli Publishing Services.

Dordunoo, C. K. (1994) "The Structure and Policy Implication of a Macroeconomic Model of Ghana", *World Development*, Vol.22, No.8, pp.1243-1251.

Energy Commission(2006) *Strategic National Plan 2006-2020: Energy Supply to the Economy.*

Environmental Protection Agency(2005) *Ghana State of Environmental Report 2004*.

FAO(2005)*Fertilizer use by Crop in Ghana*.

Fosu, A. K. and Aryeetey E. (2008) "Ghana's Post-Independence Economic Growth: 1960-2000" in Aryeetey and Kanbur (eds.)

Gaisie, S. K. (2007) "Fertility Decline in Ghana: Implications for Public Policy" in Mba and Kwankye (eds.).

ISSER (2008) *The State of the Ghanaian Economy in 2007*, Institute of Statistical, Social and Economic Research (ISSER), University of Ghana; Legon.

Mba, C. J. and Kwankye, S. O. (2007) (eds.) *Population, Health and Development in Ghana: Attaining the Millenium Development Goals*, Sub-Saharan Publishers, Legon.

Ministry of Lands and Forestry(1994) *Forest and Wildlife Policy*.

National Development Planning Commission (2005) *Growth and Poverty Reduction Strategy (GPRS-II)* (2006-2009).

ORC Macro (2003) *Ghana: 2003 Demographic and Health Survey: Key Findings*.

Republic of Ghana(2002) Food and Agriculture Sector Development Policy (FASDEP).

Sarris, A. H.（1993）"Household Welfare During Crisis and Adjustment in Ghana" , *Journal of African Economies*, Volume 2, Number 2, 195-237.

Varmola, M., ed.(2002)*Hardwood Plantations in Ghana*, Forest Plantations Working Paper FP/24, FAO.

World Bank (1993) *Ghana 2000 and Beyond: Setting the Stage for Accelerated Growth and Poverty Reduction*.

CHAPTER 2
Population Dynamisms and Environmental Problems in the Ashanti Region

2.1 SETTING THE THEME

2.1.1 Ashanti Region

The task of this commissioned survey lies in revealing the impact of demographic changes in rural areas of the Republic of Ghana – a country that has achieved steady economic development in recent years in sub-Saharan Africa – on its agriculture and rural environment. For this purpose, we conducted a field survey in the Ashanti Region where Kumasi, the second largest city in Ghana with a population in excess of 1 million, is located.

The Ashanti Region is an inland region located slightly south of the center of Ghana. With an area of approximately 24,000 square kilometers, it is the third largest region that accounts for 10.4% of Ghana's land. Meanwhile, its population of 3.19 million accounts for 17.3% of the country's total population and is the largest among its ten regions [Ghana Statistical Service (2002)]. For this reason, the population density of the Ashanti Region is higher compared to Ghana's average population density. However, the population density in rural areas of the Ashanti Region remains at a similar level as the rest of the country because more than 1 million of the population is concentrated in the region's capital city of Kumasi. Ashanti people, belonging to the Akan language family, are the dominant ethnic group in the Ashanti Region; Kumasi was the former capital of the Ashanti Kingdom.

2.1.2 Changes in Rural Population

Descriptions in the previous paragraph are based on the results of a census conducted in 2000. Ghana has enjoyed steady economic development demonstrating a 5% average annual growth since 2001. This economic development is believed to be as a result of economic stimulation in big cities like Kumasi. One can assume that migration to cities accelerated as a result, while rural areas in the suburbs of Kumasi may have experienced an exodus to urban areas. Then again, the international price of cacao, which is the main cash crop in the peripheries of Kumasi, has remained low from the 1980s to the year 2000. As cacao farms in Ashanti Region are dependent on migrants from northern Ghana for tenants and laborers, low cacao prices had an effect on reducing population due to this exodus, or at least restraining population increase by stopping population inflow. However, global skyrocketing of resources filtered down to cacao harvesting in 2006 and its price nearly doubled by 2008. Should cacao production respond significantly to such a short-term rise in international prices, demand for farm laborers may have increased in the rural areas outside Kumasi and invited new migrants from the northern and other regions of Ghana.

Empirical evidence based on data is essential, as it is difficult to simply predict the effect of changes in economic development and the international economic climate from the year 2000 onward, on the rural population in the suburbs of Kumasi, Ashanti Region. However, we do not know how the population has

changed up to present as no census has been conducted in Ghana since 2000.[1] For this reason, the first task of this survey is to reveal the changes in population over the past 10 years in the rural areas that surround Kumasi, according to our data.

2.1.3 Changes in Rural Environment

What kind of aforementioned macro changes in economic environment and the movement of rural population have on the rural environment surrounding Kumasi? Let us first assume the possibility of an increase in rural population increased over the past 10 years. One can expect that a population increase will cause extensive expansion of farmland or reduction/elimination of its fallow period because shifting cultivation in a fallow period has generally been practiced in the rural areas outside Kumasi. Rural environment would deteriorate from the viewpoint of its forest resources because extensive expansion of farmland results in reduction of virgin forests (or secondary forest that has fully recovered after a very long fallow period), while the reduction of fallow periods cause a reduction of secondary forest. Soil fertility will also start to decline when the fallow period is shortened or discontinued. Soil deterioration will increase unless proper soil management is practiced and will eventually destroy the environment through desertification.[2]

It is thus considered that growth of the rural population will inevitably cause deterioration of the rural environment. In fact, expansion of farmland and reduction of fertilizer input per unit area due to short-term population increase were observed in the rural areas of Burkina Faso, where many Burkinaés living in Côte d'Ivoire returned to their home village after the outbreak of a civil war in Côte d'Ivoire [Sakurai (2006)]. Since the relationship between population growth and environment should be site specific, it is still unknown how much we can generalize it. For this reason, the second task of this survey is to reveal the environmental changes that have occurred over the past 10 years in the rural areas surrounding Kumasi. The survey will include actual measurements using satellite images and take into account the importance of area and quality of forest (biomass volume) in a rural environment.

Trees that generate income such as cacao and palm were planted in rural areas outside Kumasi, where the survey was conducted. When small trees are intercropped with food crops, they cannot be distinguished from ordinary fields on satellite images. Once they grow, they still cannot be easily distinguished from well-grown secondary forests. Standard fallow periods can be predicted from the ratio of farmland and bush in areas where tree planting is not practiced, providing an indication of land scarcity. This is not so simple in rural areas outside Kumasi, where tree planting is practiced. Moreover, some may claim that planting uniform tree species such as cacao and palm would not produce desirable vegetation from the viewpoint of biodiversity. It may also give rise to criticism that vegetation analysis using satellite images that cannot distinguish cash tree plantations from natural vegetations is not a method suited for rural areas around Kumasi. This survey, however, must still rely on satellite images, as no other methods exist for knowing the condition of vegetation 10 years ago.

---

[1] The next census in Ghana is scheduled for 2010.

[2] The terms "soil deterioration" and "desertification" are often used without distinction [Sakurai (2006)].

2.1.4 Relationship Between Population and Environment

A simple causality that "population increase induces environmental deterioration" can only be observed under very limited conditions. The first condition is the rural area in question is an autarky in terms of food supply and has to support its additional population with locally-produced food. This condition does not necessarily mean total autarky, hence people could rely on income from local non-agricultural employment, seasonal migration, or remittance from outside, but available food is limited to local supply. In reality, however, rural areas that are completely food-self-sufficient are rare. The case of Burkina Faso cited earlier came about as a result of not only population rapidly increasing over short-term due to unexpected war, but also people seeking an immediate source of income in the agricultural sector after non-agricultural sources such as seasonal migration and remittance were cut off. As drought is a frequent phenomenon in the semiarid regions of northern Ghana and Burkina Faso, it is common for people to diversify their source of income to seasonal migration and non-agricultural sectors so that they are still able to buy food at the market in the event of food shortage. However, risk hedging through diversification of income source is not conspicuous in rural areas surrounding Kumasi as they belong to the tropical rainforest and are less prone to risks of agricultural production compared to semiarid regions. For this reason, the degree of food-self-sufficiency is considered to be high, except in areas that have been urbanized.[3] Meanwhile, agricultural income around Kumasi is characterized by cacao and palm cultivation, however, engaging in agriculture does not necessarily mean engaging exclusively in food production. Whether one converts cacao and palm plantations into farms for food production or buys food via other sources, would depend on their relative prices at the time, and the latter would not cause the destruction of rural environment in the form of farm expansion.

The second condition in which population growth causes deterioration of rural environment is lack of technological change. Farmland has to be expanded according to the influx of population, in the event that it would not be possible to purchase food from the outside and agricultural production per unit area remains unchanged. Productivity per unit area will also decline rather than remain consistent because extensive expansion of farmland signifies use of land with inferior conditions such as lower fertility and longer distances from home for production, requiring more area for production as a result. As highlighted by Boserup (1981), relative scarcity of land as a result of population increase is known to lead to adoption of land-saving technology. The occurrence of such technological change would stop endless deforestation and soil deterioration. However, in sub-Saharan Africa where problems in the diffusion of new agricultural technologies have existed, there is concern over entire rural communities falling into poverty after being caught in the vicious cycle of extensive expansion of farmland and decline in land productivity. However, such concern only applies to cases where technological change is not happening in concurrence with land scarcity, and in reality land-saving technology according to population growth has been observed in sub-Saharan Africa. For instance, in the areas surrounding Bouaké, an inland city of Côte d'Ivoire, there

[3] Needless to say, there are cases where food that is not being produced (such as rice) is purchased for consumption, even when food self-sufficiency is attained on a calorie basis. Although cases of diversifying income sources for the purpose of risk diversification may be few in the Kumasi area, it is common for people to seek income in non-agricultural sectors to increase their income.

is more rice cropping in the lowland villages with a higher that average population density [Sakurai (2005) and Sakurai (2006)]. Since rice cropping in lowlands is a non-traditional farming practice in the Bouaké area, shortage of farmland is believed to have promoted the adoption of new agricultural technology. However, water management technology for improving rice productivity such as bunds and canals is more common in villages that accepted large number of migrants rather than in villages with high population density. This fact suggests that outsiders that bring in technology are needed for the propagation of new technology in the area [Sakurai (2005) and Sakurai (2006)]. It is therefore slightly unrealistic to assume that technological change will never occur in sub-Saharan Africa even though land scarcity does not necessarily lead to automatic technological change.

Then is there any possibility for technological change taking place in the study site? The surrounding areas of Kumasi consist of undulating hilly terrain and inland valley bottoms had never been utilized for agriculture until recently. In the recent years, however, cultivation of rice and vegetables has been expanding in lowlands. This is also true in the Bouaké areas that Sakurai (2005) and Sakurai (2006) studied. For this reason, this survey will assume cultivation of rice and vegetables in lowlands as the technological change that would occur in response to land scarcity.

In terms of the relationship between population and environment, it is also necessary to consider the reverse relationship of population being determined by rural environment. This means that areas with ample employment opportunities in both agricultural and non-agricultural sectors should experience a large inflow of population from outside, while areas lacking employment opportunities should experience population outflow. It is therefore believed that areas with a growing population have the capacity for supporting such population. These areas are likely to be avoiding crucial deterioration of rural environment by having a large tract of arable land, abundant non-agricultural employment opportunities and/or higher agricultural productivity realized through intensification. As such a relationship is expected to exist between population and environment - looking at their relationship at a single point of time may lead to the conclusion that rural environment is favourable in areas with a high population density. In order to eliminate the apparent correlations in cross-sectional data as much as possible, this survey focuses on the changes that have taken place over the past 10 years, rather than the single period at the end of 2008, when the commissioned survey was conducted.

2.1.5 Factors Other than Population Change

Discussions up until the previous paragraph were based on the hypothesis that changes in rural population are causing changes in rural environments (or vice versa). However, rural population is not the only factor effecting rural environments (e.g. vegetation and land use). It is demand for farmland – a factor for agricultural production – that is bringing about change in vegetation and land use. Demand for land naturally increases once population increases, as the need to increase agricultural production arises to support them. However, demand for land increases not only to keep food self-sufficiency but also for cash crop production.

International prices for cacao rose sharply in 2006 – Cacao fields must have expanded if the villages surrounding Kumasi had responded to this price rise.

Fallow areas with natural vegetation must have shrunk if cacao plantations were expanded without affecting food production, although such changes cannot necessarily be confirmed via the satellite images. Secondly, Ghana's economic development in recent years is expected to have caused a concentration of population in urban areas and increased food demand in cities, which means that production of food for cities may have become active. While this applies to all staple farm products for city dwellers such as maize, cassava and yam, production of vegetables and rice using lowlands should have expanded in the Kumasi area, as pointed out in the previous section. Producing vegetables in the Kumasi area is an advantage, as well as a necessity, as the perishable nature of vegetables makes them unsuited for long-distance transport. Meanwhile, rice is brought into the Kumasi markets from various regions of Ghana but the producers in rural areas around Kumasi are expected to respond to the increase in demand because many tracts of land suited for rice production are left unused in the lowlands around Kumasi and because rice is a cash crop that is rarely consumed at home.

2.2 METHOD OF SURVERY

2.2.1 Selection of Villages and Households for the Survey in 2000

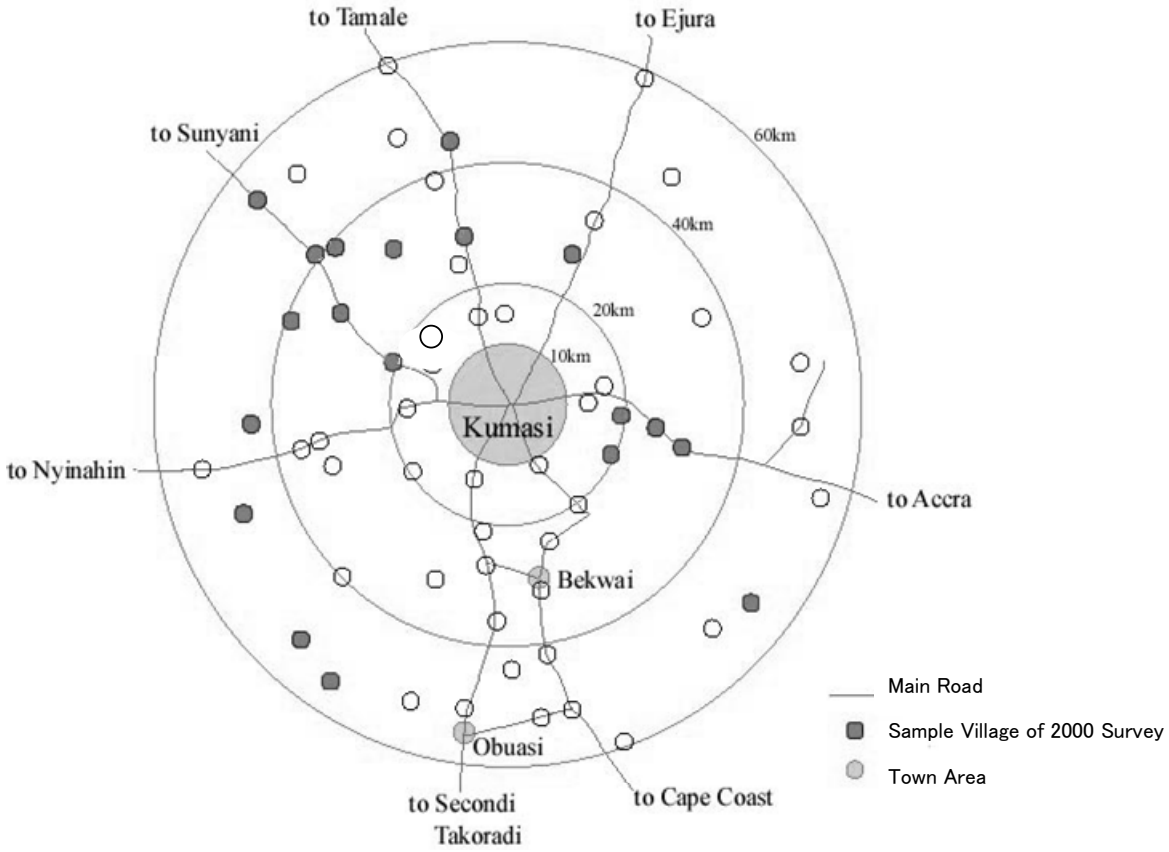
"Setting the Theme," is necessary to obtain data from at least two points in time, i.e. the time when Ghana's economic growth started (around 2000) and the time of this survey (2008), in order to highlight the changes that have taken place over nearly a decade. For this reason, we revisited the villages that were surveyed in the year 2000 and conducted another interview in 2008, in order to utilize and analyze the information collected from 2000.

The 2000 survey was conducted by the Japan International Research Center for Agricultural Sciences (JIRCAS) as a part of its West Africa Rice Project.[4] A selection of villages from the 2000 survey should first be outlined to explain the basis for selecting the villages in this survey. First, we drew a 60 kilometer diameter circle with the central district of Kumasi (near Central Market) at the center on a 1:50,000 scale map issued by the Survey Department of Ghana and put serial numbers on all the villages (whose names are on the map) inside the circle.[5] There were 1,586 villages on the map. As Kumasi is a big city with a population of 1 million, the surrounding areas of Kumasi were already urbanized in 2000, making them part of Kumasi's suburbs even though they appeared on the map as villages. Villages within a 10 kilometer diameter from the center were excluded from the survey in view of our objective of surveying rural areas. The number of villages went down to 1,491 as a result. Seven arterial roads extend from Kumasi; 255 out of 1,491 villages are located along these roads and the remaining 1,236 villages are located at some distance from these roads. We then conducted a preliminary survey by randomly selecting 40 villages which are located along arterial roads and another 40 villages that are not. As a result, we found that 40 out of these 80 villages did not have any lowlands. We therefore included an additional 20 villages that had lowlands rather than 40 villages without lowlands so that a total of 60 villages would be

[4] JIRCAS' West Africa Rice Project was implemented for 5 years from 1998 to 2002 in cooperation with WARDA-The Africa Rice Center (located in Bouaké, Cote d'Ivoire at the time). An outline of the survey in Ghana and parts of the results are summarized in Shinagawa (2001), and Tachibana, Shinagawa, and Sakurai (2002).
[5] The area around Central Market where administrative agencies and commercial facilities are concentrated was designated as the central district of Kumasi.

included in the survey. In doing so, we adjusted the number of villages in view of their location by selecting 12 villages in the 10-20 kilometer range from downtown Kumasi (consisting of 6 villages along an arterial road and 6 villages at a distance from an arterial road), 24 villages in the 20-40 kilometer range from downtown Kumasi (consisting of 12 villages along an arterial road and 12 villages at a distance from an arterial road) and 24 villages in the 40-60 kilometer range from downtown Kumasi (consisting of 12 villages along an arterial road and 12 villages at a distance from an arterial road). The results of the sample rate are as shown in Table 2.1. These villages are distributed around Kumasi, as shown in Figure 2.1.

Figure 2.1: Location of Sample Villages



We conducted a village-level survey on the 60 villages selected in this manner from August to October of 2000 (hereafter "2000 Village Survey"). Data collection was conducted by means of group interviews of village chiefs, village executives and rice farmers (depending on the village). As many as 43 out of 60 villages had at least one farmer that engaged in rice cropping during the rainy season of 2000 according to the 2000 Village Survey. The 19 villages shown in black in Figure 2.1 had 8 or more farmers that grew rice during the rainy season of 2000 and were therefore selected for the household survey. A total of 76 households, consisting of 4 rice farms randomly selected from each of the 19 villages, were selected. The survey was conducted from November to December of 2000 (hereinafter "2000 Household Survey").

Table 2.1: Sampling Rate of Sample Village for 2000 Village Survey

Distance from the Center of Kumasi	Villages on Main Road		Villages off Main Road	
	Number of Villages	Number of Villages Sampled (%)	Number of Villages	Number of Villages Sampled (%)
10−20km	35	6 (17.4%)	138	6 (4.3%)
20−40km	114	12 (10.5%)	534	12 (2.2%)
40−60km	106	12 (11.3%)	564	12 (2.1%)
Total Number of Villages	255	30 (11.8%)	1236	30 (2.4%)

Source: Hearing Survey

In addition, 6 villages that had a relatively large number of rice farmers were selected from the 19 villages for conducting a village census. The village censuses were carried out from August to September 2001, and based on the census results, 4 villages that had comparatively more farmers that specialized rice production (growing rice but not maize in the current rainy season) were selected as the site for the 2001 farm household survey (hereinafter "2001 Household Survey"). A total of 58 rice farmers who grew only rice and 55 maize farmers who grew only maize were selected randomly from the 4 villages.

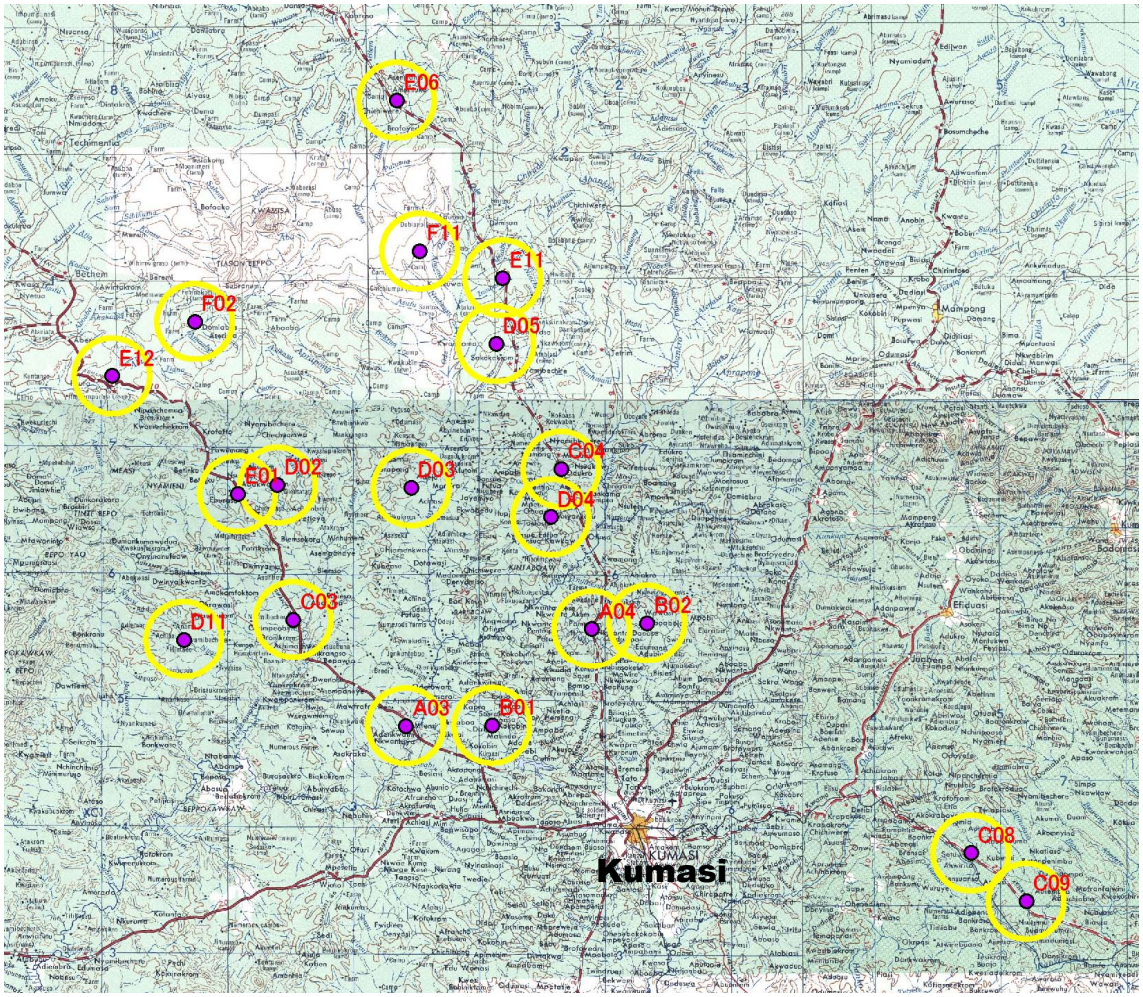
2.2.2 Selection of Villages and Households for the Survey in 2008

This field survey commissioned by the Ministry of Agriculture, Forestry and Fisheries was planned in such a way to make the most efficient use of the aforementioned surveys (2000 Village Survey, 2000 Household Survey and 2001 Household Survey) within the limited time period. As can be seen in Figure 2.1, villages where rice cropping was actively pursued (villages where the 2000 Household Survey was conducted) in 2000 were concentrated in the northwest area of Kumasi. We therefore decided to conduct our study on 8 villages located along the arterial road in the direction towards Sunyani. Among the 8 villages, 6 villages were included in the 2000 Household Survey. Two of these villages were also included in the 2001 Household Survey. Two other villages included in the 2001 Household Survey were located along the arterial road that ran from Kumasi towards Accra – a road in the opposite direction towards Sunyani. Thus a total of 10 villages, consisting of 8 villages along the road bound for Sunyani and 2 villages along the road bound for Accra were selected for the 2008 Village Survey.

Another purpose of this survey was to identify the changes in vegetation and land use by making use of satellite images. For this reason, we obtained satellite image data of the area covering the selected 10 villages from two distinct time periods (2002 and 2008, repectively). No data could be obtained for the 2 villages located along the road to Accra because of image restrictions, due to cloud cover. Data from previous years was also unavailable for 5 out of 8 villages located along the road to Sunyani. On the other hand, 9 villages located along the road running in the direction of Tamale, a city located north of Kumasi, became the subject of satellite image analysis, despite the fact that they were not included in the 2008 Village Survey. The locations of the villages included in the satellite image analysis are shown in Figure 2.2. The figure shows the village center (location of bus stop) and a circle with a radius of 3 kilometers from that center. As will be later addressed, the 3 kilometer radius was regarded as the area of village for the purpose of analyzing the changes in vegetation and land use. Villages C08 and C09, located east of Kumasi along the road to Accra, were excluded from the analysis of the satellite images.

As the purpose of this survey was to identifying the relationship between rural population and rural environment, emphasis was placed on village surveys and satellite image analysis. We did not conduct the rural household survey because the detailed household level data on agricultural production, similar to that obtained in the rural household surveys of 2000 and 2001, was deemed unnecessary for the objective. However, we decided to visit the farm households included in the 2001 Household Survey in order to perform a simple follow-up survey to grasp the reality of migration. Thus the subject for this rapid follow-up interview consisted of 58 rice-only farming households and 55 maize-only farming households that had lived in the 4 villages at the time of the 2001 Household Survey (They are D11, A03, C08, and C09 in Figure 2.2).

Figure 2.2: Location of the Villages for Satellite Data Analysis



2.2.3 Conducting the Field Survey

The field work in the Kumasi area for the 2008 Village Survey and 2008 Household Survey was conducted over a 6-day period from December 21 to December 26, 2008. The survey was carried out by 3 Japanese researchers from Japan and 4 Ghanaians living in Kumasi, most of whom were graduate students majoring in agricultural economics at the College of Agriculture & Natural Sciences, Kwame Nkrumah University of Science and Technology in Kumasi. One of the 4 Ghanaian members was a doctorial candidate with

extensive experience in household surveys, and skilled in negotiations with village chiefs and executives. He headed 10 if the village surveys, along with a researcher from Japan. Meanwhile, the other 3 Ghanaian members that had just started their Master's courses and were less experienced in fieldwork conducted household surveys under the supervision of 2 Japanese researchers.

Location information had been obtained for the all surveyed villages (latitude and longitude) during the 2000 Village Survey using the GPS. For the sake of accuracy, we obtained coordinates again near the bus stop of each village during the 2008 Village Survey. Purchase of satellite data was therefore done in January 2009 after the village survey was conducted, and the analysis of vegetation was conducted by a GIS specialist at JIRCAS. The method of satellite data analysis will be further explained in a proceeding section.

2.3 VILLAGE SURVEY

2.3.1 Changes in Population

The changes in population in surveyed villages are summarized in Table 2.2. Columns 1 and 2 show the results of the censuses taken by the Government of Ghana in 1984 and 2000. The census results can be used in many of the 60 villages included in the 2000 Village Survey. Villages D03 and D05, whose data were not found for both years, must have either been treated as a hamlet attached to another village at the time of survey because their estimated population in 2000 was less than 50 (even though they were listed as a village on the map) or were noticed in the census because of their small size. Village C03's population was not as small as Villages D03 and D05, but was still not found in the 1984 census. Ashanti is the majority ethnic group in the Ashanti Region, and the Ashanti people make for the majority of population in all villages in Table 2.2, except Villages C03 and D05. Villages C03 and D05 are believed to be colonies of minority groups formed initially as an annex to the Ashanti villages.

We asked villagers to approximate the population of their village in the 2000 Village Survey as village-level results of the 2000 census were not available at the time of conducting the 2000 Village Survey. The results are shown in Column 3. A considerable gap was observed between the response from villagers and the results of census in some villages. The estimated population in the 2000 Village Survey was more than twice as large as the 2000 census in as many as 5 villages (B01, D02, E12, A04 and B02). Among them, there was consistency for Village B01: It had claimed that its population was 2,000 at the time of interview for the 2000 Village Survey, and still claimed in the 2008 Village Survey that its population in the year 2000 was 2,000. It therefore appears that the census and the villagers had different notions about the boundary of their village. Meanwhile, the population quoted in 2000 is the same as the population quoted in 2008 in Villages D02 and E12 even though the number they gave in response to the question asked in 2008 about the population in 2000 was quite small. The absolute number of the population total may not be very reliable in these cases, although their impression of changes in population may be reflective of actual changes. Since the 2008 Village Survey was not conducted for Villages A04 and B02, there is no basis for estimating their present population.

Table 2.2: Population Changes at Village Level

Village[1]	Location	(1) 1984 Census	(2) 2000 Census	(3) Estimated population as of 2000 based on 2000 survey [2]	(4) Estimated population as of 2000 based on 2008 survey[3]	(5) Estimated population as of 2008 based on 2008 survey[3]	(6) 2000-08 annual growth rate of population based on 2008 survey[4]	(7) Estimated population as of 2008 based on annual growth rate[5]
A03	NW[6]	962	2,092	3,000	2,300	3,000	3.38	2,729
B01	NW	730	878	2,000	2,000	2,600	3.33	2,600
C03	NW	NA	438	500	480	630	3.46	630
D02	NW	114	225	500	350	500	4.56	321
D11	NW	259	402	700	550	700	3.06	512
E01	NW	862	1,682	1,600	1,350	1,500	1.33	1,869
E12	NW	871	2,013	5,000	3,000	5,000	6.59	3,355
F02	NW	478	804	800	500	800	6.05	1,286
A04	N[6]	822	1,455	4,000	NA	NA	NA	NA
B02	N	1,125	1,340	3,000	NA	NA	NA	NA
C04	N	400	490	700	NA	NA	NA	NA
D03	N	NA	NA	25	NA	NA	NA	NA
D04	N	NA	392	700	NA	NA	NA	NA
D05	N	NA	NA	40	NA	NA	NA	NA
E06	N	1,144	1,321	1,000	NA	NA	NA	NA
E11	N	946	1,743	2,000	NA	NA	NA	NA
F11	N	1,051	1,424	1,227	NA	NA	NA	NA
C08	E[6]	855	986	NA	2,500	3,000	2.31	1,183
C09	E	723	1,020	1,355	1,400	2,000	4.56	2,000

[1] See Figure 2.2.
[2] 2008 village population estimated by villagers at the time of 2000 Village Survey.
[3] 2008 village population estimated by villagers at the time of 2008 Village Survey.
[4] Calculations are based on the estimated population as of 2000, and the estimated population as of 2008 obtained in 2008 Village Survey.
[5] 2008 village population estimate is based on the population growth rate 2000-28 obtained in the 2008 Village Survey and 2000 village population obtained in 2000 Census. Exceptions are Villages B01, C03, and C09, where the 2008 village population is the one estimated by villagers in the 2008 Village Survey (data in column 5).
[6] NW: North West, N: North, E: East

The population of each village as of 2008 was estimated as follows, based on the considerations made up to this point: First, Villages B01, C03 and C09 fall under a category in which the estimated population for the year 2000 in the 2000 Village Survey (Column 3) and the estimated population for the year 2000 in the 2008 Village Survey (Column 4) almost coincide (difference of less than ±10%), but differ considerably from the results of the 2000 census (difference of more than ±10%). In this case, the census and the villagers seem to have different ideas about the boundary of their village and villagers' estimation could have been more accurate. Hence, the population for years 2000 and 2008 obtained in the 2008 Village Survey (Columns 4 and 5, respectively) will be

regarded as the total population of these villages. Therefore, the population growth rate will be obtained from them as shown in Column 6, and the estimated population for 2008 in Column 7 will be the same as Column 5.

In the second category, the estimated population for the year 2000 in the 2000 census (Column 2) coincides with the estimated population for the year 2000 in the 2000 Village Survey (Column 3) (difference of less than ±10%), while a difference in excess of ±10% exists between the estimated population for the year 2000 in the 2000 Village Survey (Column 3) and the estimated population for the year 2000 in the 2008 Village Survey (Column 4). Villages E01 and F02 fall under this category. In these cases, we considered that it would be correct to use the census results for the population in 2000 and the 2008 interview results for the population growth rate (Column 6), not for the population itself. Then, population for the year 2008 is estimated using this growth rate, which appears in Column 7.

The third category involved cases where the estimated population for the year 2000 in the 2000 census, the 2000 Village Survey and the 2008 Village Survey (Columns 2, 3 and 4, respectively) differed greater than 10% from each other. While it is difficult to determine which of the data is most reliable, Villages A03, D02, D11 and E12 that fall under this category have one characteristic in common; i.e. the estimated population for the year 2000 in the 2000 Village Survey (Column 3) and the estimated population as of 2008 in the 2008 Village Survey (Column 5) are identical. In other words, it appears that a long-term fixed notion of the population figure in their village exists in these villages. As previously mentioned, we cannot rely on the absolute number of population in this case, even though it may realistically reflect the changes in population. We therefore used the census results for the population total in 2000 as we did in the second case, and calculated the estimated population in 2008 in Column 7 using the population growth rate.

Lastly, the estimated population data for 2000 in the 2000 Village Survey (Column 3) was missing for Village C08 and could not be determined using the methods described above. Village C08, however, was one of the villages where we had conducted our own census prior to the 2001 Household Survey, as mentioned above. Since the village population numbers obtained from our own census are quite similar to the 2000 census, we included Village C08 in the second category which trusts the 2000 census statistics.

Based on the foregoing, we estimated that the 10 study villages had a total population of 12,084 in 2000 and 16,485 in 2008. This translates into a high annual growth rate of 3.96% suggesting an increase caused by the influx of migrants.

2.3.2 Migration

Using the village surveys of 2000 and 2008, we calculated the number of families that migrated in and out of the village a over the period of several years prior to the years 2000 and 2008 (5 years for 2000 and 8 years for 2008), as well as their destinations and their origin (Table 2.3, in-migration data only for 2000). As a result, we found that families were moving into respective villages in significant numbers both in 2000 and 2008. Villages with large in-migration in 2000 also tended to have large in-migration in 2008 (the correlation of corresponding samples is 0.85 with 0.003 is of significance) but no significant difference was observed for the mean value per year (7.20 families per year on

average with 5.80 standard deviation for 1995-2000, while 8.55 families per year on average with 8.00 standard deviation for 2000-2008). These figures show that there was no significant change in the number of people migrating into the rural areas around Kumasi before and after the acceleration of economic growth in 2000, though this is only true when changes that took place over the 8-year period from 2000 are averaged per year. Turning our attention to the annual changes, rapid increase in cacao prices from 2006 onward may have had an impact on migration.

Since the annual number of out-migrating families from 2000 to 2008 averaged 2.45, there was a net increase of 6.10 families per year during this period. Assuming that a family consists of an average of 6 members, we can estimate that there was an increase of 3,000 people in the 10 villages over an 8-year period. As our estimation in the previous section showed that population increased by 4,400 in the 10 villages during the same period, it would mean that 3,000 of this increase was as a result of in-migration. If the remaining increase of 1,400 was due to a natural increase, the annual natural increase rate of the surveyed villages over the past 8 years would total around 1.38%. The actual natural increase rate should be slightly lower as this number does not include a natural increase of migrant population following their migration.

The net increase for during 1995-2000 is not known because the number of families that left the villages was unknown in the 2000 Village Survey. It is therefore not possible to make a comparison between the net increase from 2000 to 2008. We can assume that the number of families leaving the village could not have been greater than the present level because we did not hear about people leaving the village in large numbers back in 2000. For this reason, we believe that no significant changes have taken place in terms of net increase after economic growth began in 2000.

Changes in population of the rural areas around Kumasi due to migration are not significant in terms of numbers. However, changes have taken place in terms of where these families were living prior to migration. Comparing the 1995-2000 period with the 2000-2008 period, migrants from the Upper East Region migrated to the higher populated villages during both periods. The Upper East Region is located in the northern part of Ghana bordering Burkina Faso, and is a region with high a rural population density that have been sending many migrants to cacao-producing zones. A sign of change, however, was noted as migrants from the Upper East Region, who were observed in all villages from 1995-2000, were found only in 7 out of 10 villages in 2000-2008. There are two significant differences between the two periods. Firstly, the diversity of regions from which migrants come was clearly reduced in the 2000-2008 period. In 1995-2000, as many as 6 villages had migrants coming from 4 or more regions but only 1 village had migrants coming from 4 or more regions in 2000-2008 with all other villages having migrants from 3 or less regions. Migrants from other countries were also noticeable in 1995-2000. Secondly, the number of migrants from within the Ashanti Region increased. The number of villages with migrants from the Ashanti Region doubled from 3 in 1995-2000 to 6 in 2000-2008 including migrants from Kumasi. While further study as to its cause is needed for these two significant changes, they suggest that changes in migration pattern of Ghana are taking place in the recent years. In other words, farmers were coming from various regions of Ghana and from overseas to work in cacao farms until the year 2000. Recently, however, these first generation migrants and their children (second generation) appear to be

Table 2.3: Village Level Population Movement

Village[1]	Share Ashanti population in the village in 2008	1995—2000 Immigrated Family (IF)		2000—2008 Immigrated Family (IF)		2000—2008 Emigrated Family (EF)	
		Number of HHs[2]	From where[3] (Origin)	Number of HHs[2]	From where[3] (Origin)	Number of HHs[2]	To where[3] (Destination)
A03	70%	10	UE, UW, Volta, Togo*	12.5	UE, UW	2.53	Kumasi
B01	99%	10	UE, Volta, Central, Cote d'Ivoire*, Burkina Faso*	6.25	Northern, Ashanti	0.13	Ashanti
C03	40%	4	Northern, UE, Volta, Eastern,Ashanti	0.50	UE	0.63	Ashanti
D02	60%	1.8	Northern, UE, BH, Volta	1.25	BH	0.63	Ashanti
D11	30%	2	UE, BH	1.25	Western, Ashanti	1.88	Northern, Ashanti
E01	70%	8	Northern, UE, BH, Volta, Niger*	6.25	BH, Ashanti	5	Kumasi
E12	70%	20	UE, Volta, Ashanti	27.5	UE, Eastern, Volta, Benin	6.25	BH, Ashanti, Accra
F02	80%	2	UE, UW, Central, Ashanti, Benin*	10	UE, UW, Ashanti	1.25	Kumasi
C08	90%	NA	NA	7.5	UE, Kumasi	0	NA
C09	70%	7	UE, Volta	12.5	UE, Volta, Central, Kumasi	6.25	Ashanti. Accra
	Average:	7.2	mode: UE	8.55	mode: UE	2.45	mode: Ashanti

[1] See Figure 2.2.
[2] Number of moved Households (HHs) per year.
[3] Only major regions/countries are listed, not necessarily exhaustive. Names without * are regions or cities in Ghana. UE: Upper East, UW: Upper West, BH: Brong-Ahafo.

moving in increasing numbers to other villages in the Ashanti Region. Such cases also include those who return to rural areas after working in the city.

Increasing migration within the Ashanti Region is also substantiated by the out-migration pattern of population. Although the number of those leaving the village is not limited to non-Ashanti outsiders (first and second generation migrants), their most common destination is another village in the Ashanti Region. Relocation to urban areas such as Kumasi and Accra is also noticeable. While no data is available on migration for 1995-2000, it can be imagined that economic development from 2000 onward is causing migration to cities.

The share of population of the Ashanti people in each village is also shown in Table 2.3. While it ranges from 30% to 99%, no significant correlation can be found between migration and the percentage of Ashanti people.

2.3.3 Migration Patterns at Household Level

Let us examine the information obtained in the 2008 follow-up survey on 113 farmers in 4 villages that were included in the 2001 Household Survey, to confirm the migration pattern of farm households in more detail. As explained in the previous section, 113 farmers in the 2001 Household Survey consisted of 58 rice-only farmers and 55 maize-only farmers (all adult male farmers). Six of them had died at the time of the follow-up survey. Out of the remaining 107, residency in the village was confirmed for 74. However, the total does not necessarily reflect the whole situation of the surveyed villages because the sample farmers consist of rice-only farmers and maize-only farmers almost equally, despite a very small percentage of rice-only farmers in each village. For instance, Ashanti constituted 13 out of 58 rice-only farmers and 27 out of 55 maize-only farmers, which means that the percentage of Ashanti among rice-only farmers was significantly low. Looking at rice-only farmers and maize-only farmers separately, since the number of the Ashanti population estimated from the percentage in Table 2.3 and the number of samples from each village is 77 (68%), the percentage of Ashanti maize-only farmers is also lower than the predicted figure, for unknown reasons.

As shown in Table 2.4, in 2001, 2 out of 58 rice-only farmers had passed away in their village. We were able to confirm that 38 out of the remaining 56 were still living in the village at the time of the 2008 Household Survey. This means that 67.9% of them were still living in the village. Among the 18 that were not in the village, we were not able to locate 5 people in our search using data obtained in the 2001 Household Survey (e.g. name, ethnic group, age). We were able to find the approximate destination of the remaining 13 that we succeeded in locating. Their most common destination was another village in the Ashanti Region (5), followed by a village in the Northern Region from which they had migrated (4). Only 2 had moved to cities such as Kumasi and Accra. Meanwhile, out of 55 maize-only farmers surveyed in 2001, 4 had passed away and 36 were living in their village in 2008. This means 36 out of 51 (70.6%) were living in the village they lived back in 2001. This result shows that there is no difference in the percentage of rice-only farmers and maize-only farmers who are still living in their village. However, the destinations of 11 farmers that left their village are very different from rice farmers. Seven out of 11 moved to cities such as Accra and were engaging in non-agricultural jobs. Despite the existence of many non-Ashanti people among maize-only farmers, the destination of their migration was limited to the Ashanti Region.

Table 2.4: Attrition of 2001 Sample Households as of 2008

Village[1]	Category of Farm Household in 2001 survey	Ethnic group	Number of HHs[2] in 2001	Situation in 2008 Household Survey				Emigration Destination					
								Urban		Rural			
				Living in same village	Dead	Missing[2]	Emigrated	Kumasi	Accra	Within the same region	North-ern	West-ern	East-ern
A03	Rice production only	Ashanti	1	1	0	0	0	0	0	0	0	0	0
		Non Ashanti	17	11	0	1	5	1	0	2	2	0	0
	Maize production only	Ashanti	10	7	1	1	1	0	0	1	0	0	0
		Non Ashanti	7	5	0	1	1	0	0	1	0	0	0
D11	Rice production only	Ashanti	3	2	0	0	1	0	0	1	0	0	0
		Non Ashanti	7	6	1	0	0	0	0	0	0	0	0
	Maize production only	Ashanti	1	1	0	0	0	0	0	0	0	0	0
		Non Ashanti	8	3	1	2	2	1	0	1	0	0	0
C08	Rice production only	Ashanti	9	8	0	0	1	0	1	0	0	0	0
		Non Ashanti	4	2	1	0	1	0	0	0	0	1	0
	Maize production only	Ashanti	6	5	0	0	1	0	1	0	0	0	0
		Non Ashanti	6	5	0	0	1	0	0	1	0	0	0
C09	Rice production only	Ashanti	0	0	0	0	0	0	0	0	0	0	0
		Non Ashanti	17	8	0	4	5	0	0	2	2	0	1
	Maize production only	Ashanti	10	6	1	0	3	2	1	0	0	0	0
		Non Ashanti	7	4	1	0	2	0	2	0	0	0	0
Total Number			113	74	6	9	24	4	5	4	4	1	1
	Rice production only		58	38	2	5	13	1	1	5	4	1	1
	Maize production only		55	36	4	4	11	3	4	4	0	0	0
	Ashanti		40	30	2	1	7	2	3	2	0	0	0
	Non Ashanti		73	44	4	8	17	2	2	7	4	1	1

[1] See Figure 2.2.
[2] Number of Households(HHs) in 2001.
[3] "Missing" people are those who cannot be identified by attributes such as name/age/ethnic group, as recorded in the 2001 household survey.

A large number of maize-only farmers switching to non-agricultural sectors indicates that maize-only farmers may tend to shift selectively to non-agricultural sectors because they are mostly Ashanti people who are relatively well educated. We divided the 113 farmers into Ashanti and non-Ashanti groups in Table 2.4 and compared their present status to confirm this point. The group consisted of 40 Ashanti and 73 non-Ashanti farmers which meant there were 1.8 times as many non-Ashanti farmers as Ashanti farmers. The percentage of farmers still living in their village obtained by subtracting the number of deceased from the total was significantly lower for non-Ashanti: 78.9% for Ashanti and 63.8% for non-Ashanti. A significantly lower percentage for non-Ashanti confirmed that the mobility of non-Ashanti people was higher compared to that of Ashanti people. In particular, the number of sample farmers that could not be identified in the follow-up survey and classified as "missing", was significantly higher among non-Ashanti. Out-migration was also more common among non-Ashanti people but the number of those that migrated to Kumasi and Accra is almost the same between the two groups. The fact that non-Ashanti outnumbered Ashanti by 1.8 times in the sample suggests that an Ashanti has more tendency to work in non-agricultural sectors, or that they have the same tendency as non-Ashanti to work in non-agricultural sectors. For this reason, one cannot negate the possibility that career changes to non-agricultural sectors is relatively more common among maize-only farmers because of a higher percentage of Ashanti people among them. On the other hand, the characteristics of rice and maize as commercial crops can be reflected, despite differences between ethnic groups. Although this is merely a hypothesis, rice-only farmers are farmers specializing growing rice as a cash crop while (some of) maize-only farmers may be growing maize as a tentative source of staple food until they find jobs in non-agricultural sectors.

What we have found from the migration patterns of farm households based on household surveys is their high mobility demonstrated by the fact that as many as 30% of households left their villages over a period of only 8 years. Moreover, a quarter of these households did not even leave a trace in the memory of other villagers. These households practice farming for several years (sometimes only 1 year) in one village and move on to other land. These households probably continue to migrate without being bound to particular land until they own a cacao farm in proximity to a village or return to their home village for various reasons.

2.3.4 Changes in Land Use

The topic of discussion in this section is the changes in land use on a village level based on village surveys. In Table 2.5, we divided village land into 4 categories, based on percentage: 1) farmland used for growing food crops, 2) plantation on which tree crops such as cacao and palm are planted, 3) fallow bush, and 4) natural forest. Among the 10 villages surveyed, Village E12 was the only village that had natural forest within its boundaries and the forest accounted for 70% of the entire area. This natural forest is a government forest reserve where the villagers are not permitted to cultivate, but logging is practiced under management of the government. We regarded the remaining 30% of the land in Village E12 as 100% of land for this village in Table 2.5, because the forest practically cannot be used as farmland, thus recalculating the percentage of land use.

Table 2.5: Changes in Land Use at Village-Level

Villages[1]	Share of food crop area (%)		Share of tree crop area (%)		Share of fallow area (%)	
	2000	2008	2000	2008	2000	2008
A03	45	50	25	25	30	25
B01	70	65	20	25	10	10
C03	60	30	30	60	10	10
D02	40	30	30	40	30	30
D11	55	40	30	50	15	10
E01	40	20	40	60	20	20
E12[2]	50	27	33	66	17	7
F02	60	35	30	60	10	5
C08	65	70	15	10	20	20
C09	70	60	20	30	10	10
Average	56	43	27	43	17	15
P-value[3]	0.009		0.005		0.052	

[1] See Figure 2.2
[2] In addition to the land under the three categories Village E12 has natural forest, which covers about 70% of total village area.
[3] This is obtained by a t-test for paired samples to evaluate whether the two averages are equal.

The average of 10 villages concerning food crops dropped from 56% in 2000 to 43% in 2008, and the difference is statistically significant at a 1% significance level. Meanwhile, the average percentage of tree crops had increased from 27% to 43% during the same period, which is also different at a significance level of 1%. In contrast, the percentage of fallow land had dropped slightly with hardly any change (difference in mean value is not significant even at 5% level). These figures show that cacao planting has expanded in the surveyed villages due to the cacao boom in recent years, causing a contraction of food crop area rather than follow area.

Village-wise, the food crop area exceeded 50% in 4 villages (A03, B01, C08 and C09) in 2008. As can be seen in Figure 2.2, they are the closest to Kumasi among the 10 villages. The fact that A03 and C08 are the only villages where the percentage of food crop cultivation increased between 2000 and 2008, demonstrates a strong tendency to select food crops over cacao in areas in the vicinity of Kumasi. Meanwhile, tree crop area accounted for more than 50% in 5 villages (C03, D11, E01, E12 and F02). Among them 3 villages (C03, E12 and F02) increased the percentage of tree crop area more than twofold after 2000, indicating a rapid expansion of tree crops (presumably cacao) in villages that are distantly located from Kumasi. Incidentally, the percentage of tree crop area in D02 was lower than these 5 villages at 40%. This village, like the other 5 villages, places emphasis on tree crops, in that the area of tree crops exceeds the area of food crops; the reason why tree crop area was less than 50% in D02 village is that the percentage of fallow area was highest among the 10 villages at 30%. Thus the cultivation of tree crops is increasing in place of food crops in all 6 villages that are located far from Kumasi.

2.3.5 Soil Degradation

What kind of impact does the reduction in food crop area have on farmland? Table 2.6 lists the values that serve as indicators of land scarcity. Areas under cultivation per standard farm household are increasing in some villages and decreasing in other villages with no significant difference among an average of 10 villages. It makes sense that there was no major change in area under cultivation considering the fact that the expansion of tree crop area was realized by reducing the food crop area. Alternatively, since population growth had occurred in all surveyed villages, as was shown in Table 2.2, the fact that area under cultivation per farm household remained constant cannot be explained unless the majority of the additional population were agricultural workers and/or that the non-agricultural sectors had expanded. Furthermore, even if an area under cultivation per farm household remains constant, food crop area would decline once the area for non-edible cash crops (e.g. cacao) is expanded – the result of which would be a decline in food production. There would of course be no problem if food could be purchased by the income from cash crops. The alternate problem would be that that the fallow period has been reduced significantly as shown in Table 2.6. The standard fallow period was reduced by 1 to 5 years over the past 8 years in all the villages except for 3 that did not experience any changes in fallow period. This fact translates to an increase in the extent of land use intensity that could lead to soil degradation, unless it is accompanied by adequate soil fertility management. In reality, in 7 out of the 10 study villages, villagers stated that the problem of soil degradation has worsened over the past 8 years. In addition, the current condition of soil degradation was allegedly "very serious" in 3 of these villages.

From a long-term perspective, the reduction of a fallow period and the transition from shifting cultivation to continuous cultivation on permanent farms has occurred in various parts of the world. Table 2.6 also presents the number of years over a period of continuous cultivation which was estimated based on the surveyed data. The estimation was calculated by assuming that the ratio of continuous cultivation years against fallow years is the same as the ratio of food crop area against fallow area, as shown in Table 2.5, and using the standard fallow period for 2000 and 2008 in Table 2.6 as the base. Contrary to our expectations, the estimated number of years of continuous cultivation greatly decreased between 2000 and 2008 in terms of the average for the 10 villages. In some villages, the reduction in the continuous cultivation period is quite large. This increase in the estimated period of continuous cultivation originated from the increase in relative percentage of fallow land, which is the result of a reduction in food crop area by conversion into tree crops without any significant changes taking place in fallow areas. The continuous cultivation period obtained in this manner is not accurate, and fallowing may no longer be practiced at many farms in cases where the estimated period exceeds 10 years (i.e. fallow area being very small compared to cropped area). Then again, if the expansion of tree crops takes place in relatively land-rich villages where farmers are still practicing shifting cultivation, tree crops will have a positive impact on fallow management of arable land for food crops.

Table 2.6: Degree of Land Scarcity at Village Level

Village[1]	Standard farm size per household(acre)			Standard fallow period (year)			Estimated period of continuous cropping (year) [2]			Land Degradation		2008 Prices of upland field (¢/acre)
	2000	2008	Differ-ence	2000	2008	Differ-ence	2000	2008	Differ-ence	Degree of Seriousness of Present Situation[3]	Changes since 2000[4]	
A03	2	3	+1	4	3	-1	6	6	0	1	1	3,000
B01	1	2	+1	5	3	-2	35	19.5	-15.5	1	1	NA[5]
C03	4	3	-1	3	2	-1	18	6	-8	2	2	300
D02	1.5	2	+0.5	4	4	0	5.3	4	-1.3	0	0	NA[5]
D11	5	3	-2	4	2	-2	14.7	8	-6.7	0	0	400
E01	4	3	-1	10	5	-5	20	5	-15	1	1	500
E12	3	5	+2	5	3	-2	1	0.3	-0.7	2	1	2,500
F02	2	3	+1	4	4	0	24	28	+4	0	-2	4,000
C08	4	3	-1	2	2	0	6.5	7	+0.5	2	2	1,000
C09	1	2	+1	6	4	-2	42	24	-18	1	1	1,000
Average	2.75	2.8	0.05	4.7	3.2	-1.5	17.3	10.8	-6.5	1.0	0.7	1,600
P-value [6]	0.722			0.012			0.031			NA	NA	NA

[1] See Figure 2.2.
[2] Estimated assuming that the ratio between the share of fallow area in Table 2.5 and the standard fallow period in Table 2.6 is the same as the ratio between the share of food crop area in Table 2.5 and a continuous cropping period, as shown in Table 2.6.
[3] The scale of villagers' evaluation: 0=no serious at all, 1=a little serious, 2= very serious
[4] The scale of villagers' evaluation: 2=improved very much, -1=improved, 0=no changes, 1=getting worse, 2= very much getting worse
[5] Purchase and sale of land are not permitted under the customary law. Since there is no land transaction (or even if it does happen, it will not be publicly reported), land price cannot be known.
[6] This is obtained by a t-test for paired samples to test if the two averages are equal.

Lastly, let us examine the prices of farm land at the study site. Land market is generally underdeveloped in sub-Saharan Africa where the modern land ownership system, accompanied by a registration system, has not been established. Ghana is no exception to this rule with people traditionally believing that the buying and selling of land should not be permitted, as witnessed in 2 of the surveyed villages. In reality, however, land ownership is transferred through payment in compensation and the transfer is confirmed by a third party such as village chief. In other villages, the standard price has been disclosed according to actual transactions. Price will be determined by supply and demand as long as the land market is functioning, with productivity of land being reflected in its price. Although this is not clear at first glance, farm prices in Table 2.6 have a significant positive correlation with the population growth rate in Table 2.2 and a significantly negative correlation with the changes in soil degradation since 2000, as shown in Table 2.6. These results suggest that the land market, despite its reputation of being imperfect, reflects demand and productivity at the study site.

2.3.6 Forest Resources

Besides soil degradation, reduction in forest resources is another important index of rural environment. What requires attention here is the fact that the word "forest" in sub-Saharan Africa often refers to protected virgin forest. Much of natural vegetation seen in the periphery of any village is regrowth on fallow land and is distinguished from "forest" in that it could be cultivated again if necessary. However, there is no significance in distinguishing virgin forest and regenerated forest from the viewpoint that having natural vegetation around residential areas leads to the conservation of water sources and soil, which, in turn, improves the living environment. In addition, cacao and palm plantations that are commonly seen in the surrounding areas of Kumasi form sufficient natural resources from the viewpoint of biomass – even though they are inferior to natural vegetation in terms of biodiversity – and should not categorically be seen as the source of negative environmental impact. When Table 2.5 is examined with these points in mind, one can assert that expansion in the area of tree crops and considerable reduction in the area of food crops amidst slight reduction in fallow area between 2000 and 2008 in surveyed villages, signifies an increase of trees in the rural areas, and that it had a positive impact on the rural environment.

Meanwhile, if we limit forest to virgin forest, Village E12 is the only village that is surrounded by forest, as shown in Table 2.7. Because logging in this forest is an important economic activity for the residents of Village E12, decline in quality of forest is a serious issue. However, the residents of other villages that do not have forest are hardly inconvenienced by the lack of forest. Logging activities still continue in villages located far from Kumasi (D02, D11, E01 and F02) because there are still large trees left in the fallow bush as although they have lost virgin forest. Illegal logging also takes place in these villages and is regarded as a (very) serious problem by the villagers. However, it appears that the reason for their concern is not necessarily environmental deterioration caused by illegal logging.

Table 2.7: Forest Resources in the Villages

Villages[1]	Share of forest area in the village[2]	Is no forest a problem? [4] 0=not at all 1=a little problem 2=serious problem	How many years have passed since the last logging?[3]	Is there any illegal logging in the village? 0=No 1=Yes	Degree of seriousness of illegal logging [4] 0=No effect 1=not so serious 2=serious 3=very serious
A03	0	0	6	0	No trees
B01	0	0	15	1	3
C03	0	0	3	0	No trees
D02	0	0	0	1	2
D11	0	1	0	1	3
E01	0	0	0	1	3
E12	70	NA	0	1	2
F02	0	0	0	1	2
C08	0	0	10	1	1
C09	0	0	4	1	1
Average	7	NA	3.8	NA	NA

[1] See Figure 2.2.
[2] Only village E12 has a natural forest, which is protected by the government.
[3] 0 means that logging was still practiced in 2008.
[4] Evaluation by villagers. E12 is the only village that has a natural forest, and the villagers' response is that deforestation is "Very Serious".

2.3.7 Use of Lowlands

Up to this point, discussion has revolved mainly around the land use in uplands: farms and forests. However, lowlands are becoming an increasingly important ecology in the areas around Kumasi. Lowlands have been rarely utilized for cropping until population increases and farms are being expanded extensively. Additionally, lowlands are extremely suited for intensive cultivation of cash crops such as rice and vegetables compared to uplands, because of their abundance of water. For this reason, if intensification of agriculture is going to occur, it would occur first in the lowlands.

Land use in lowlands of surveyed villages is listed in Table 2.8. There were a total of 35 lowland areas at the study site, corresponding to 3.5 lowlands for each village in average. Although not shown on the table, lowlands were highly utilized by the surveyed villages: only 1 out of 35 lowlands were used for agriculture in 2000 and there was no unused lowland in 2008. In addition to growing rice in the rainy season, lowlands in the Kumasi area were generally used to grow maize and vegetables in the dry season and minor season. Trees such as palm and teak are also planted in some areas. The number of lowlands used for growing rice had declined from 27 out of 35 in 2000 to 21 out of 35 in 2008. The decline was concentrated in certain villages: there are no rice growing lowlands in villages E12 and F02. Meanwhile, the number of lowlands used for growing vegetables increased from 22 in 2000 to 29 in 2008. The decline in rice-growing lowlands and increase in vegetable-growing lowlands are close but it does not necessarily mean that farmers changed from rice to vegetable cultivation. Although not shown in Table 2.8, out of 7 lowlands that

Table 2.8: Utilization of Lowlands at Village Level

Village[1]	Number of lowlands in the village	Number of Rice-producing lowlands		Number of Vegetable-producing lowlands		Number of Maize-producing lowlands		Number of lowlands with Oil Palm plantations	
		2000	2008	2000	2008	2000	2008	2000	2008
A03	3	3	3	1	2	3	1	0	0
B01	5	1	2	4	5	1	0	0	5
C03	4	4	3	0	1	2	1	0	0
D02	3	3	3	1	1	0	3	2	0
D11	2	2	2	1	2	2	2	2	2
E01	3	3	3	3	3	3	0	3	0
E12	3	2	0	1	3	1	3	2	3
F02	5	2	0	4	5	3	5	3	0
C08	4	4	2	4	4	0	0	1	3
C09	3	3	3	3	3	3	1	3	1
Total	35	27	21	22	29	18	16	16	14

[1] See Figure 2.2.

discontinued rice cropping in 2008, only 3 were not growing vegetables in 2000 but did grow vegetables in 2008. The remaining 4 lowlands that were no longer growing rice in 2008 were growing vegetables in both 2000 and 2008. Only a small number of lowlands were growing maize and palm compared to rice and vegetables, and their numbers declined by only small margin between 2000 and 2008. Cultivation of maize and palm appears to be stable when one only looks at the numbers but its analysis reveals that this is not really the case.

Tables 2.9 through 2.12 divide the lowlands into 4 patterns based on the crops grown in the lowlands and present their corresponding number. Table 2.9 shows that, out of 21 lowlands where rice was grown in 2008, 20 were also used for growing rice back in 2000. Similarly, Table 2.10 shows that 22 out of 29 lowlands where maize was grown in 2008 were also growing maize back in 2000. These numbers show that cultivation of rice and vegetables has been continued consistently in many lowlands, even though it was discontinued and restarted in some cases. In contrast, out of 16 lowlands where maize was grown in 2008, only 8 were used for maize cultivation in 2000. The situation is similar for palm with only 6 out of 14 lowlands growing palm in 2008 also growing palm back in 2000. Thus maize and palm do not appear to be stable crops even despite the little changes observed in the number of lowlands that grew them.

Table 2.9: Stability of Rice Production

Crops produced in 2000	Crops produced in 2008	Number of lowlands in 2008
Rice	Rice	20
	Other than rice	7
Other than rice	Rice	1
	Other than rice	7

Table 2.10: Stability of Vegetable Production

Crops produced in 2000	Crops produced in 2008	Number of lowlands in 2008
Vegetables	Vegetables	22
	Other than vegetables	0
Other than vegetables	Vegetables	7
	Other than vegetables	6

Table 2.11: Stability of Maize Production

Crops produced in 2000	Crops produced in 2008	Number of lowlands in 2008
Maize	Maize	8
	Other than maize	10
Other than maize	Maize	8
	Other than maize	9

Table 2.12: Stability of Oil Palm

Crops produced in 2000	Crops produced in 2008	Number of lowlands in 2008
Oil palm	Oil palm	6
	Other than oil palm	10
Other than oil palm	Oil palm	8
	Other than oil palm	11

Fluctuations in the actual number of rice farmers are shown in Table 2.13. The number of rice farmers in all the lowlands of surveyed villages had dropped from 253 in 2000 to 169 in 2008. Rice cultivation has disappeared in villages E12 and F02, but they had relatively little impact on the entire reduction because there were only a few rice farmers to begin with. A decline in the number of farmers growing rice on each lowland has manifested as a decline in the total number of rice farmers while the number of lowlands used for rice cultivation remains unchanged.

We had expected an activation of lowland use around Kumasi compared to 2000 because of extensive expansion of farmland caused by population growth in rural areas as well as increased demand for rice and vegetables from the economic development of Kumasi. Contrary to our expectations, however, the results of our analysis showed that rice production had been cut back. Only the production of vegetables had increased to meet the demands from cities.

Table 2.13: Changes in Number of Rice Farmers at Village Level

Villages[1]	Number of lowlands in village	2000		2008		Difference in the number of rice producers
		Number of rice producing lowlands	Number of rice producers	Number of rice producing lowlands	Number of rice producers	
A03	3	3	64	3	60	-4
B01	5	1	1	2	7	6
C03	4	4	36	3	22	-14
D02	3	3	23	3	10	-13
D11	2	2	21	2	36	15
E01	3	3	23	3	6	-17
E12	3	2	11	0	0	-11
F02	5	2	2	0	0	-2
C08	4	4	48	2	3	-45
C09	3	3	24	3	25	1
Total	35	27	253	21	169	-84

[1] see Figure 2.2.

2.3.8 New Rice Cropping Technology

The number of lowlands used for rice production and the number of farmers engaging in rice production had diminished from the year 2000, despite our anticipation of increased production in response to growth in demand from urban areas. However, diffusion of new technology that did not exist at the time of the previous survey we conducted (from 2000 to 2001) was otherwise confirmed in this survey. Double cropping was practiced in all the 3 lowlands located in village A03, which is the village located closest to Kumasi among the surveyed villages. Single cropping in the rainy season was the only method practiced in these lowlands from 2000 to 2001 and remains so in villages other than A03. Double cropping is now practiced by the majority of farmers in village A03 after it was introduced around 3 years ago by following the advice of an agricultural engineer from outside the village. It does not involve building bunds or canals, but makes use of moisture remaining in the soil to grow rice during the dry season. In fact, when we visited village A03 during the dry season, we witnessed rice farmers working busily in their paddy fields.

Alternatively, a project by the Ghanaian Government to build a small dam to irrigate lowland fields was in progress in village B01, another village near Kumasi. The construction allegedly had not begun but the plan was officially approved. Village B01 has limited record of rice cropping and all 7 farmers engaging in rice cropping in lowlands of Village B01 in 2008 lived in other villages. Notwithstanding our doubts about who will be growing rice after the irrigation is put in place, the villagers expressed their willingness to restart rice cropping by taking full advantage of the government project.

As can be seen from the example of lowland rice production in Côte d'Ivoire as discussed above, new technology is not passed on unless it is provided by someone. In this sense, the 2 villages near Kumasi in this survey offer interesting examples for determining whether it is possible to establish rice cropping and improve its productivity. The fact that this was taking place in 2 out of 10 surveyed villages suggests the possibility of many other efforts that are being made in the entire area surrounding Kumasi. On the other hand, villages such as E12 and F02 that are left behind from such diffusion of technology because of their distance from the city will experience disappearance of rice cropping.

2.4 VEGETATION COVER ANALYSIS OVER TWO PERIODS USING SATELLITE DATA

Time-series analysis, using data from earth observation satellites which are operated in constant intervals, is effective in grasping the changes in land use and vegetation over time. For this reason, we used the satellite data of our sample villages observed in January 2002 and February 2008 to study the changes in vegetation cover of an area within the 3 kilometer diameter range from the village center.

2.4.1 Method of Analysis

(1) Satellite data used for analysis:

VNIR (Visible and Near-infrared Radiometer) data from ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer), which was installed on Satellite Terra launched by the United States in 1999, was used for our analysis.

ASTER is an earth observation sensor developed by the Ministry of Economy, Trade and Industry of Japan that covers 14 bands from visible to thermal infrared range. It has an observation range of 60 kilometers and a recurrent cycle of 16 days. VNIR is one of the sensors comprising ASTER with a 15-meter ground resolution that detects solar reflection from land surface in 3 wavelength bands including visible green range, visible red range and near-infrared. Although it is an optical sensor that cannot penetrate through clouds, it is widely used for analysis of vegetation and land use, as it is equipped with a wavelength band that reflects the spectral properties of plants.

As the result of a data search focusing on cloud cover for 2000 and 2008 when village interviews were conducted, we decided to use the data (1 scene) observed on January 15, 2002 as there was not any appropriate data available for 2000. We also decided to join the 2 scenes observed on February 24, 2008, for 2008. Specifications of data used in this analysis are shown in Table 2.14.

Table 2.14: Information Obtained from Satellite Data

Date of Observation	15 January 2002	24 February 2008
Product ID	AST3A1 02011510412309012200005	AST3A1 08022410451109012200010 AST3A1 08022410450209012200011
Censor and Observed Wavelength Width	Visible and Near-Infrared Radiometer (VNIR) Band1: 0.52－0.60μm Bnad2: 0.63－0.69μm Band3N: 0.76－0.86μm (nadir) Band3B: 0.76－0.86μm (backward)	
Ground Resolution	15m	
Geographical Coordinate system	WGS84	
Map projection	Universal Traverse Mercator projection (UTM Zone: 30)	
Quantization Bitrate	8 bit	

(2) Data processing procedures:

The Normalized Difference Vegetation Index (NDVI) was calculated using satellite data from 2002 and 2008 respectively. NDVI is an index that uses the property of green plants of having low reflectance in visible red wavelength band and high reflectance in near-infrared wavelength band, and is widely used as index reflecting the existence of vegetation as well as its volume and activity. Since Band 2 and Band 3 correspond to a visible red wavelength band and a near-infrared wavelength band, respectively, in ASTER, NDVI is obtained by Formula (1).

ASTER's data is obtained by normalizing the radiance measured by sensors into 256 levels and the range of each piece of data differs depending on ground cover and weather at the time of observation. As the data from 2008 that we used for this analysis was mainly cloudy and had large data range differences with 2002, corrections were made so that average brightness value of water area (where yearly differences are small) would be equal. Therefore, NDVI was obtained by using Formula (1) for 2002 data and Formula (2) for 2008 data.

Formula (1)

$$NDVI = \frac{(Band3 - Band2)}{(Band3 + Band2)}$$

Formula (2)

$$NDVI2008 = \frac{[(Band3 - 26) - (Band2 - 40)]}{[(Band3 - 26) + (Band2 - 40)]}$$

We then set the threshold in view of the color tone that appears on the color composite image and the local conditions confirmed by the December 2008 field survey to create an NDVI classification map. Furthermore, the location information of 19 villages including the 10 study villages (GPS coordinates at

the center of each village) were imported into the geographic information system (GIS) to generate a 3 kilometer buffer range around the center points (see Figure 2.2) and the area for each NDVI classification was calculated for each site, in order to compare the changes between the two points in time.

2.4.2 Results and Reviews

Figures 2.3 and 2.4 correspond to color composite images and NDVI images from January 2002 and February 2008 that were used for the analysis. The 3 kilometer buffer included in the analysis is superimposed on the color composite image. Out of 19 villages, 12 sites and 17 sites fell into the observation range of satellite data in 2002 and 2008 respectively. In addition, vegetation is shown in green and bare land is shown in pink/purple on the color composite image, and the difference in vegetation is expressed in more detail by converting into NDVI.

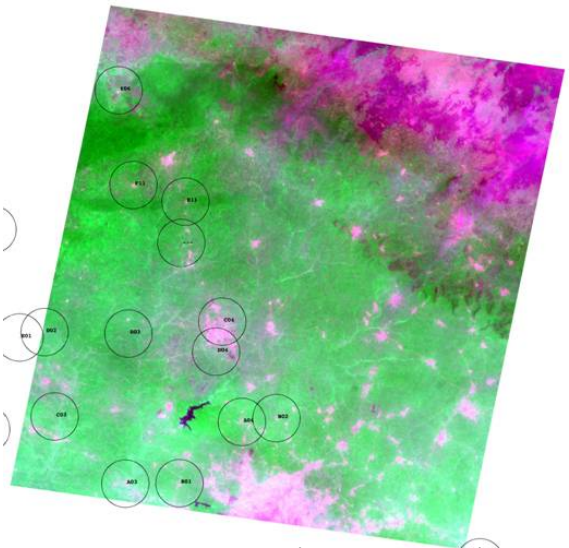
The classification of NDVI and its corresponding color composite image of the 3 kilometer area of each sample village are shown in Figure 2.5 for 2002 and Figure 2.6 for 2008. Area composition at each site is shown in Figure 2.7. NDVI classification consists of areas with hardly any vegetation (Non-vegetation: bare land), areas with small NDVI and appear to have little vegetation (Vegetation 1: low vegetation) and areas with large NDVI and appear to have much vegetation (Vegetation 2: high vegetation) and color-coded them red, yellow and green, respectively. We also added a close-up (Figure 2.8) since Figures 2.5 and 2.6 may be too small to read the vegetation status of each site.

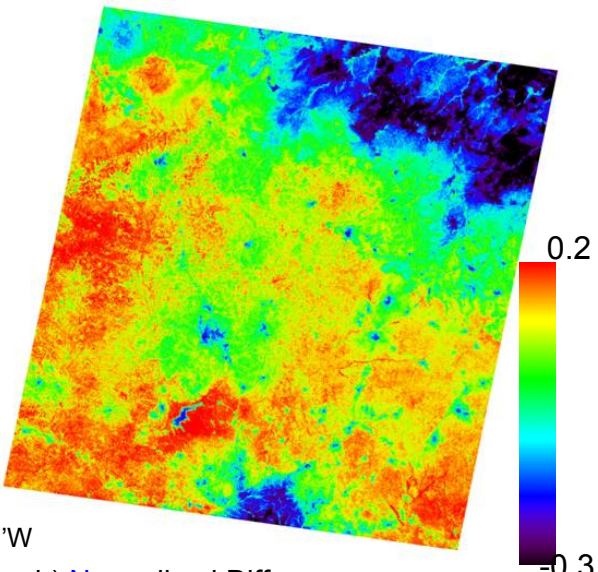
In 2002, the percentage of bare land was high in Villages C04 and D04 at 80-90%, followed by Villages E06 and F11 at 30-40%. Villages C04, D04 and E06 still had 50-80% bare land in 2008 while it decreased in Village F11. Meanwhile, increase of bare land was significant in Villages A03, B01, C03 and A04 between 2002 and 2008. As for vegetation 2 where NDVI is high, a decrease was observed in Villages A03, B01, C03, A04, B02 and E06 while an increase was observed in C04, D03, D04, D05, E11 and F11.

In theory, NDVI is consistently between -1.0 and 1.0. However, NDVI obtained from the data for this analysis is distributed in the range of -0.3 to +0.3 and has a narrow range. For this reason, area classification is very sensitive to how the threshold is set. Moreover, it is important to note that seasonal changes are reflected in addition to yearly changes because there was a 6-week difference in the satellite observations. Particularly the classification of farm land should have strong seasonality since it depends on whether the land is bare. It is important to make comparisons with local information and perform a review with these points in mind (Section 2.4 prepared by Yukiyo Yamamoto, JIRCAS).

Figure 2.3: ASTER Pictures in 2002

7°18' 35.61"N 1°47' 56.50"W





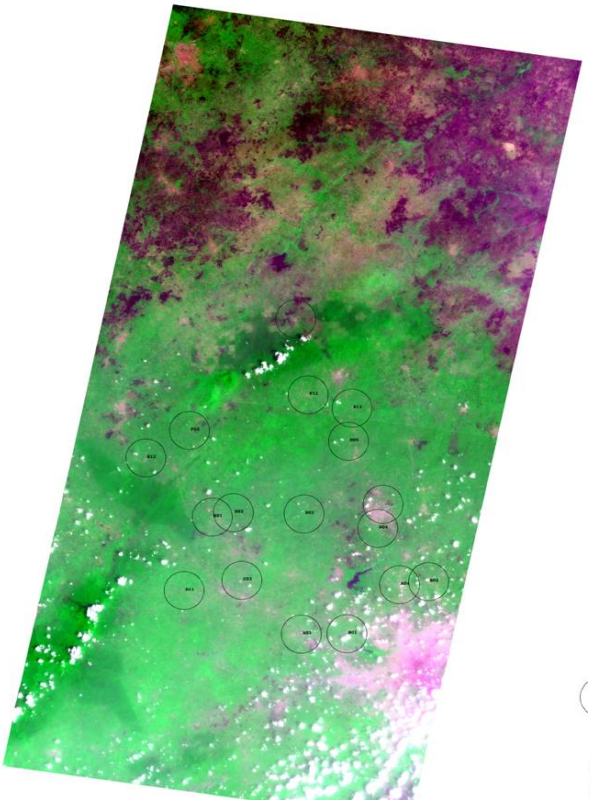
6°41' 26.44"N 1°23' 51.52"W

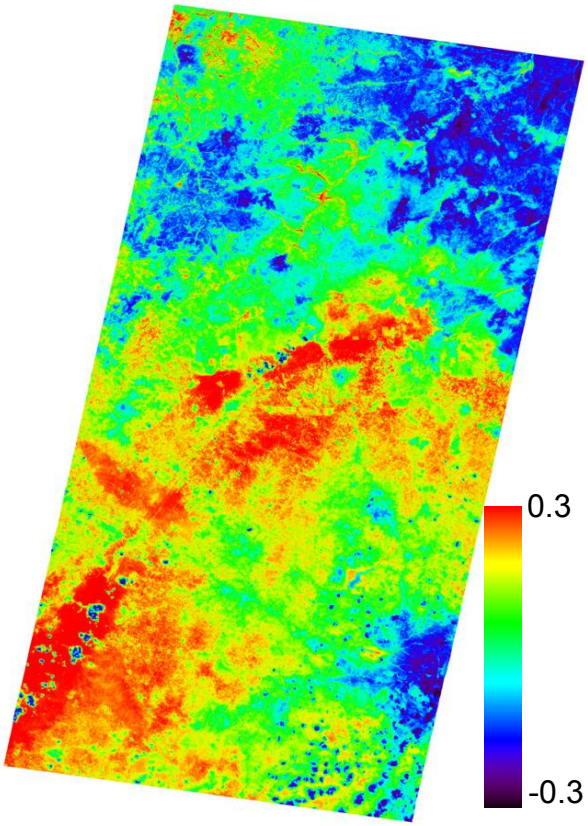
a) Colored Composite Picture (R:Band2、G:Band3N、B:Band1)

b) Normalized Difference Vegetation Index(NDVI) Picture

Figure 2.4: ASTER Pictures in 2008

7°39' 36.43"N 1°57' 18.23'' W



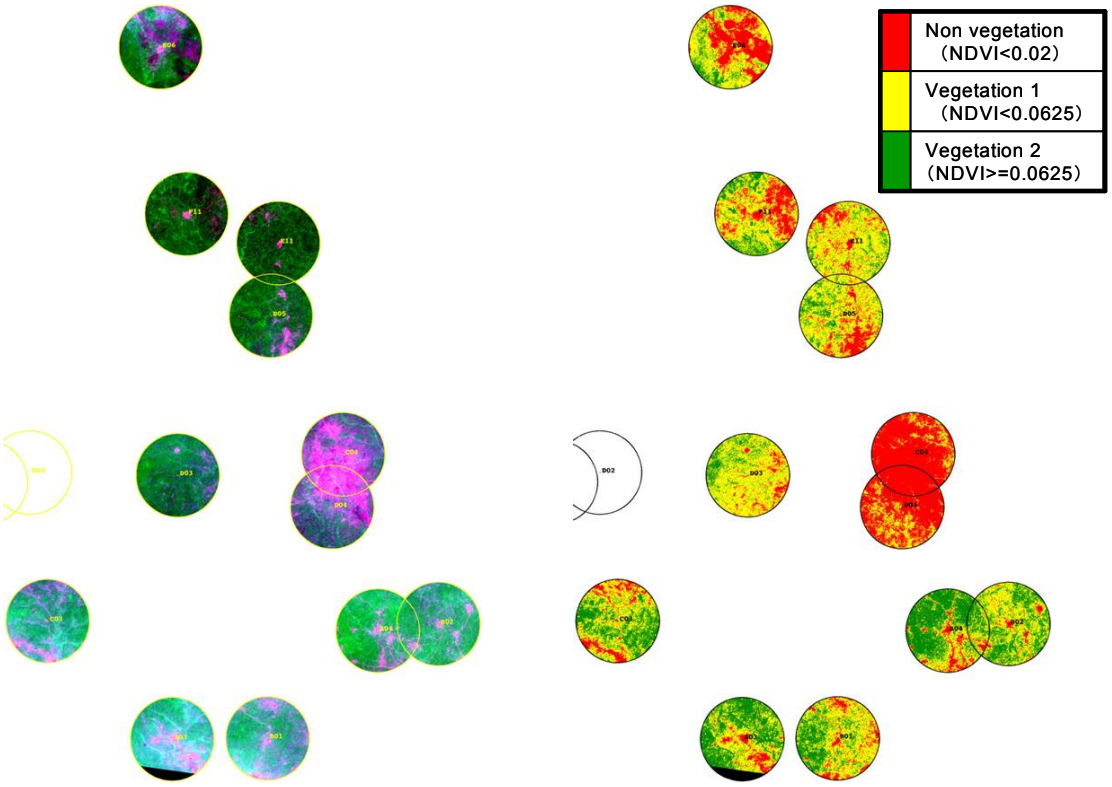


6°29' 57.39"N 1°38' 13.29'' W

a) Colored Composite Picture (R:Band2、G:Band3N、B:Band1)

b) Normalized Difference Vegetation Index (NDVI) Picture

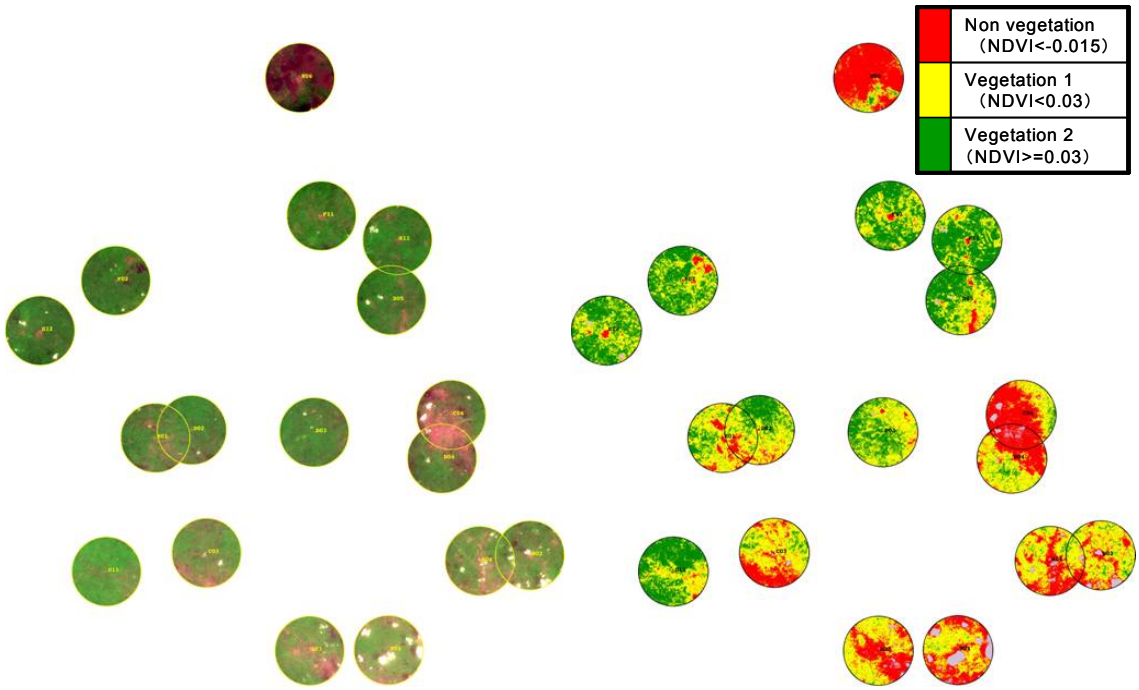
Figure 2.5: Target Sites Within a 3km Radius Area in 2002



a) Colored Composite Picture
（R:Band2、G:Band3N、B:Band1）

b) NDVI Classification Drawings

Figure 2.6: Target Sites Within a 3km Radius Area in 2008



a) Colored Composite Pictures
（R:Band2、G:Band3N、B:Band1）

b) NDVI Classification Drawings

Figure 2.7: Vegetation Compositions of Target Sites Within a 3km Radius

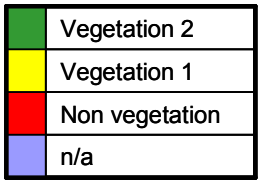


Figure 2.7 a) Vegetation Compositions in 2002

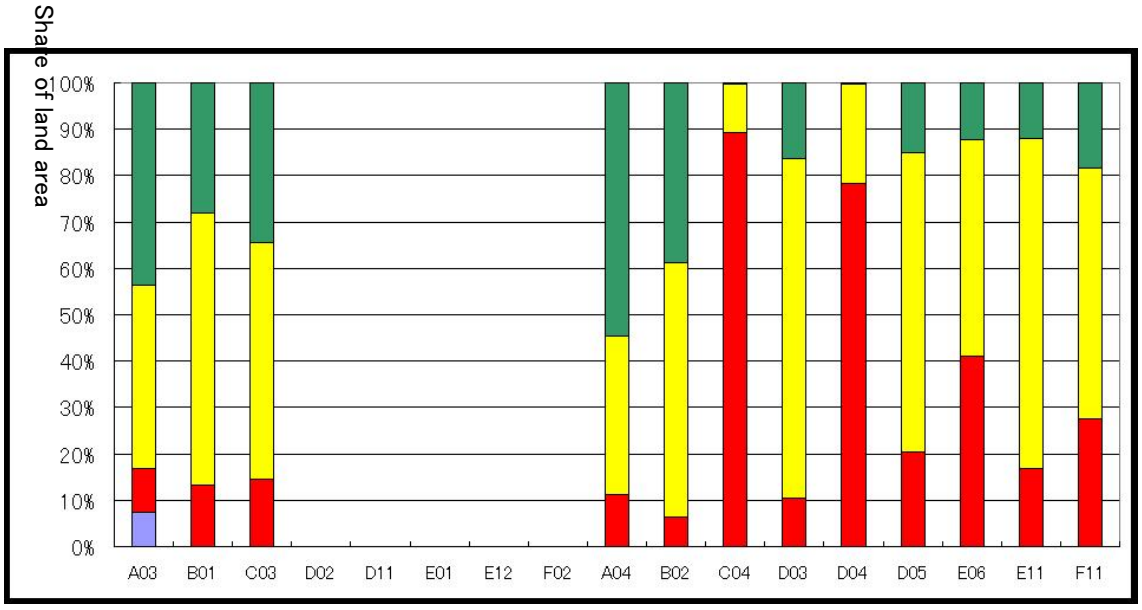


Figure 2.7 b) Vegetation Compositions in 2008

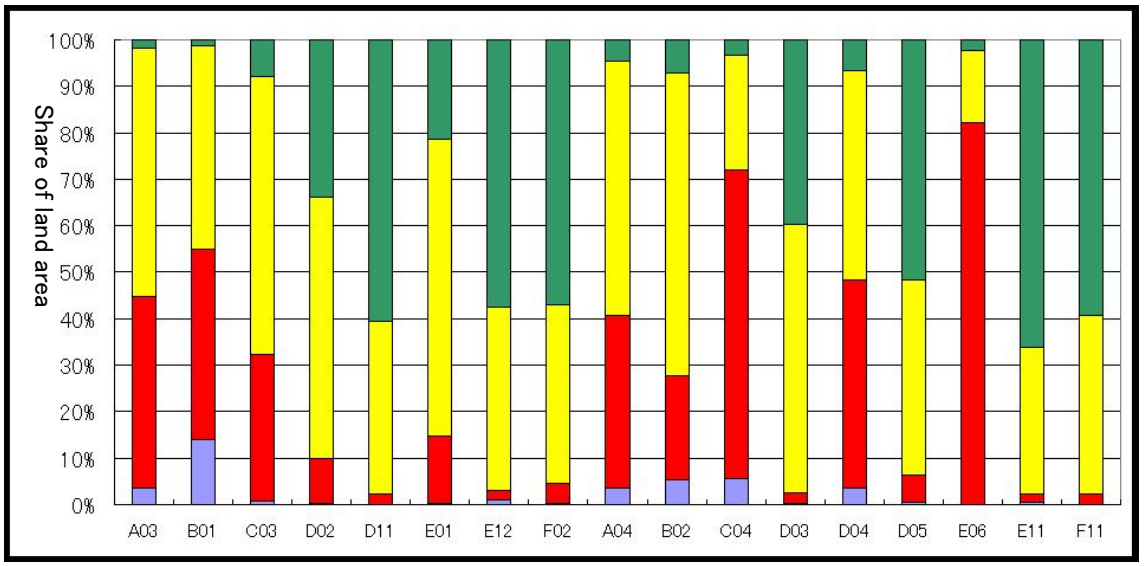
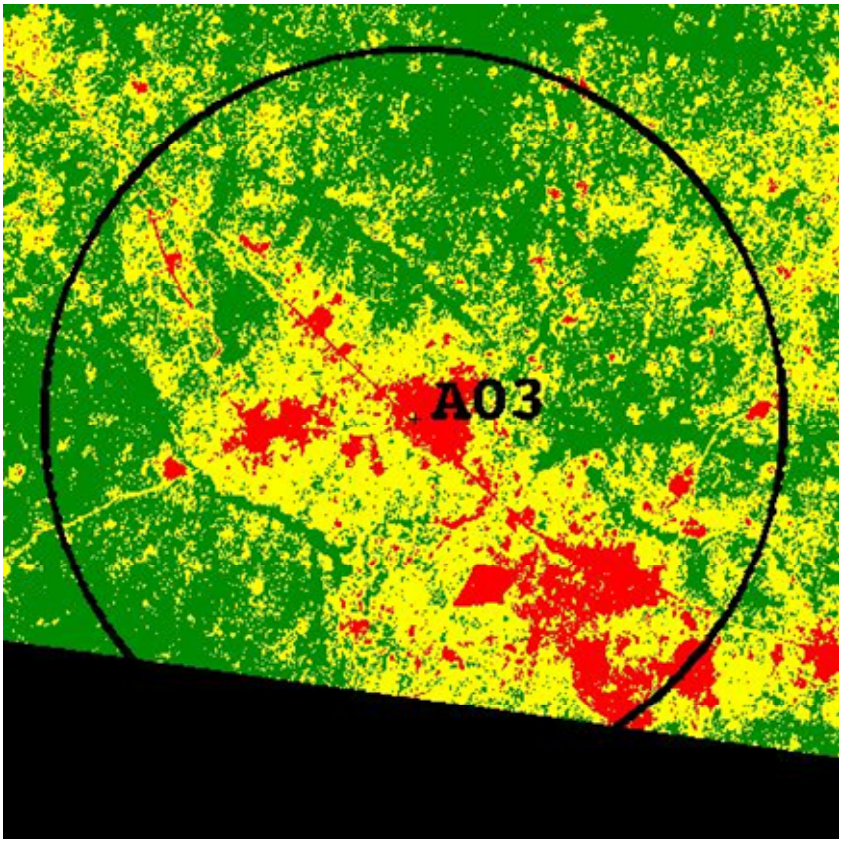


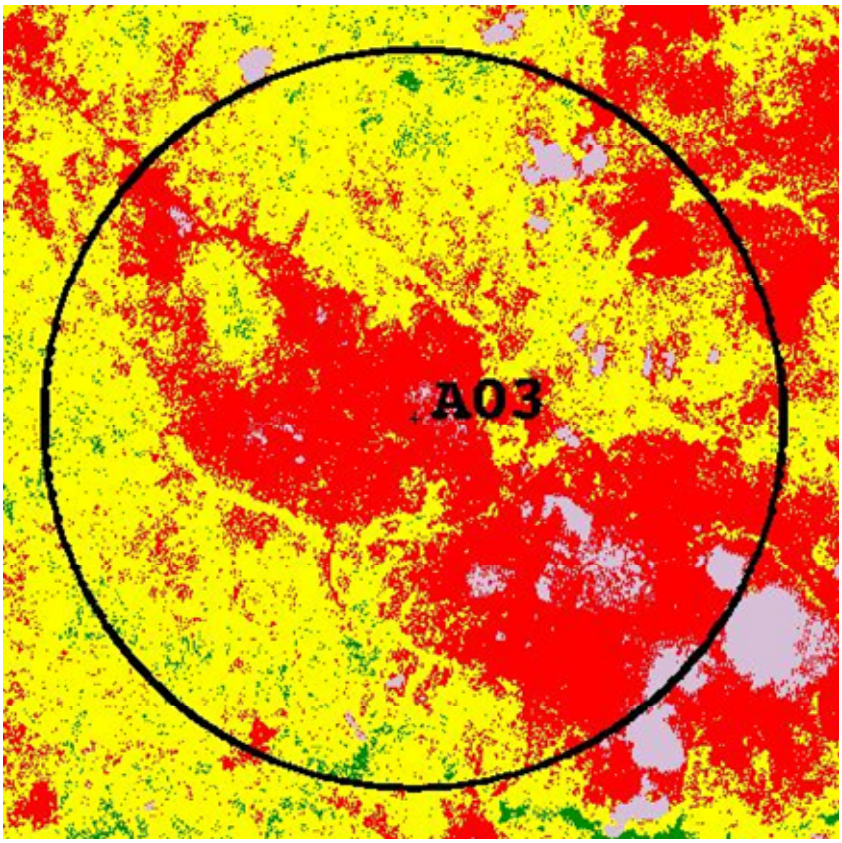
Figure 2.8: Enlarged Pictures of NDVI Classification Drawings Around the Surveyed Villages

Explanatory Note:

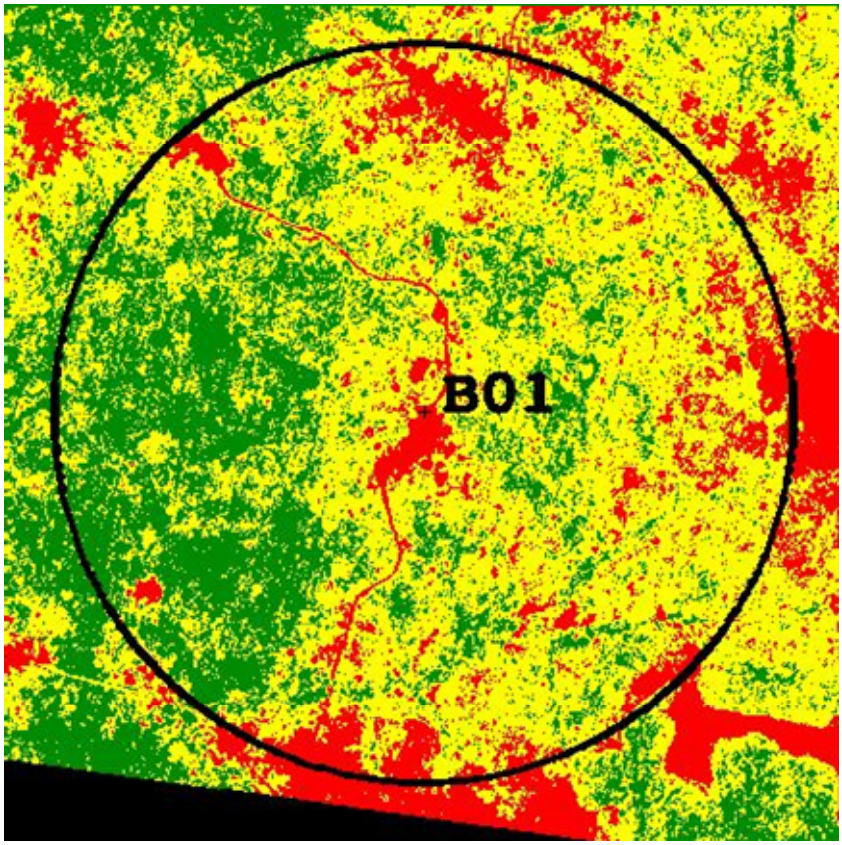
Category		2002	2008
	Non vegetation	NDVI<0.02	NDVI<-0.015
	Vegetation 1	NDVI<0.0625	NDVI<0.03
	Vegetation 2	NDVI>=0.0625	NDVI>=0.03
	Invalid area		



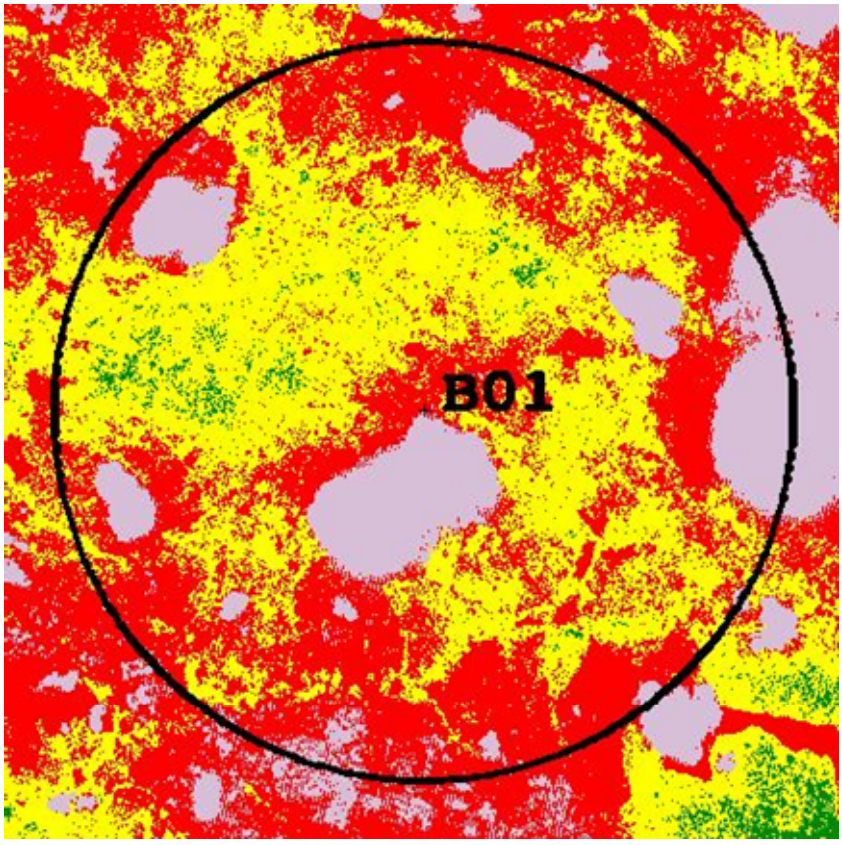
Village A03: NDVI Classification Area, 2002



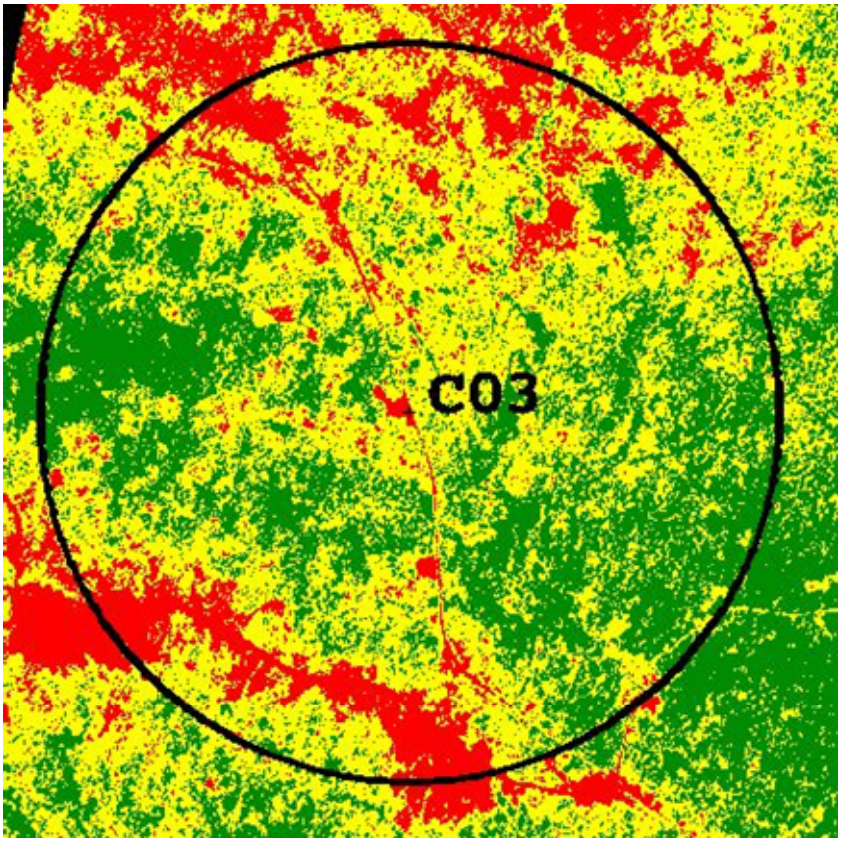
Village A03: NDVI Classification Area, 2008



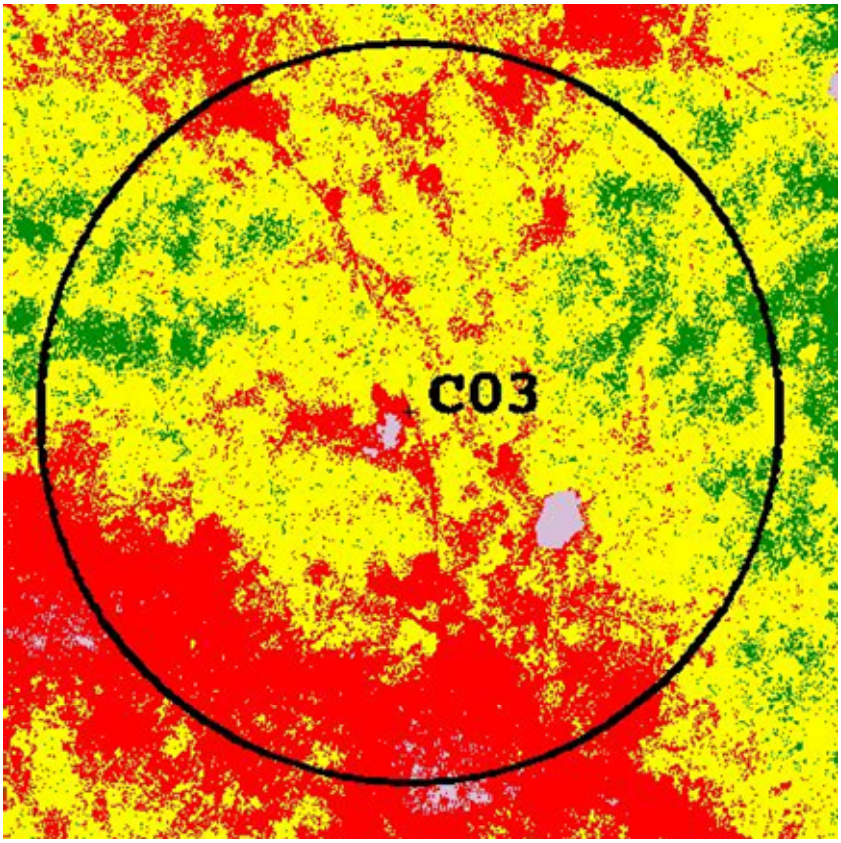
Village B01: NDVI Classification Area, 2002



Village B01: NDVI Classification Area, 2008

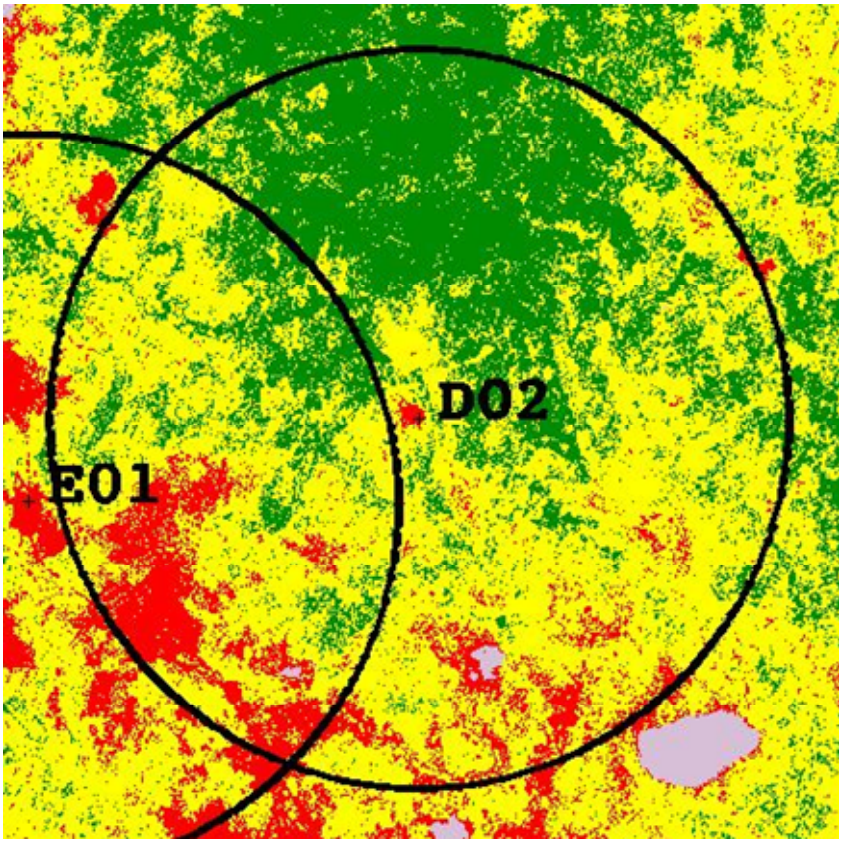


Village C03: NDVI Classification Area, 2002



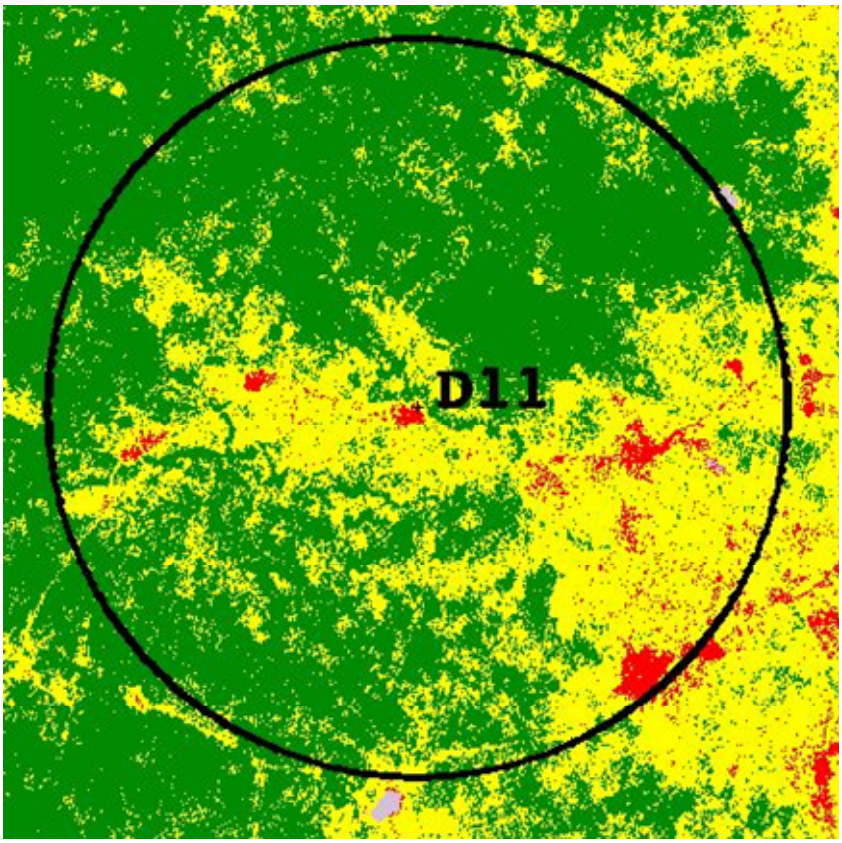
Village C03: NDVI Classification Area, 2008

No Image Available
for Village D02: NDVI
Classification Area, 2002



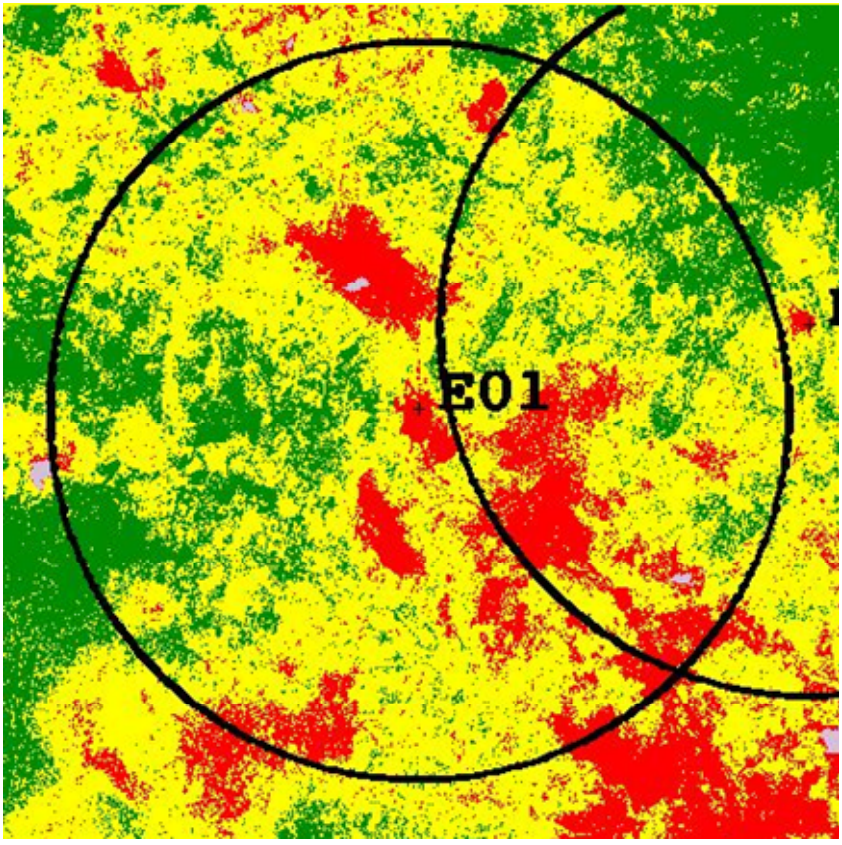
Village D02: NDVI Classification Area, 2008

No Image Available
for Village D11: NDVI
Classification Area, 2002



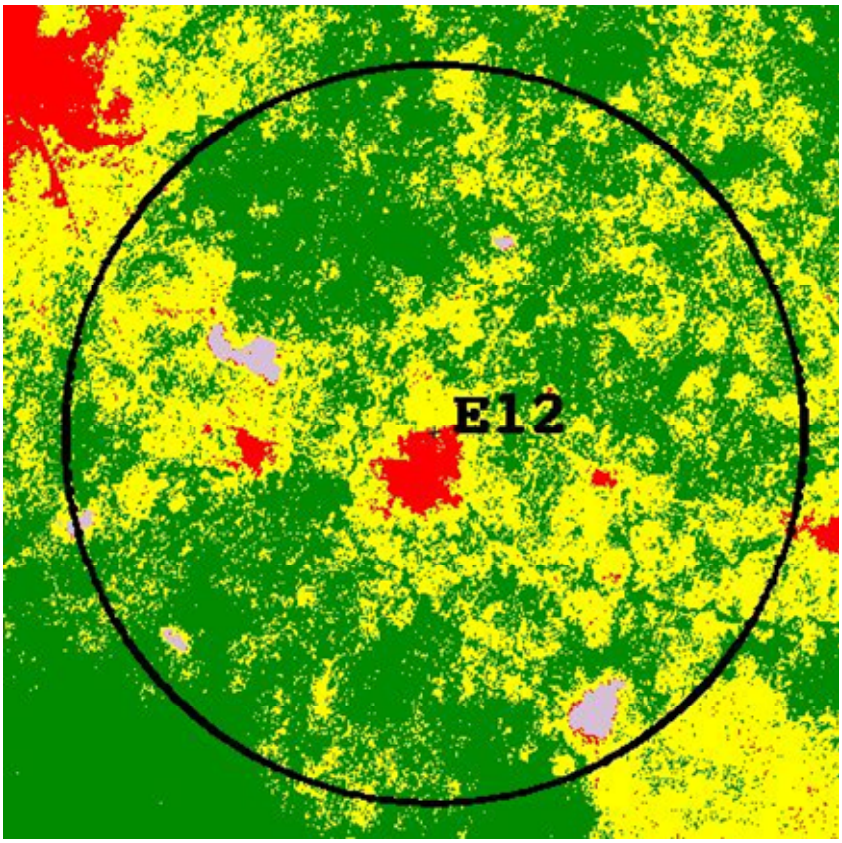
Village D11: NDVI Classification Area, 2008

No Image Available
for Village E01: NDVI
Classification Area, 2002



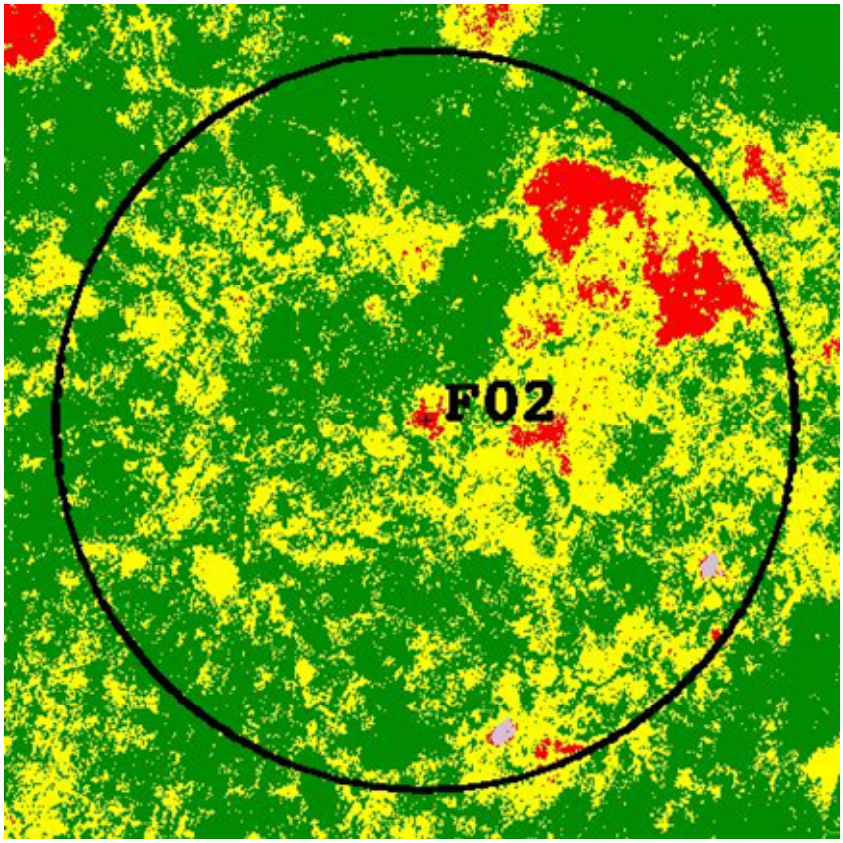
Village E01: NDVI Classification Area, 2008

No Image Available
For Village E12: NDVI
Classification Area, 2002

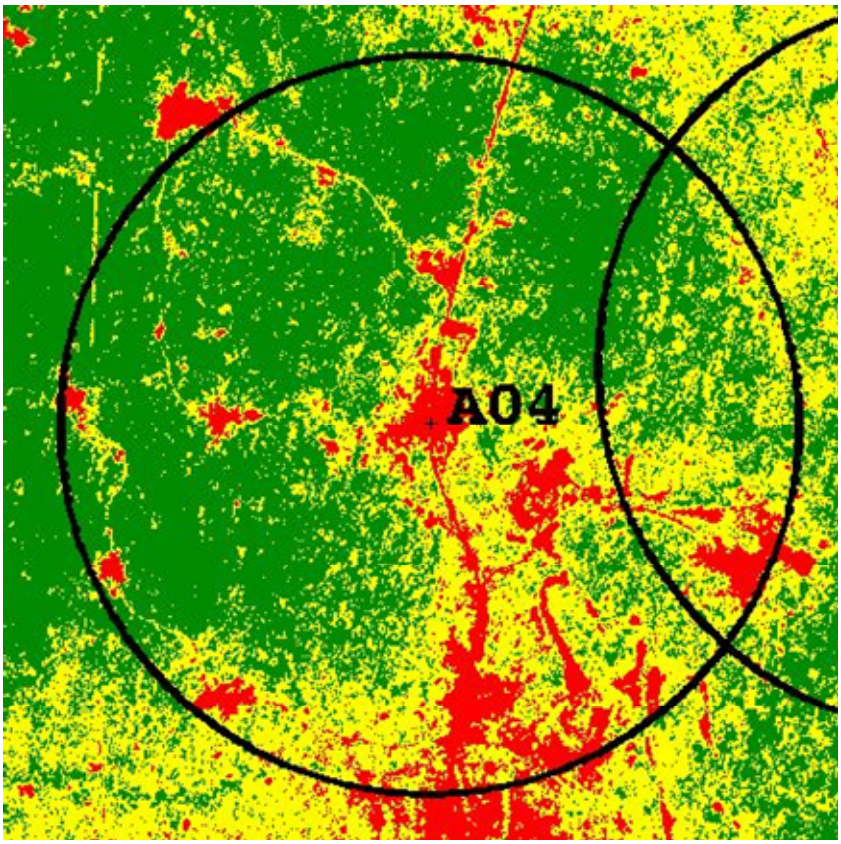


Village E12: NDVI Classification Area, 2008

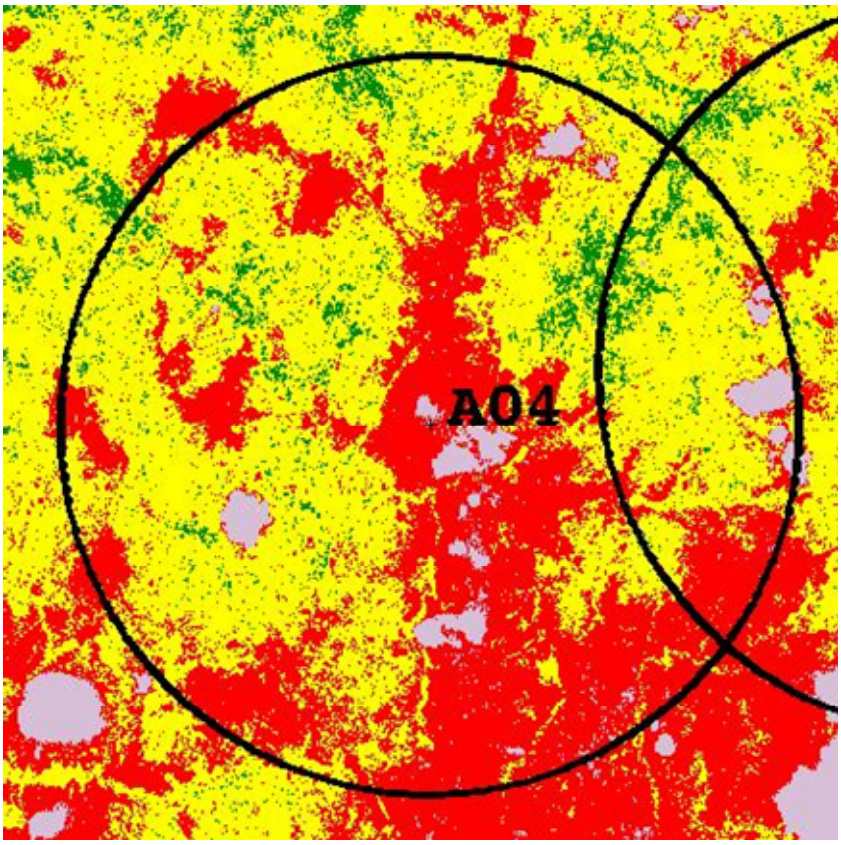
No Image Available
For Village F02: NDVI
Classification Area, 2002



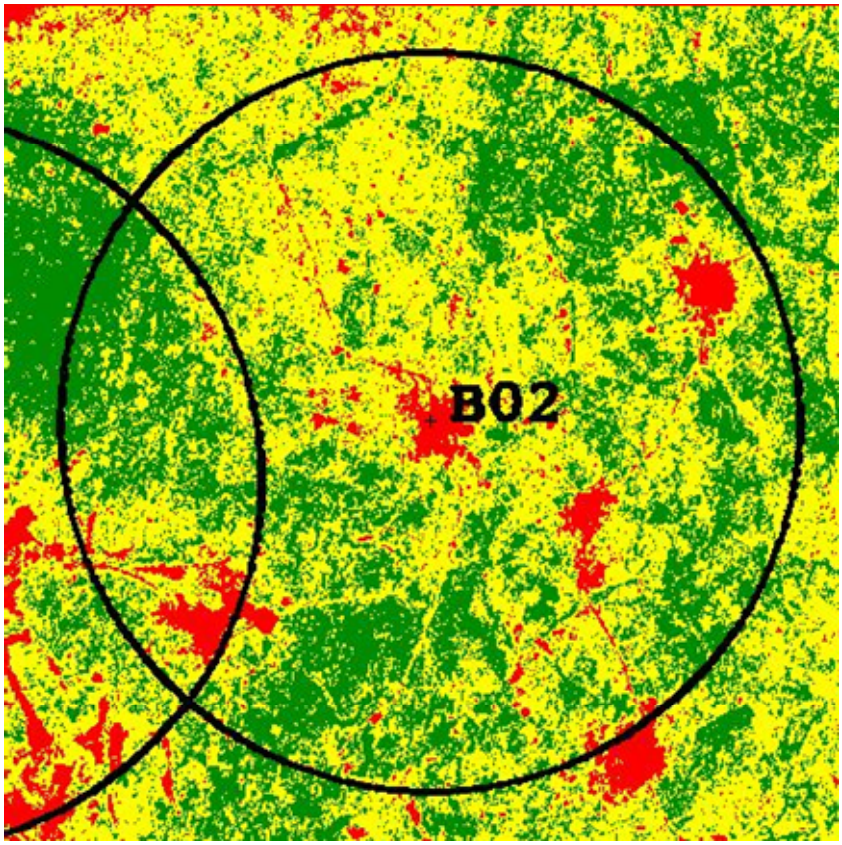
Village F02: NDVI Classification Area, 2008



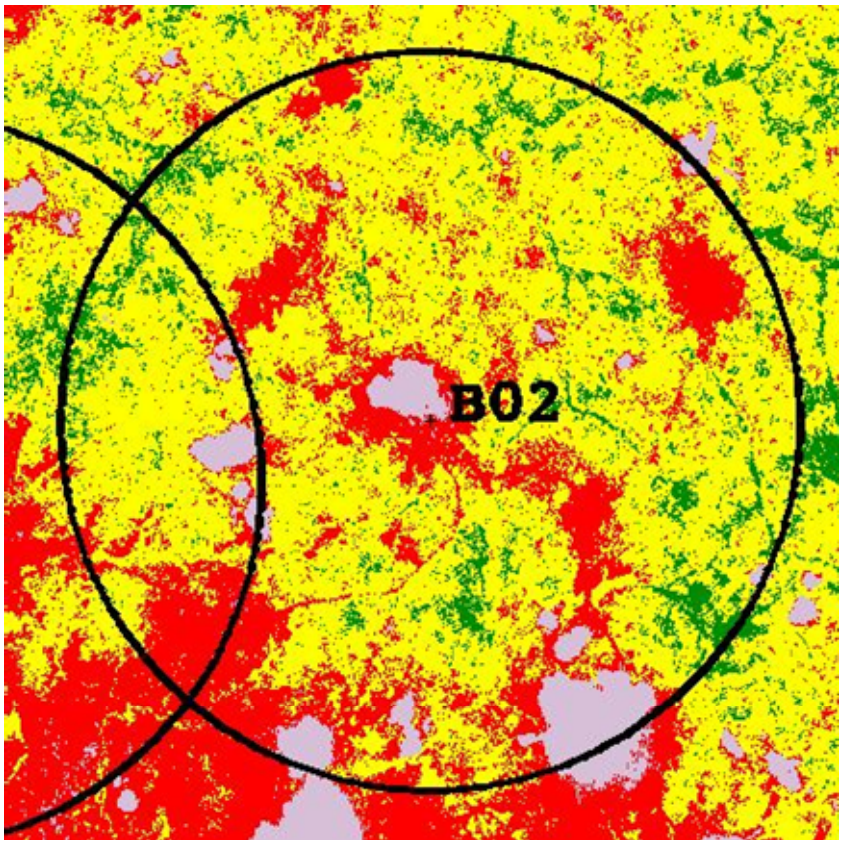
Village A04: NDVI Classification Area, 2002



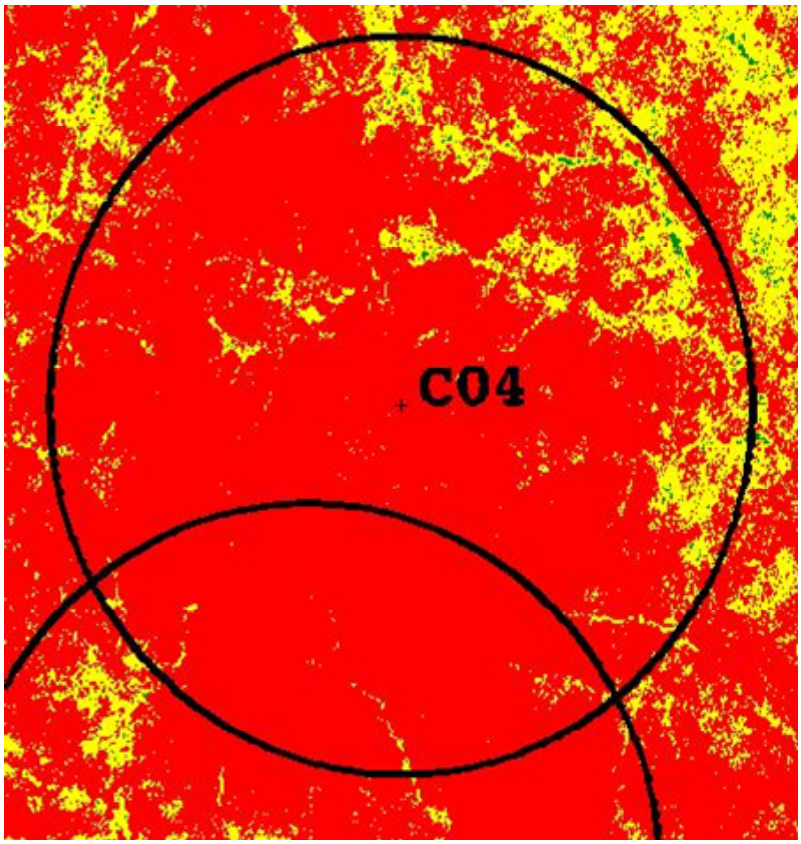
Village A04: NDVI Classification Area, 2008



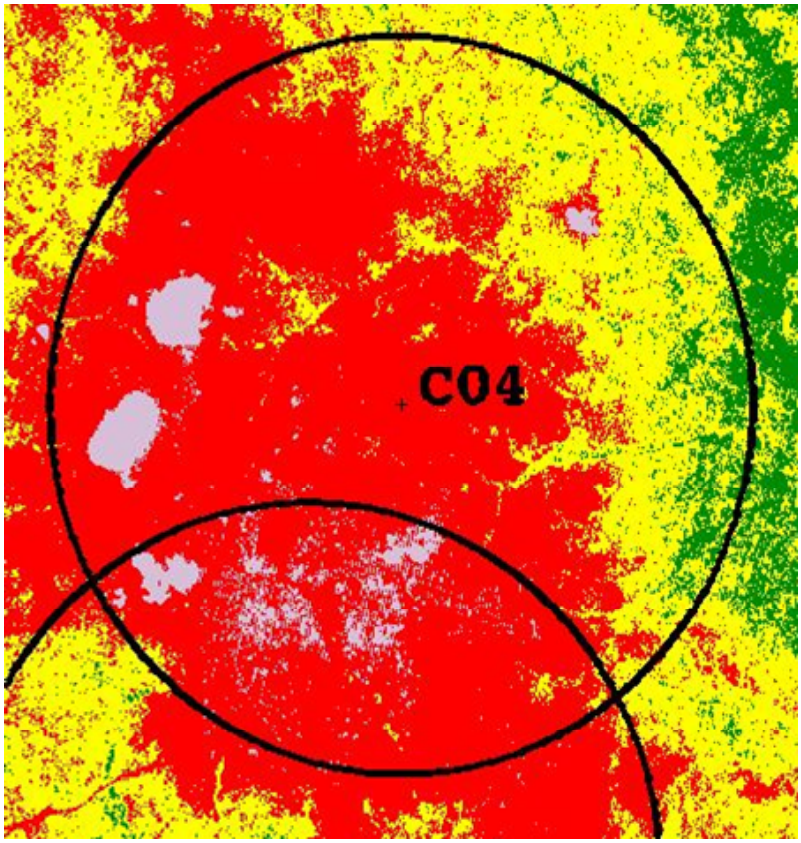
Village B02: NDVI Classification Area, 2002



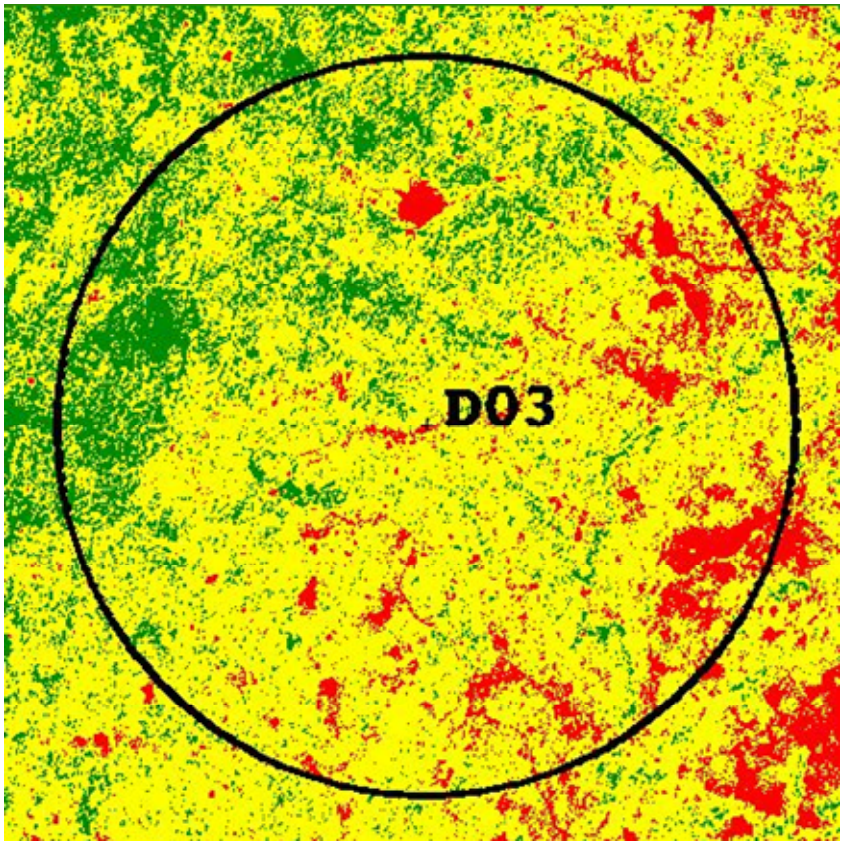
Village B02: NDVI Classification Area, 2008



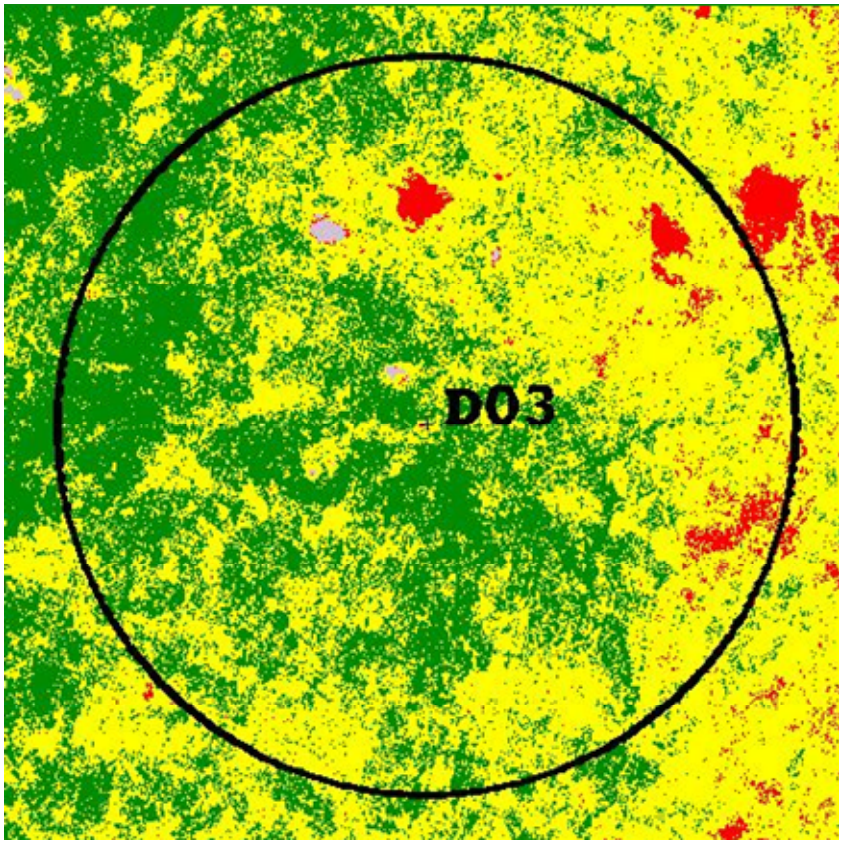
Village C04: NDVI Classification Area, 2002



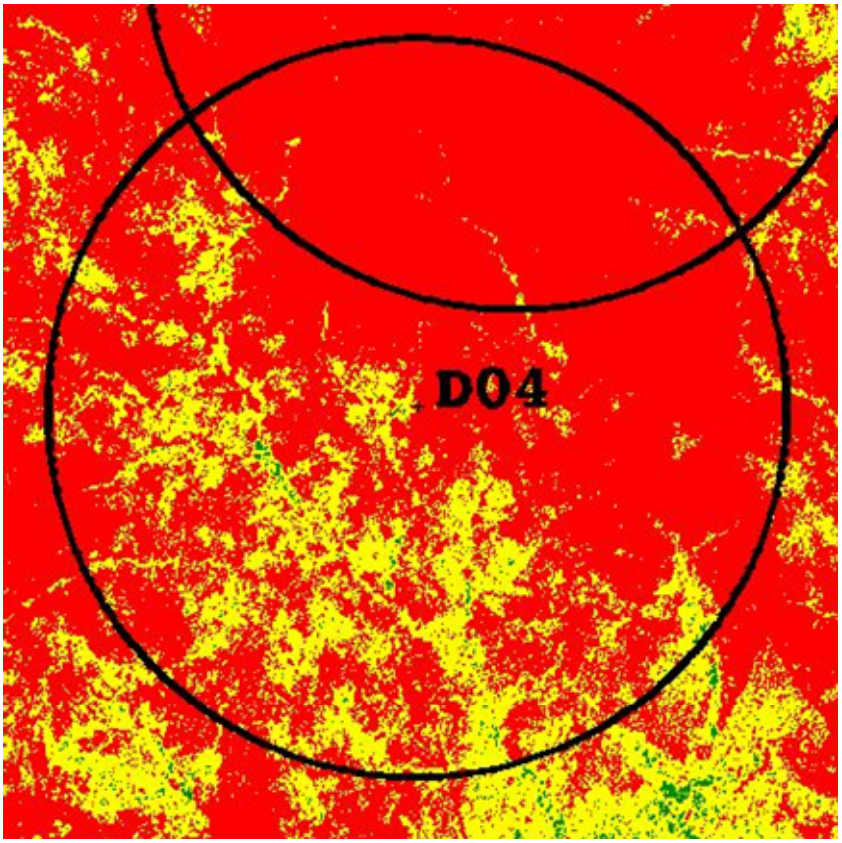
Village C04: NDVI Classification Area, 2008



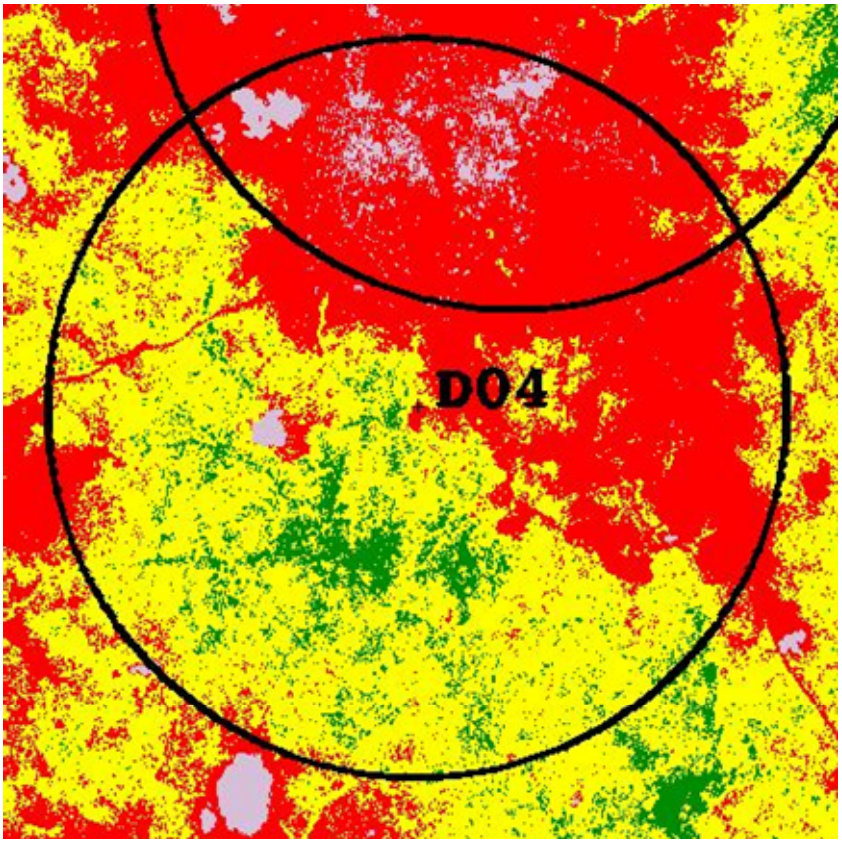
Village D03: NDVI Classification Area, 2002



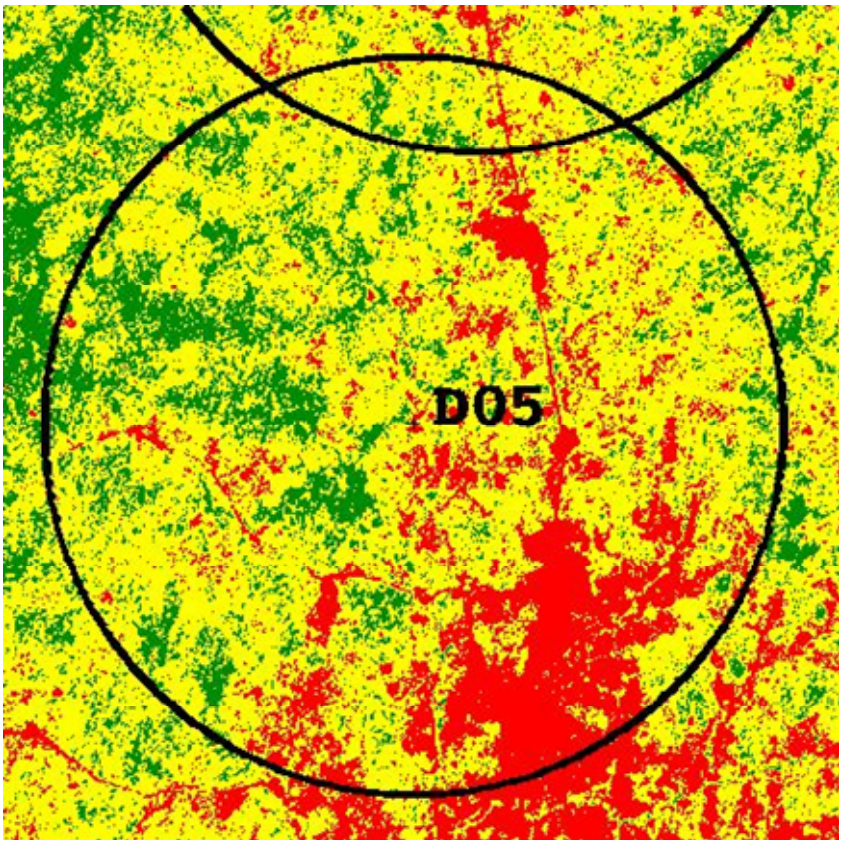
Village D03: NDVI Classification Area, 2008



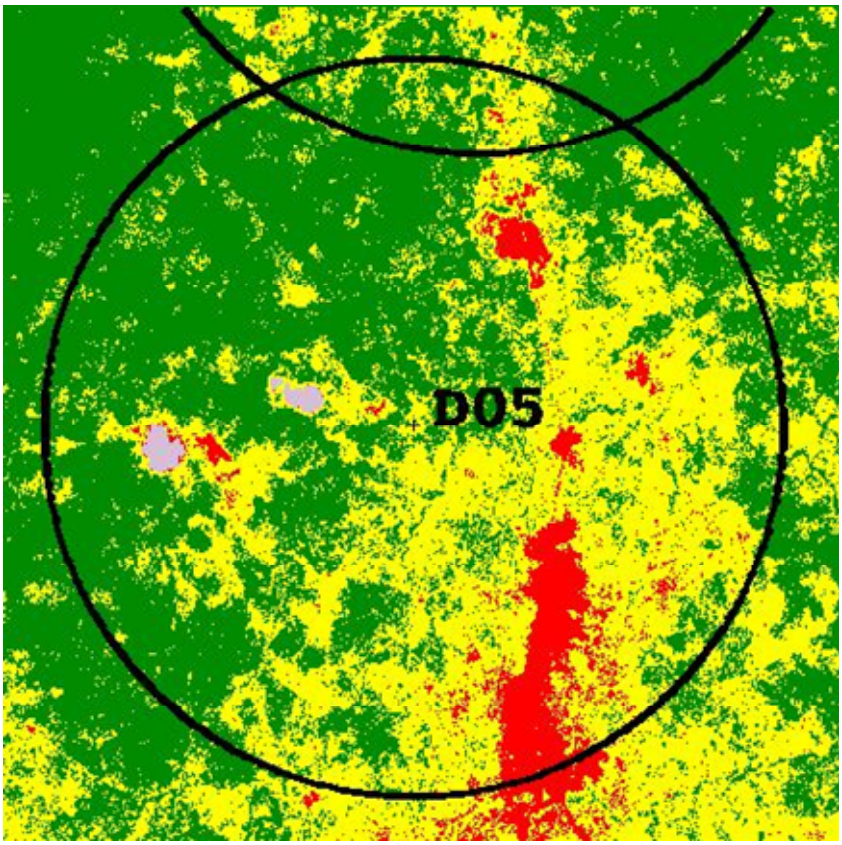
Village D04: NDVI Classification Area, 2002



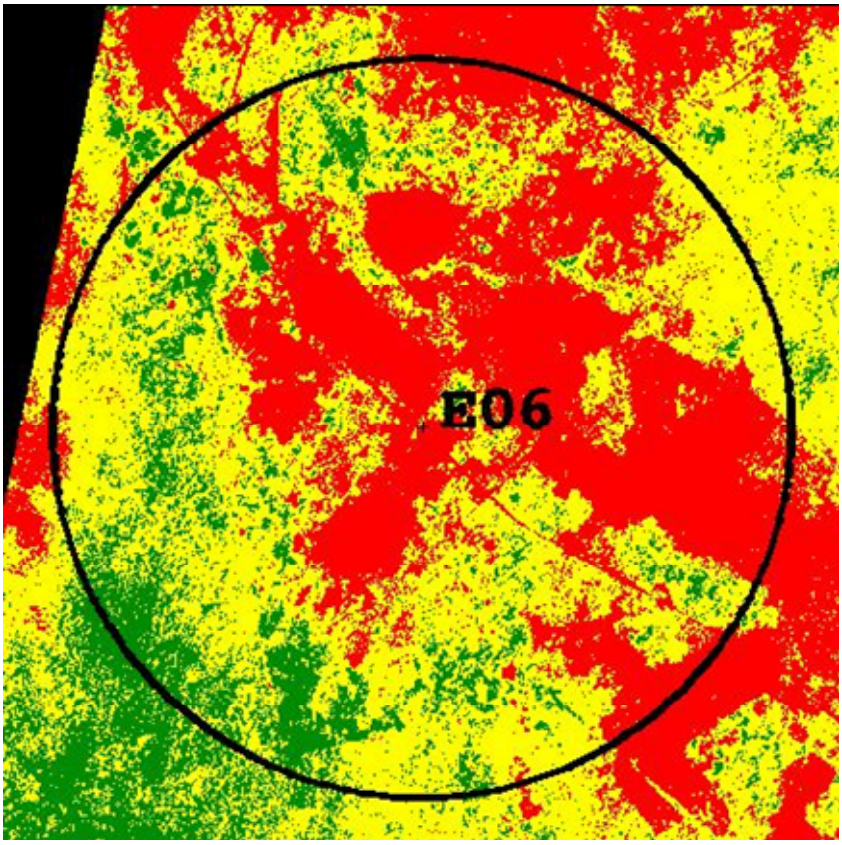
Village D04: NDVI Classification Area, 2008



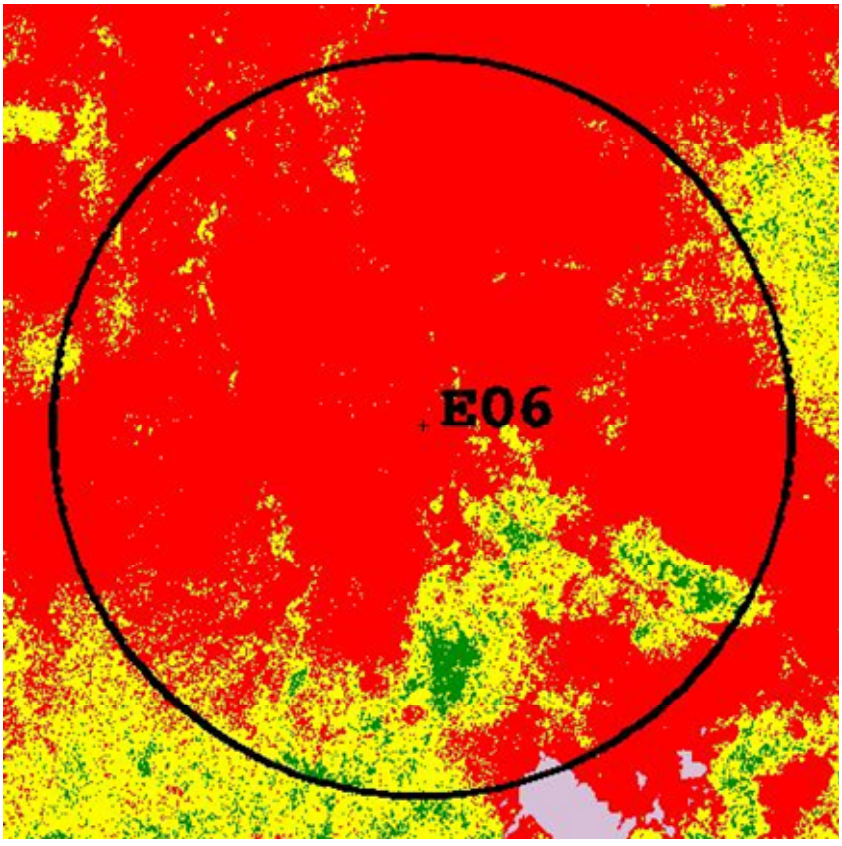
Village D05: NDVI Classification Area, 2002



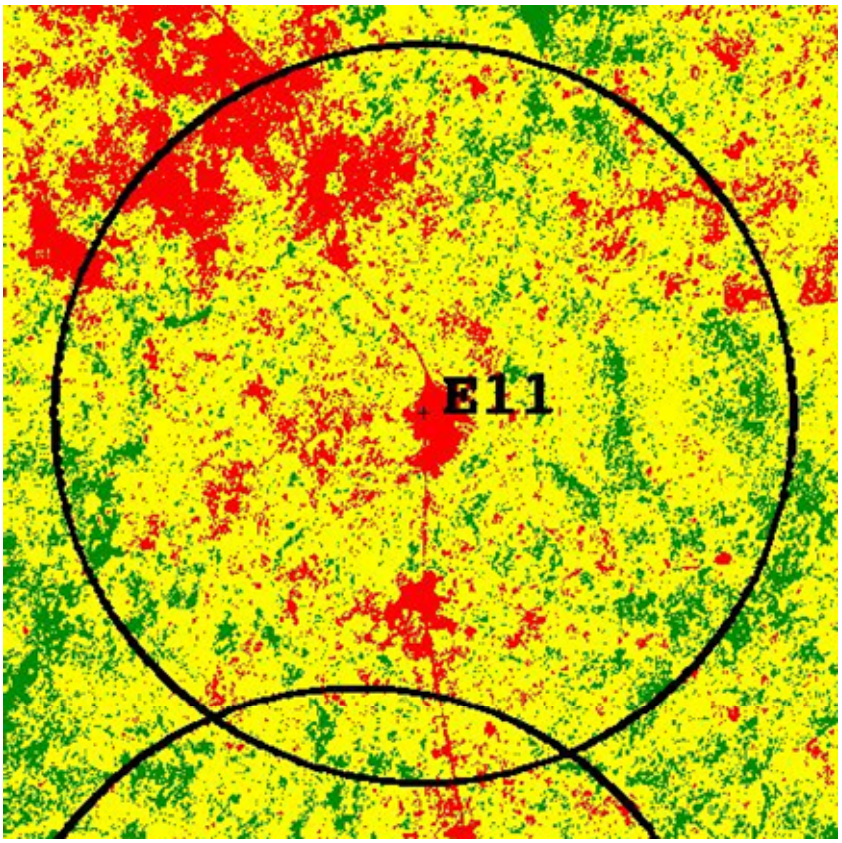
Village D05: NDVI Classification Area, 2008



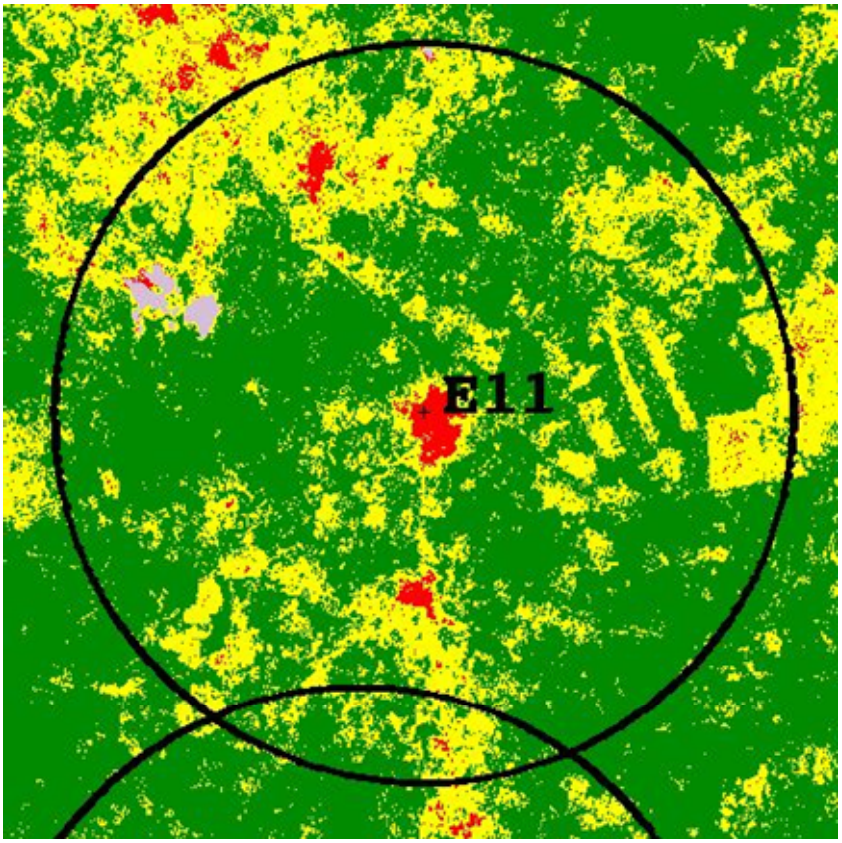
Village E06: NDVI Classification Area, 2002



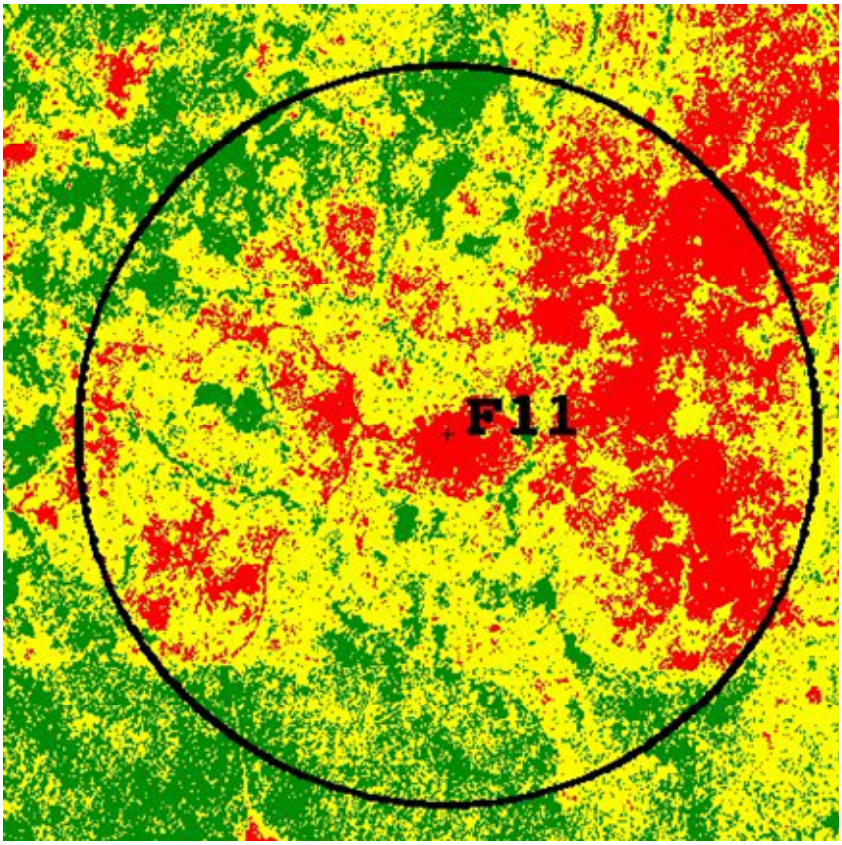
Village E06: NDVI Classification Area, 2008



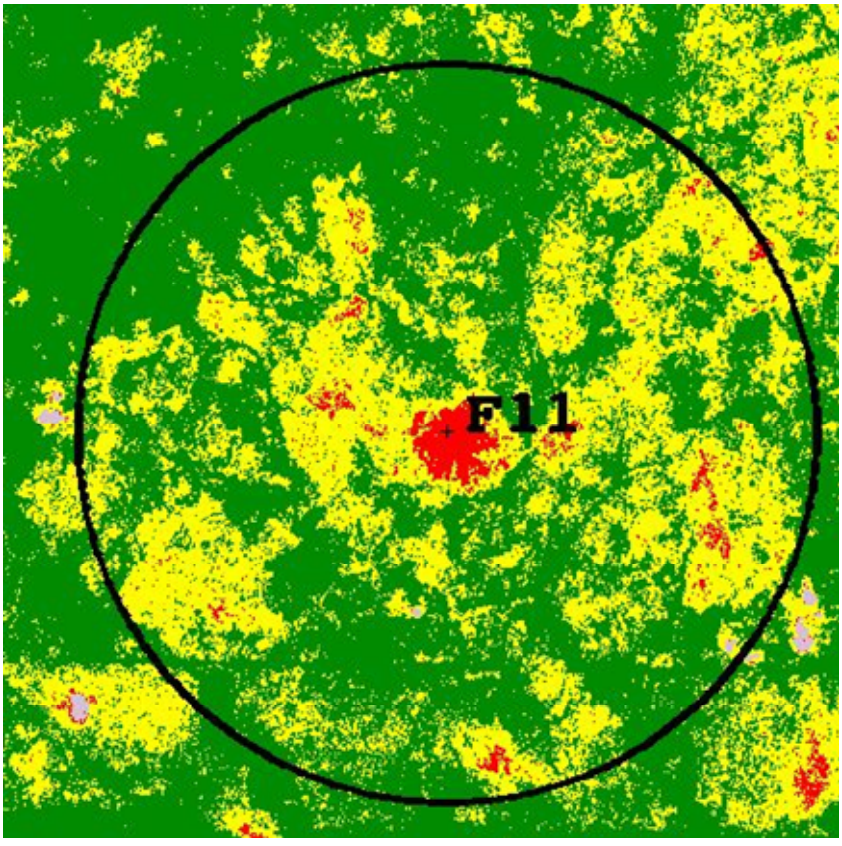
Village E11: NDVI Classification Area, 2002



Village E11: NDVI Classification Area, 2008



Village F11: NDVI Classification Area, 2002



Village F11: NDVI Classification Area, 2008

2.5 ANALYSIS OF THE IMPACT OF POPULATION GROWTH

The last subject of this chapter involves the verification of whether the changes in land use and vegetation we have seen so far have been affected by the increase in population since 2000.

2.5.1 Comparison of Satellite Data and Ground Data

In this section we will confirm that the vegetation data obtained in Section 4 is fully consistent with the land use data obtained in village survey (Table 2.5), as it would not be possible to determine which data to trust if there were no correlation between the two. As is apparent from Figure 2.7, satellite data from 2002 was available only for 3 out of the 10 villages covered in the 2008 Village Survey. Accordingly, we will use 2008 data exclusively. Table 2.15 compares the percentage of bare land area, low vegetation area and high vegetation for each village obtained from satellite data with the percentage of food crop area, tree crop area and fallow area obtained from village interviews. The table shows that, while no significant correlation exists between the 2000 land use data and 2008 vegetation data, land use variables for 2008 have significant correlation with their respective vegetation data from 2008. This can be regarded as evidence that classification of vegetation based on satellite data properly reflects the actual vegetation and land use.

Table 2.15: Correlation Between Satellite Data and Land Utilization Data [1]

Land Utilization / Vegetation variables	Land use share in 2000			Land use share in 2008		
	Food crops	Tree crops	Fallow land	Food crops	Tree crops	Fallow land
No vegetation share (2008)	0.35	-0.66*	0.02	0.70*	-0.72**	0.20
Low vegetation share (2008)	-0.38	0.17	0.36	-0.16	-0.21	0.63*
High vegetation share (2008)	-0.10	0.41	-0.16	-0.44	0.61	-0.40
Number of Sample	8	8	8	8	8	8

[1] Figures in table are the coefficient of correlation. *, **, *** indicate that the coefficient is estimated at a significance level of 10%, 5%, and 1% respectively.

Looking into the content of the results, land seen as bare land under vegetation classification is most likely farmland (post-harvest) because the food crop area is showing a positive correlation with bare land. In fact, some villages that are shown in clear red in NDVI despite the fact that bare land, were not seen to that extent on the ground. Secondly, we can consider that trees are being planted on land classified under low vegetation or high vegetation but not on bare land, as negative significant correlation exists between tree crops and percentage of bare land. As trees range from young trees to large trees, they may be classified under low vegetation or high vegetation depending on the stage of their growth. Fallow land is covered with various types of natural vegetation and takes on an appearance of low vegetation as a whole. It is therefore understandable that a high correlation exists between the percentage

of fallow land and the percentage of low vegetation. We can conclude from the above mentioned facts that the classification of satellite data is highly reliable as they show consistency, even though they do not correspond one-on-one with food crops, tree crops, and fallow land.

2.5.2 Population Growth, Vegetation and Land Use

Among the population data available in Table 2.2, we will use the 1984 census (which covers the villages located not only in the northwest but also in the north), the 2000 census and 2000 population estimate from the 2000 Village Survey as our population index to maximize the use of the vegetation data obtained in Section 4. We also obtained the average population growth rate per year from the results of 1984 census and 2000 census that are not shown on Table 2.2. We also added the distance of each village in a straight line from downtown Kumasi as a variable of village characteristics that are not affected by changes over time. We obtained the correlation coefficients between these demographic variables and vegetation changes (difference in percentage of particular vegetation type between 2002 and 2008) and listed the results in Table 2.16.

Table 2.16: Correlation Between Vegetation Changes and Population (2002-2008) [1]

Population variables / Vegetation variables	Census 1984	Census 2000	2000 Village Survey	Annual population growth rate (1984-00)	Direct distance to the Center of Kumasi
Changes of no vegetation share	0.28	0.33	0.53*	0.02	-0.26
Changes of low vegetation share	-0.40	-0.38	0.34	0.11	-0.76***
Changes of high vegetation share	0.05	-0.01	-0.61**	-0.08	0.67**
Number of Sample	8	10	12	8	12

[1] Figures in table are the coefficient of correlation. *, **, *** indicate that the coefficient is estimated at a significance level of 10%, 5%, and 1% respectively.

The estimated population in 2000 has a positive and significant correlation with the increase in percentage of bare land thereafter and significant negative correlation with increase in percentage of high vegetation area (i.e. positive significant correlation with reduction in percentage of high vegetation area). However, no positive correlation can be identified between the vegetation-related index and census-based population or population growth rate obtained from this population, possibly due to the small sample size as a result of missing data. Meanwhile, the distance to Kumasi has a significantly negative correlation with the increase in percentage of a low vegetation area and significant positive correlation with the increase in percentage of a high vegetation area. These facts indicate that there is a tendency of bare land expanding and high vegetation area represented by forests and long-term fallow land shrinking in villages that used to have a large population. In other

words, we confirmed that the population increase was causing environmental degradation. The impact of the distance from Kumasi, hypothesized to reflect the impact of distance from the market on land use, will be examined in the subsequent section.

We shall now focus on the relationship between changes in land use between 2000 and 2008 as shown in Table 2.5, and variables concerning land scarcity and population in Table 2.6. The population variable used includes the 2000 census, estimated population for 2000 obtained during the 2008 Village Survey, estimated population for 2008, population growth rate obtained from the two, and straight line distance to Kumasi. As shown in Table 2.17, the percentage of food crop area tends to increase in villages with a large population, while the percentage of tree crop area decreases, but these results are not affected by the choice of population estimates: either estimated population for 2000 obtained during the 2008 Village Survey or estimated population for 2008 obtained during the 2008 Village Survey. However, population growth rate does not have a significant impact on land use shares. The correlation with the population growth rate can be found with changes in cultivated area per standard farm household and the price of farmland at the time of survey in 2008. The former shows that expansion of cultivated area is greater in villages with high population growth. Cultivated areas per household are supposed to shrink with an increase in population and land becomes scarce, but the outcome was the opposite. Surveyed areas were probably not in a condition where land becomes scarce and segmented.

However, higher farm prices corresponding to higher population growth rate signifies demand for farmland being reflected on land price and suggests that supply of land is not enough to keep pace with the growing population. While this is not a population variable, a "straight-line" distance to Kumasi has a positive correlation with the percentage of tree crop area and a negative correlation with the severity of soil degradation. It shows that villages located far from Kumasi have a tendency to plant tree crops and suffer less from soil degradation, which is believed to be caused by continuous cropping of food crops. While it is not possible to establish a causal relationship from such a simple correlation analysis, the analysis results can be interpreted as follows; highly-populated villages, particularly those located close to Kumasi, have a tendency to place more emphasis on staple food production than trees such as cacao, which may be giving rise to environmental problems, including soil degradation.

Table 2.17: Correlation between Land Utilization and Population (2000-2008) [1]

Population variables / Land Utilization variables	Census 2000	Estimated population in 2000	Estimated population in 2008	Annual population growth rate 00-08	Direct distance to the center of Kumasi
Changes of the share of food crop area	0.43	0.74**	0.65**	-0.12	-0.51
Changes of the share of tree crop area	-0.37	-0.73**	-0.63*	0.19	0.57*
Changes of the share of fallow land	-0.25	0.01	-0.06	-0.37	-0.31
Changes of cultivated area per household	0.26	0.32	0.40	0.58*	-0.08
Changes of standard fallow years	-0.29	-0.13	-0.16	0.28	0.15
Changes of estimated length of continuous cropping	0.11	0.12	0.17	0.42	0.41
Degree of land degradation seriousness	0.22	0.49	0.39	-0.50	-0.61*
Price of upland field in 2008	0.41	0.22	0.30	0.67*	0.40
Number of samples	10	10	10	10	10

[1] Figures in table are the coefficient of correlation. *, **, *** indicate that the coefficient is estimated at a significance level of 10%, 5%, and 1% respectively.

2.5.3 Population Growth and Forest Resources

Table 2.7 summarizes the forest resources in the surveyed areas. No substantial difference was found among the 10 villages partly due to the scarcity of forests in the region. For instance, we compared the average population of villages that are still logging its forest (where 0 year has past since the last logging) with the other villages that have stopped logging but were not able to find any significant difference. Nor were we able to find any significant relationship between the severity of illegal logging and village population. Nevertheless, we were able to identify a strong negative correlation between the straight-line distance to Kumasi and the number of years since discontinuation of logging, although the distance is not related to village population (correlation function: -0.81, significance level: 1% or less). In other words, logging was banned sooner in villages that are close to Kumasi but is still practiced in villages that are farther away from Kumasi. Logging continued because resources are still there. Villagers do not seem to have any recognition that logging itself is an environmental issue.

2.5.4 Population Growth and Use of Lowlands

The summary of lowland use is already presented in Tables 2.8 and 2.13. How are changes in the choice crops and changes in the number of farmers related to village-level population growth? The results of the coefficient of correlation obtained are shown in Table 2.18. No significant correlation was observed between the use of lowlands and village population in 2000 and 2008. However, significant, positive correlation was observed between the population growth rate from 2000 to 2008 and cultivation of maize and vegetables, which signifies the expansion of maize and vegetable cultivation in the lowlands of villages that saw a large increase in population. Since maize is the staple of the areas surveyed, expansion of maize cultivation – concurrently with population growth - is believed to be as the result of an increasing need for production of staple foods. Meanwhile, demand for vegetables is expanding in urban areas of Kumasi with the development of economy and their importance as a favourable cash crop is increasing in areas on the outskirts of Kumasi. Hence, farmers growing cash crops would increase when population grows. Rice should also be grown as a cash crop like vegetables but its production has not expanded despite population growth presumably because they are not as profitable as vegetables.

Table 2.18: Correlation Between Lowland Utilization and Population (2000-2008)[1]

Population variables / Land Utilization variables	Census 2000	Estimated population in 2000	Estimated population in 2008	Annual population growth rate 00-08	Direct Distance to the center of Kumasi
Changes of the number of rice producing lowlands	-0.13	-0.20	-0.27	-0.44	-0.58*
Changes of the number of rice producers	0.16	-0.04	-0.09	-0.24	-0.51
Changes of the number of vegetable producing lowlands	0.31	0.30	0.45	0.55*	0.26
Changes of the number of maize producing lowlands	-0.35	-0.17	-0.03	0.70**	0.62*
Changes of the number of oil palm planted lowlands	0.04	0.55	0.50	-0.13	-0.59*
Number of Samples	10	10	10	10	10

[1] Figures in table are the coefficient of correlation. *, **, *** indicate that the coefficient is estimated at a significance level of 10%, 5%, and 1% respectively.

The distance to Kumasi is the determining factor in rice cropping. Lowlands that are no longer used to grow rice are particularly significant in villages that are located far from Kumasi. The tendency to discontinue palm cultivation is also strong in these villages. Cost of transportation must put these remote villages at disadvantage because both rice and palm need to be transported to the market in Kumasi in order to be converted into cash. In contrast, cultivation of maize expanded at a greater rate in villages located further away from Kumasi because it is mostly intended for home consumption rather than for selling in the Kumasi market, and cost of transport does not become an issue. Moreover, even in the case of selling maize, it is a common practice in the Kumasi area that traders visit villages by truck to purchase maize.

The hypothesis that population pressure induces lowland agriculture was confirmed by the case studied in the Kumasi area. Increase was observed for vegetables that are sold for cash and maize which is a staple crop. Expansion of maize cultivation can be seen as an indication of lowland utilization contributing to solving the problems of land shortage and/or soil degradation caused by the population increase, to a certain degree. In this sense, the use of lowlands will be one of the solutions for environmental problems attributable to population growth.

2.6 CONCLUSIONS

In this chapter, we identified the impact of rural population on rural environment and agriculture based on the survey we conducted in rural areas around Kumasi in the Ashanti Region of the Republic of Ghana and the satellite data covering the surveyed area. The estimation of population in 10 villages included in the survey concluded that the total population was 12,084 and 16,485 in 2000 and 2008, respectively. They correspond to annual growth rate of 3.96% which was accompanied by an influx of immigrants.

The share of land dedicated to food crops had decreased while that of tree crops (mainly consisting of cacao) had increased in the 10 villages. However, villages with a larger population increased the areas used for food crops while decreasing the areas used for tree crops. Although there is concern that such expansion of growing areas for food crops may cause shortening of fallow period or reduction of area cultivated by each farm household, no connection has been observed between population growth and soil degradation so far. While 7 out of 10 villages claimed that soil degradation was serious, it appears that the problem is serious not in villages experiencing population growth, but in villages located close to Kumasi.

Meanwhile, the villagers do not seem to have a strong awareness about reduction and destruction of forests, possibly because there are no natural forests to be protected around these villages to begin with. Even so, logging continues inside the village boundaries in half of the villages. Illegal logging that harvests timber without a permit is rampant and is regarded as a serious problem not from the an environmental stance, but from the perspective of protecting economic resources.

Lowlands are actively utilized in villages with high a population growth rate. This must be as a result of a shortage of farms for food production caused by an increase in planting cacao trees. For this reason, a positive correlation can be

observed between population growth rate and production of staple crops such as maize and cash crops such as vegetables. On the other hand, rice, which had attracted attention along with vegetables as cash crops intended for cities, was reduced to nearly three fourths of the 2000 level both in terms of the number of lowlands used for rice cropping and the number of farmers engaged. One of the reasons for such decline is that locally produced rice cannot compete with cheap rice imported from overseas because of its low productivity due to lack of technology. As for diffusion of technology, we occasionally witnessed efforts for improving productivity that were not previously seen in 2000, including the adoption of double cropping, as well as construction of small dams and improvement of lowlands through projects. Hence, production of rice is expected to expand in the surrounding areas of Kumasi. As it is clear that lowlands are being used in villages with a high population growth rate, the introduction of high productivity rice cropping in the lowlands of villages experiencing high population growth should contribute to the alleviation of the problems caused by population pressure, such as shortened fallow period and soil degradation.

Development of non-agricultural sectors is also important in alleviating the population pressure in rural areas. However, we did not go into these sectors in depth because of our focus on agriculture. It remains a subject for future study.

References:

Boserup, E. *Population and Technological Change: A Study of Long-Term Trends*. Chicago: University of Chicago Press, 1981.

Ghana Statistical Service. *2000 Population and Housing Census, Special Report on Urban Localities*, Accra: Ghana Statistical Service, 2002.

Sakurai, T. Intensification of Rainfed Lowland Rice Production in West Africa: Present Status and Potential Green Revolution. *Developing Economies*, vol. XLIV, no. 2, pp. 232-251, 2006.

Sakurai, T. Lowland Ownership and Investment in Water Control Technology in West Africa, Journal of Rural Economics, vol.76, no.4, pp.241-250, 2005 (in Japanese).

Sakurai, T. Civil War Shock, Poverty, and Soil Degradation: Evidence from Rural Household Data in Burkina Faso, Journal of Rural Economics, vol.78, no.1, pp.34-49, 2006 (in Japanese).

Shinagawa, M. The Potential of Lowland Rice Cultivation in Ashanti Region, Ghana, Master Thesis, Graduate School of Agriculture, Hokkaido University, 2001 (in Japanese).

Tachibana, T., M. Shinagawa, and T. Sakurai. Lowland Rice Cultivation in Ghana: A Field Survey around an Inland Market, Kumasi. In: T. Sakurai, H. Takagi, and J. Furuya (eds.) *Economic Analysis of Agriculture Technologies and Rural Institutions in West Africa*, JIRCAS Working Report No. 25, Japan International Research Center for Agricultural Sciences, Tsukuba, Japan, pp. 127-140, 2002.

CHAPTER 3
Challenges of International Cooperation;
Recommendations Concerning Official Development Assistance for Ghana

---

3.1 GENERAL REMARKS ON GHANA

Ghana's agriculture can be roughly divided by region into north and south based on the ecological condition, as highlighted in previous chapters. Northern Ghana is a semiarid region with a savannah that experiences frequent drought. For this reason, farmers have diversified their income-earning sources to migrant labor and non-agricultural sectors, and buy food in the market in the event of shortage. In contrast, farmers in southern Ghana do not have to hedge their risk to such extent by diversifying their income because tropical rainforests of southern Ghana are less subject to risks of agricultural production from climate change compared to the semiarid region. Self-sufficient agriculture is the prevalent form of food production in the south, as typified by cultivation of maize, the staple crop.

The Republic of Ghana is a country that was praised at one point as the "honor student of structural adjustment policy." However, the course of economic growth was not steady partly due to change of government. Adoption of a system that overestimated the exchange rate to the extreme and almost destroyed the economic incentive for the production of cacao, which was Ghana's greatest export, was the greatest failure of this country's economic policy.[1] However, there is no doubt that the greatest problem faced by Ghana's economic development is the fact that low land productivity and existence of the poor are turning into a serious constraining factor for sustainable agricultural development and growth. The risk of the entire country's economic growth being fundamentally blocked is high, if there is not any dramatic improvement in Ghana's agricultural productivity. There is also a great risk of the increased cultivation of lands in poorer conditions causing irreversible deterioration of agricultural resources, which would negatively affect future generations, unless poverty eradication advances in rural areas amidst ongoing population growth. Ghana's agriculture undeniably faces these problems that are seen in sub-Saharan Africa entirely. To put it differently, new agricultural technology that would improve productivity and maintain the sustainability of agricultural resources is slow to spread. For this reason, a vicious cycle of extensive expansion of farmland causing decline in land productivity and the entire rural community consequently being caught in the trap of poverty is observed; Ghana is not exempt to this problem, which is common in sub-Saharan Africa.

In his recent book *Common Wealth*[2], Jeffrey Sachs proposes that strategic investment with emphasis on the following four points must be urgently made in order to eradicate poverty in Africa:

---

[1] William Easterly *The Elusive Quest for Growth : Economists' Adventures and Misadventures in the Tropics* MIT Press 2001.

[2] Jeffrey D. Sachs *Common Wealth : Economics for a Crowded Planet* Penguin Books 2008.

1. Invest in improving the productivity of agriculture which is the most important vocation and industry.
2. Invest in medical care including prevention.
3. Invest in education that teaches basic knowledge for coping with globalization of economy to the poor.
4. Invest in basic infrastructure including information technology and uncontaminated drinking water.

On top of this, Sachs proposes prompt implementation of the "Millennium Village Project", the aim of which is to make immediate investments in Africa in reference to these four areas as part of the U.N.'s Millennium Development Project. This is in line with the proposal made by William Easterly in *The White Man's Burden*[3], where he asserts that emphasis of assistance should be placed on basic goods that are clearly and urgently needed today by the poor including vaccines, antibiotics, basic food, improved seeds, fertilizers, roads, water pipes, textbooks and nurses. In other words, it is a strategy that determines the areas that require the most urgent assistance in the selected villages and concentrates their investments on that area. The content of such an investment strategy includes specific examples such as input goods for improving agricultural productivity consisting of high-yield seeds and fertilizers, malaria prevention, health clinics, supply of safe water, and supply of school lunches to improve children's attendance.

There are numerous cases in discussions on the eradication of poverty in Africa that list the factors that are regarded as important, stating "That is necessary and so is this." These so-called "something-for-everyone" discussions are not necessarily wrong. However, it appears that a clear road map for a time-consuming process of poverty eradication has yet to be proposed. As emphasized by Albert Hirshman in *Getting Ahead Collectively: Grassroots Experiences in Latin America*[4], an accurate blueprint for a development process over an extended period of time is needed after closely examining various historical and ecological conditions of the region in question in order to conceive poverty eradication and rural/agricultural development as an effective and pragmatic strategy. In this sense, the proposal by Sachs, although general, offers relatively precious ideas in relation to the situation in Africa.

Concerning investment for the improvement of agricultural productivity, as mentioned in the four aforementioned points, we know from the experience of the Green Revolution in Asia that high yield varieties that improve land productivity as well as fertilizer input, offer sufficiently high return on investment. As stressed by Sachs, the problem is that poor farmers do not have access to the necessary funds for purchasing these new inputs. The greatest problem lies in the fact farmers cannot get loans from financial institutions to make investments that would improve their productivity because of poverty. It was also regarded as a problem of credit rationing in the rural financing market in the agricultural modernization of Asia. It is clear that this problem has also become a major constraint in improving Ghana's agricultural productivity.

---

[3] William Easterly *The White Man's Burden：Why the West's Efforts to Aid the Rest Have Done So Much Ill and So Little Good* Penguin Books 2006.

[4] Albert Hirschman *Getting Ahead Collectivity —Grassroots Experiences in Latin America* Pergamon Press 1984.

Sachs also points out the critical importance of improving productivity of water use in agricultural production in order to improve productivity on a sustainable basis in most semiarid regions of Africa. He emphasizes this point using the expression "More grains from a drop of water." In concrete terms, it refers to research and development of varieties with drought resistance and construction of an irrigation system that would prevent water from being wasted. This is an important issue in Ghana, particularly in rural areas outside Kumasi in the Ashanti Region, where our survey was conducted.

The region is made up of tropical rainforest and its agriculture is dependent on rain water. Under these circumstances, production of vegetables and rice as commodities sold in cities started to expand in swamps that had not been utilized before. Compared to fields in higher locations, swamps are well-suited for intensive cultivation of cash crops such as rice and vegetables because of an abundance in water. It is non-traditional form of agriculture that is practiced to make up for the shortage of fields; i.e. it is one of the measures against shortage of land associated with population growth. Rice production in the swamps of surveyed areas was rather stagnant at the time of our survey due to increase in import of inexpensive rice from Thailand. However, conservation and sustainability of this farm resource known as "swamp" cannot be guaranteed by simply continuing to use rain water the way it is used today. Introduction of double cropping and the launch of projects to build small dams to irrigate swamps is good news. As indicated by Sachs, they are the very projects that improve the efficiency of the usage of scarce water, and are also expected to contribute to the conservation of farmlands that do have water. As the survey results from this report indicate, swamps are used in villages experiencing a high population growth rate. Therefore, popularization of rice cropping accompanied by this kind of new farming method would also help in reducing the fallow period of fields where agriculture is primarily practiced, as well as alleviating the deterioration of their soil.

Moreover, developing a mechanism for a sound and efficient market economy in realms related to rural areas and agriculture would become an extremely important policy agenda from a long-term perspective of the future development of rural areas and agriculture in Ghana. As can be seen in production of vegetables and rice in swamps, as well as an increase of cacao production in recent years, we must confirm that farmers in Ghana are taking economic actions that can respond fully and rationally to stimuli from the market economy. Then the improvement of the wholesale market located in the center of a reasonable geographic range will be important in the secondary market to build and increase farmers' income. Creating a system for price determination (e.g. bidding) in such a market would also have a large effect in providing market information to the farmers.

At the same time, however, it is necessary to cope with the major trend of collaborating with foreign markets, seeing as Ghana will undoubtedly be thrown into the wave of globalization and farmers will be compelled to deepen their linkage with not only domestic distribution but also with the overseas market. Introduction of new methods of transaction and transport for the distribution of farm products and food as well as entry of new companies for providing such services are anticipated. For instance, when the Japanese frozen chicken market linked with Thailand, chicken distribution in Thailand, which mainly consisted of cash transactions among small merchants, was replaced by contractual transactions with large companies. The distribution

system for farms raising chickens was transformed into something completely different. Such major changes may also occur in Ghana.

It will be essential to improve and develop the mechanism of rural markets so that farmers can cope with these changes. By doing so, consideration must be taken for the fact that it is not sufficient to prepare a market for distribution after something has already been produced. Institutional reform is indispensable in areas directly involving agricultural production, i.e. a scheme for transaction of elements such as farmland and farming funds.

One is the development of mechanisms for rural financing, as indicated by Sachs. While it is not possible to propose a concrete mechanism here, it is obvious that farmers do not have sufficient self-capital. It is therefore prudent to urgently scrutinize banks and financial institutions for the rural poor that are emerging in various countries and regions of Asia, and opt for those that are best suited for the rural areas of Ghana.

Furthermore, streamlining of the land system, including settlement of rights for land ownership and land use, will become critically important. Streamlining of the land system represents a challenge as this land system often differs greatly from one country or region to another. However, it is also clear that sustainable agricultural growth cannot be expected without such reform.

Our survey has revealed that the land market in sub-Saharan Africa remains undeveloped because modern land ownership involving the registration system has not yet been established. Ghana is no exception to this rule. People traditionally believe that buying and selling of land is not permitted. In reality, however, land ownership is transferred through payment of counter value in cash and other means with the transaction being confirmed by a third party such as village chiefs. This fact seems to suggest that the system of private land ownership is starting to develop in rural Ghana. While we should not jump to any conclusions, it can be interpreted as private ownership of farmland starting to develop in sub-Saharan Africa as land becomes a scarce resource as a result of population growth. Additionally, a land lease market is just as important as land ownership. At any rate, the land system must be revamped to create a system that can coexist and is consistent with sustainable agricultural development, including the mode of ownership and the scheme for correct transactions. Such development of ownership and utilization schemes will undoubtedly become the most important task in due course.

As emphasized in the World Bank's *World Development Report 2008*, agriculture will continue to be the fundamental means of sustainable development and poverty eradication in the 21st Century. This proposition applies perfectly to sub-Saharan Africa. What we must not neglect in envisaging an agricultural development plan is that there cannot possibly be an effective general-purpose strategy that can be applied to any country/region because the historical background and ecological condition of agriculture differ from one country/region to another. The most important base work lies in scrutinizing the country/region and discovering location-appropriate strategies. Concrete strategies for Ghana, and for that matter for northern Ghana and southern Ghana, must be developed.

3.2 RECOMMENDATIONS CONCERNING ODA FOR GHANA

3.2.1 Purpose of the Survey

The Japanese Government stipulates in its ODA Guidelines that it would "play an active role in global issues including environmental problem, infectious diseases, population and food." The then Prime Minister Fukuda attended the Fourth Tokyo International Conference on African Development (TICADIV) which was held at the end of May 2008 in Yokohama, Japan. In his address, he stipulated that infrastructure building, private investment, and agricultural production are important for the growth of Africa. Mr. Fukuda added that Africa's population problem is an issue that must be solved for the development of the economy and stabilization of society, and that it has a great impact on the attainment of Millennium Development Goals (MDGs) such as poverty, education, gender and environment. Furthermore, the Yokohama Declaration of TICAD IV made reference to the fact that wide-spread poverty and unemployment continue to occur in rural and urban areas with the increase of population, which poses a serious problem along with low agricultural productivity, impacting climate change. Increased food production and improvement of agricultural productivity are important in attaining food security, poverty eradication, and economic growth in Africa. This said, it is essential that measures are taken against the problems of environment and climate change for sustainable agricultural and rural development. Consideration must also be taken for the extreme vulnerability of African countries to negatively impact forest destruction and desertification as well as to the frequent occurrence of abnormal weather. Under these circumstances, this survey project was carried with a focus on the population problem as one of the factors impacting agriculture and rural environment.

The objectives of this survey are: to study and analyze the impact of desertification and deforestation that are occurring in rural areas due to demographic trends such as rapid population growth and migration from rural to urban areas; to examine concrete measures for increasing the capacity of supporting the population amidst the projected continuation of population growth; to contribute to effective and efficient cooperation in the field of agriculture, forestry and fisheries by identifying the solutions for environmental problems that are occurring in rural and agricultural areas; to reflect the outcome in the preparation of the Country Assistance Program.

The tasks of this survey project included studying and analyzing the impact of population problems (i.e. trends such as rapid population growth and migration from rural to urban areas) on desertification and deforestation in rural areas, identifying the measures against environmental problems that are occurring in farms and rural areas, and compiling the results into a report. As for the selection of the country of study, the Ministry of Agriculture, Forestry and Fisheries selected the Republic of Ghana (hereinafter "Ghana") in view of the fact that the country has been maintaining high economic growth in recent years within the sub-Saharan Africa region, but experiencing population growth and serious environmental problems such as deforestation. Agriculture is also Ghana's primary industry and employs more than half the population. In addition, Japan is scheduled to revise its Country Assistance Program from 2008 onward.

We offer the following recommendations concerning official development aid for Ghana based on the findings obtained from the field survey, information collected and analysis based on such findings and information:

3.2.2 Current Condition of Ghana

High population growth continued in Ghana since its independence in 1957. Although a decline in the population growth rate has been confirmed with the drop in total fertility rate (TFR) observed in a recent survey, the annual population growth rate remains at approximately 2.4% today, with one woman in a rural area still giving birth to between 4 and 5 children. Moreover, rapid decline in population growth rate is unlikely to occur a certain amount of intervention; fertility decline, which has been observed since the mid-1980s, has started to show signs of stagnation in recent years. Furthermore, fertility being maintained at a high level over several decades can be indicated, as the reproductive age population will be rapidly increasing during this period partly due to the tendency of fertility to remain at high level.

While it is not possible to draw a shortsighted conclusion that food production should be increased to cope with the anticipated population explosion, it will not be possible to maintain people's standard of living unless the economic growth corresponding to increase population is maintained. Fortunately, Ghana has attained steady economic growth since 2000. Upon closer examination, however, one sees that its growth is supported by the export of primary products such as cacao, gold and timber and the expansion of the service industry; the manufacturing sector has been left behind in an undeveloped condition. There is the possibility of the emergence of a labour-intensive manufacturing industry Ghana if the population is going to increase in the future but the wage scale will pose a problem if this does become the case. If agricultural productivity is to remain at low level, increase in population will bring about skyrocketing food prices which, in turn, would raise the wage scale and deprive competitiveness from the labor-intensive manufacturing industry. If that is the case, Ghana's economic growth would come to a halt as the industrial sector that absorbs the increasing population ceases to grow. It would even be difficult to import large quantities of rice from overseas, as it is doing now.

In order to avoid such a situation, it will be necessary to first strengthen the foundation of local agricultural production in order to contain the skyrocketing food prices. By doing so, it will also be necessary to encourage private investment in the agricultural sector. At the same time, the export-oriented manufacturing industry must be fostered by inviting foreign investment. Sustaining steady economic growth in this manner would prepare the country firmly for the forecasted population growth.

3.2.3 Rural Level Tasks and ODA Recommendations

A considerable difference in vegetation and climate exists between the southern and northern regions of Ghana, with the former belonging to tropical rain forest region and the latter to the savannah. It has resulted in a difference in farm crop varieties and productivity, and subsequently to their economic structures. Moreover, domestic price disparity tends to be large for edible crops such as cassava and banana, partly due to inadequate transportation infrastructure within the country. Assistance to rural areas in the northern region where the poverty ratio is high and attainment of MDGs is delayed is needed for the elimination of such economic disparity at home. As many farms in the north are

growing grains such as maize and rice, the key for raising the income of farm households lies in improving the cashability of their crops through improvement of grain productivity and quality. In particular, rice offers a golden opportunity for farm households to raise their income as its domestic consumption is rapidly increasing mainly in cities. Under the existing circumstances, however, problems exist with regard to postharvest treatment technology, in addition to the problem of low productivity. The majority of domestic rice contains broken rice and gravel because of inadequate postharvest treatment. There is little room for acceptance of low quality domestic rice as markets in cities are filled with imported rice which is inexpensive and of better quality than domestic rice. As considered by JICA's rice cropping promotion program, it is necessary to popularize new rice mill machines through means such as the organization of cooperatives and support for financing service in order to improve the quality of domestic rice.
from the viewpoint of not only the growth of the agricultural sector but also the conservation of forests to improve productivity through modernization of agriculture and effective utilization of land. Although farmland has been expanded through extensive farming methods such as shifting cultivation accompanied by slash-and-burn, forest areas have been rapidly declining as a result. As population will continue to grow in the future, it will be necessary to convert existing farms into permanent farms and improve productivity per unit area in order to increase food production without causing a reduction of forests. As input of adequate fertilizers and selective breeding will be important, research and dissemination of technology must be expanded for this purpose. In addition, improvement of fields and popularization of small-scale irrigation are needed to promote intensive agriculture in swamps that have not been utilized as farms until now.

Pressure on the forests' resources is coming not only from farmland expansion but also from lumber collection for fuel. Use of fuelwood for domestic purposes by local residents is not seen to be putting serious pressure on the reduction of forest resources so far. However, there is concern that resources are being overexploited by the commercial charcoal industry if basic infrastructure for electricity and natural gas remains undeveloped and demand for fuelwood increases in urban areas with population growth and economic development. Effective utilization of deadwood, introduction of "improved furnace" (which is known to have high combustion efficiency and can cook with very little firewood), and use of biomass fuel instead of firewood will be beneficial in such case. In this sense, we believe that assistance for rice production as a cash crop in the northern region would contribute to conserving forest environments by limiting the expansion of the charcoal industry as it has become one of the precious sources of income in the north where opportunities for non-agricultural income are limited.

Per contra, forests that have already been depleted must recover their resources through methods such as improved Taungya tree-planting. It is therefore important for local residents to have the motivation to conserve the trees that have been planted. In other words, it is critical to design a system that would offer economic incentive to the local residents by enabling the government (forestry committee) and local residents to reap the forests' benefits.

As for the logging industry, it would be important to develop methods for utilizing unused timber and scrap wood for sustainable use of limited lumber resources, and to clamp down on illegal logging.

3.2.4 ODA Recommendations Based on Findings from Surveyed Regions

The impact of rural population on rural environment and agriculture was identified in the field survey conducted in rural areas around Kumasi in the Ashanti Region. As a result of estimating the population of the 10 villages included in the survey, we found that the annual population growth rate of the surveyed regions between the years 2000 and 2008 came to 3.96%. It was higher than the national average and represented a high growth rate accompanied by an influx of migrant population.

When the 10 villages in the survey are examined collectively, we see that the percentage of food crops has dropped since 2000, while the percentage of tree crops (mainly consisting of cacao) has increased. However, areas for food crops have increased and areas for tree crops have decreased in villages that have a relatively larger population. While concern exists over such expansion in the cultivation area of food crops, causing shortening of fallow period and reduction in cultivation area per farm household, no linkage between population increase and soil deterioration has so far been confirmed.

Expansion of food crops expanding on a village level as a result of population increasing in villages should not have impact on fallow land to the extent that they reduce the area of tree crops. However, fallow land will be used for growing food crops sooner or later because there is a limit to the reduction of the area for tree crops. As evident in various parts of sub-Saharan Africa, this is expected to bring about shortening of fallow periods and a reduction of cultivation area per farm household with concerns emerging over similar events taking place in the surveyed area. Unfortunately we were not able to identify any relationship between population growth and soil deterioration.

As many as 7 out of 10 villages claim that they are experiencing serious soil deterioration but the problem appears to be more serious in villages near the central city of Kumasi than in villages with a large or growing population.

Meanwhile, villagers seem to lack awareness of problems such as a decrease or destruction of forests because the villages do not have natural forests to protect to begin with. Nevertheless, logging continues in 5 of the 10 village premises. Illegal logging that harvests timber without permission is rampant and regarded as a serious problem, not from an environmental viewpoint but from the viewpoint of protecting economic resources.

Swamps are actively utilized in villages with high population growth. This is as a result of a shortage of food production, caused by an increase in the planting of cacao trees. For this reason, a positive correlation can be observed between the population growth rate and the production of staple crops such as maize and cash crops (e.g. vegetables). Alternatively, rice, which had attracted attention along with vegetables as cash crops intended for cities, was reduced to nearly three fourths of the 2000 level both in terms of number of swamps used for rice cropping and number of farmers engaged in the activity. One of the reasons for

such decline is that locally-produced rice cannot compete with cheap rice imported from overseas because of its low productivity due to lack of technology. As for diffusion of technology, we occasionally witnessed efforts for improving productivity that were not seen in 2000, including adoption of double cropping, the construction of small dams, and improvement of swamps through projects. Production of rice is expected to expand in the surrounding areas of Kumasi. As it is clear that swamps are being used in villages with high population growth rates, the introduction of high productivity rice cropping in the swamps of villages experiencing high population growth rate should contribute to the alleviation of problems such as the shortening of farms' fallow period and soil deterioration. ODA to support the promotion of swamp use would thus be useful as measures for mitigating increase in demand for land.

Swamps can be used in two ways depending on their location. The first way involves areas located close to cities. As fields are already being used to grow food in these areas, there is a shortage of land for growing cash crops. We therefore propose developing swamps to popularize a system for consciously growing a wide range of cash crops such as vegetables, rice, maize, and fruit trees. The second way involves areas that are located far from cities and still have extra land, even though population growth is expected. Since cacao is already holds the place of being an important cash crop, there tends to be a short supply of land for growing food crops and land set aside to lie fallow for soil restoration purposes so that it can be used to grow food again. In these cases, the problem of land shortage can be solved once food crops (e.g. maize) are grown on swamps. While rice is definitely a desirable crop to be grown on swamps from a macroeconomic stance, the results of our field survey showed it would be quite difficult to grow rice in swamps that are located at a great distance from the principal cities.

3.2.5 Macro Level Challenges and ODA Recommendations

It is estimated that Ghana will reach a stabilized population level by around the year 2050, as the number of children considered desirable by married couples remains high, particularly in rural areas. Thus there will be continuing population growth for the time being and population pressure on land and food will rise in the future. Therefore, as cited in GPRS II, it will continue to be important to incorporate population growth within policymaking. It will also be necessary to stabilize population through specific policy measures to alleviate the problems that arise from the growth. In this regard, consistency and coordination of macro stabilization, namely fiscal reconstruction, will become important for policies dealing with population problem. In particular, since Ghana's fiscal expenditure concerning healthcare is mainly spent on the recent development of the healthcare system, attention must be drawn to the way in which measures against population growth are realistically budgeted and executed. The results will then have to be verified in detail to separate the issues.

As for diffusion of family planning, it is necessary to provide reasonable assistance for actively supporting the decisions made by couples and individuals on an ongoing basis rather than expecting "unwanted pregnancies" to decline as a result of changes in economic environment. For this purpose, it is desirable to expand family planning activities through international agencies and NGOs in the future.

Additionally, the increasing population is an indispensable production factor for the labor-intensive manufacturing industry even though it puts pressure on land and food. In this sense, it is essential to develop industries that absorb labor as a measure to address the population problem. However, a macroeconomic environment in which growth of private enterprises was difficult due to the high inflation rate and lax fiscal discipline, has been continuing in Ghana since its independence. The manufacturing industry has not fully developed despite the economic growth the country has demonstrated since 2000. While there is a need to strengthen domestic capital in the manufacturing sector, ensuring stability of the domestic financial market and developing the environment in which resulting credit creation is fully realized are essential in strengthening domestic capital. The largest macroeconomic challenge for the present day Ghana lies in realistic promotion of the measures for cultivation and self-sustaining growth of the manufacturing sector and financial market. Furthermore, a macroeconomic stabilization policy is a prerequisite condition for coping with the destabilization of the macro economy caused by inflationary trends and debt accumulation. In view of this point, attention must be given to the possibility of a consumption boosting effect of money flow from donor nations which causes inflation in the country. It gives rise to the risks originating from large-scale financial assistance from specific donors, as well as adverse effects caused by concentration of assistance from various countries enabled by aid coordination.

The problem of rice import expanding Ghana's trade deficit has been pointed out from a macroeconomic perspective. To meet the rising rice demand in cities that came as a result of economic development, rice is being imported in large quantities from Thailand and Vietnam because domestic production is insufficient. As a result, a structure in which foreign money needed for macroeconomic investment is being spent – instead consumption of food commodities has emerged. The pattern in which rising import of rice and other food commodities is weighing on investment activities is a matter that must be acknowledged as a problem of food security as well as from the viewpoint of ensuring stability of the macro economy. For this reason, efforts must be made to promote domestic production of rice and imports need to be cut back. On the other hand, demand for rice is growing in cities because it is easy to cook compared to other traditional foods. If that were the case, one of the options would be to develop an alternative food product to rice that suits the urban lifestyle by utilizing crops that are produced in large quantities at home such as cassava and yam.

3.2.6 Conclusion

Population growth is easing in Ghana even though it remains at a high level. The fact that an increase in population causes environmental deterioration, including reduction of forest resources, applies not only to Ghana but also to other countries in sub-Saharan Africa. The governments of these countries are faced with the challenge of striking a balance between conservation of natural environment and the promotion of economic growth.

In particular, Ghana was once given the status of the "honors student of structural adjustment policy" and has attained steady economic development since 2000. For this reason, Ghana is a country in which the issue of striking a balance with environmental conservation has radically manifested itself among the sub-Saharan African nations. Questions remain unsolved as to how Ghana will fix the challenges of economic growth commonly seen in sub-Saharan

Africa. Issues such as whether sustainable economic growth is possible without experiencing a dramatic increase in agricultural production like the Green Revolution in Asia, and whether deterioration of natural resources would become a constraint at the time of improving agricultural productivity, also attract a lot of attention. In this sense, it is important to recognize Ghana as a benchmark for the sake of securing food security in sub-Saharan Africa and activating economic activity. This also shows that the content reviewed with regard to ODA assistance for Ghana, which is the country selected for this survey, is important in reviewing the direction of offering assistance to sub-Saharan Africa in the future.

Although it has not been discussed in this report, it is necessary to look at the issue of food security in sub-Saharan Africa, not on the level of individual countries, but also as an issue affecting several regions. If Ghana were to become the first country in West Africa to succeed in drastically improving its agricultural productivity, Ghana should aim to become a food importer in West Africa. Ghana should then contribute to the aim of solving the population problem in regions that are even more disadvantaged, by absorbing labor forces from neighbouring countries through continuing to give priority to economic development, with emphasis on the manufacturing industry.

Appendix:
Survey Members, Cooperators, Itinerary and Collected Material

1. Survey Committee

1. 1 National Committee

Dr. HARA Yonosuke	Professor, National Graduate Institute for Policy Studies (GRIPS)
Dr. SAKURAI Takeshi	Professor, Faculty of Economics and Business, Wako University
Dr. KUSUMOTO Osamu	Asian Population and Development Association （APDA） Executive Director/Secretary General
Mr. SATO Shoichi	APDA Senior Expert
Mr. TAKEMOTO Masanori	APDA Program Manager/Researcher
Dr. MIZUKAMI Yuji	APDA Researcher

1.2 Survey Members （December 14, 2008 – December 30, 2008）

Dr. SAKURAI Takeshi	Survey Team Leader
Mr. TAKEMOTO Masanori	Survey Team Member
Dr. MIZUKAMI Yuji	Survey Team Member

2. Cooperators

① Embassy of Japan in Ghana

Ms. Yoko Anazawa	First Secretary
Mr. Tsuyoshi Shigeta	Second Secretary

② Japan International Cooperation Agency (JICA) Ghana Office

Mr. Masato Kumagai	Senior Representative
Mr.Yukinari Tanaka	Assistant Resident Representative
Mr. Mitsuhiro Kato	Agriculture & Rural Development
Ms. Megumi Tsukizoe	Representative

③ Parliament of Ghana

Hon. Akua Sena Dansua	Member of Parliament, North Dayi Constituency

④ Planned Parenthood Association of Ghana (PPAG)

Mr. Francis Yankey	Executive Director
Mr.Emmanuel Obeng	Monitoring & Evaluation Manager

⑤ Statistical Service Ghana

Mr. Sylvester Gyamfi	Head, Projects Management Unit
Mr. Akwasi Opoku Agyeman	Assistant Statistician

⑥ Ministry of Food & Agriculture (MOFA)

Mr. Samuel Oku	Deputy Director, Statistics, Research & Information Directorate
Mr. Sidney Oko Bampee Addo	Statistics, Research & Information Directorate
Mr. Daniel Wawo	Production Officer, Statistics, Research & Information Directorate
Ms. Nana Dowicor	Statistics, Research & Information Directorate

⑦ Enviromental Protection Agency(EPA)

Mr. Emmanuel C. Salu	Deputy Director

⑧ The Forestry Commision of Ghana(FC)

Mr. A.A. Boadu	Acting Operations Director, Forest Service Division

⑨ United Nations Population Fund (UNFPA)

Mr. M.Bawa Amadu	Assistant Representative
Mr. S. Alhassan	Operations Manager

⑩ University of Ghana

Dr. Samuel Asuming-Brempong	Senior Lecturer, College of Agriculture & Consumer Sciences
Dr. Alex Boakye Asiedu	Former Head of Department, Department of Geography & Resource Development
Mr. Ansu Gyabour	Data Analyst, Center For Remote Sensing & Geographic Information Service
Mr. George Koomson	Publication Officer, Institute for Statistical, Social & Economic Research

⑪ Research Assistants

Mr. Frank Ohene-Sefa	Research Assistant
Mr. Ohene Richmond Kojo	Research Assistant
Mr. Gideon Danso Abbeam	Research Assistant
Mr. Nana Kofi	Research Assistant
Mr. Robert Aidoo	Research Assistant

⑫ Others

Mr. Raymond Mensah	Consultant, Pentax Management Consultancy Service LTD.

3. Itinerary

2008/12/14 (Sun)

・20:40 Depart Haneda Airport on EK6251 (Takemoto, Mizukami)
・22:00 Arrive at Kansai International Airport (Takemoto, Mizukami)
・23:15 Depart Kansai International Airport on EK317 (Takemoto, Mizukami)

2008/12/15 (Mon)

・5:55 Arrive in Dubai (Takemoto, Mizukami)
・7:40 Depart Dubai on EK787 (Takemoto, Mizukami)
・12:40 Arrive in Accra (Takemoto, Mizukami)
Material Collection (including field maps, books, reports etc.)
・20:40 Depart Haneda Airport on EK6251 (Sakurai)
・22:00 Arrive at Kansai International Airport (Sakurai)
・23:15 Depart Kansai International Airport on EK317 (Sakurai)

2008/12/16 (Tue)

・5:55 Arrive in Dubai (Sakurai)
・7:40 Depart Dubai on EK787 (Sakurai)
・12:40 Arrive in Accra
・9:00 Consultation with Planned Parenthood Association of Ghana (PPAG) about survey mission
・12:00 Visit Ghana Statistical Services for briefing on the outline of Economic Statistics and Census Data and material collection
・14:00 Visit Library of Ghana Statistical Services for a briefing on the outline of Economic Statistics and Census Data and material collection

2008/12/17 (Wed)

・9:30 Visit Ministry of Food And Agriculture (MOFA) for a briefing on Agriculture and Food Statistics in Ghana
・11:00 Visit the United Nations Population Fund (UNFPA) Ghana Office for a briefing on Ghanaian Population Dynamics and UNFPA activities
・14:00 Visit the Embassy of Japan for a briefing from the Embassy of Japan staff on Agriculture and Rural Development in Ghana
・15:30 Visit JICA Ghana Office for a briefing from JICA staff on Agriculture and Rural Development Projects

2008/12/18 (Thu)

・9:30 Visit the Environmental Protection Agency (EPA) for a briefing on Environmental Protection and policy and discussion of the field survey
・10:30 Consultation with Mr. Raymond Mensah regarding village field survey
・11:00 Visit the University of Ghana, Department of Geography & Recourse Development and Center For Remote Sensing and Geographic Information Service for a briefing on Geographical data on the Forestry and Environmental situation in Ghana
・15:00 Visit the Institute for Statistical and Social Research, University of Ghana for material collection (Report and Books about Agricultural Economy)
・16:00 Visit with Dr. Samuel Asuming-Brempong, College of Agriculture and Consumer Sciences, University of Ghana for a briefing on Agriculture situation and Agricultural Environment in Ghana

2008/12/19 (Fri)

・9:00 Visit Forestry Commission for a briefing on Forestry Management Policy and recourse situation in Ghana
・11:30 Visit 31st December Market and observation of rice sales in Accra
・15:00 Visit the National Diet of Ghana for a courtesy call to Hon. Ms. Akua Sena Dansua and a briefing on the Political Situation and Agricultural Development Policy in Ghana

2008/12/20 (Sat)

・Move from Accra to Kumasi, Ashanti Region
・Discussion of field survey with coordinator

2008/12/21 (Sun)

・Meeting about field survey with coordinator and research assistants
・Conduct field survey in the surveyed village

2008/12/22 (Mon)

・Conduct field survey in the surveyed village
・Data input and data processing

2008/12/23 (Tue)

・Conduct field survey in the surveyed village

・Data input and data processing

2008/12/24 (Wed)

・Conduct field survey in the surveyed village

・Data input and data processing

2008/12/25 (Thu)

・Conduct field survey in the surveyed village

・Data input and data processing

2008/12/26 (Fri)

・Conduct field survey in the surveyed village

・Data input and data processing

2008/12/27 (Sat)

・Conduct field survey in the surveyed village

・Move from the surveyed area to Accra

・Data input and data processing

2008/12/28 (Sun)

・Data input and data processing

・Material Collection

・18:45 Depart Accra on EK788 (Sakurai, Takemoto, Mizukami)

2008/12/29 (Mon)

・6:25 Arrive in Dubai (Sakurai, Takemoto, Mizukami)

・Data input and data processing

2008/12/30 (Tue)

・2:50 Depart Dubai on EK316

・16:40 Arrive at Kansai International Airport (Sakurai, Takemoto, Mizukami)

・19:15 Depart on EK6252

・20:25 Arrive at Haneda (Sakurai,Takemoto,Mizukami)

4. Collected Material

1 A. Wayo Seini, "Agricultural Growth and Competitiveness Under Policy Reforms in Ghana", Institute of Statistical, Social & Economic Research (ISSER) (September 2002)

2 A. Wayo Seini, George Botchie, and Lawrence Damnyag, "Environmental Service Provided by Selected Farming Systems in Ghana", Institute of Statistical, Social & Economic Research (ISSER) (May 2004)

3 Akwasi Mensah-Bonsu and Daniel B.Sarpong, "Land Tenure System and Land for Farming in Ghana: An Empirical Analysis of Factors Affecting Access and Security", Institute of Statistical, Social & Economic Research (ISSER) (May2008)

4 Christopher Udry and Santosh Anagol, "The Return to Capital in Ghana", Institute of Statistical, Social & Economic Research (ISSER) (May 2006)

5 Christopher Udry and Timothy G. Conley, "Social Networks in Ghana", Institute of Statistical, Social & Economic Research (ISSER) (May2006)

6 Chuks J. Mba and Stephen O. Kwankye, *Population, Health and Development in Ghana: Attaining the Millennium Development Goals* (Sub-Saharan Publishers, 2007)

7 Dominic BLAY and Lawrence Damnyag, "Land Tenure System and Land Degradation in Ghana", Institute of Statistical, Social & Economic Research (ISSER) (August 2008)

8 Ellen Bortei-Doku Aryeetey, Nii Ashie Kotey, Nicholas Amponsah, and Kojo Bentsi-Enchill, "Legal and Institutional Reform in Ghana", Institute of Statistical, Social & Economic Research (ISSER) (2007)

9 Ellen Bortei-Doku Aryeetey and Ernest Aryeetey, "Operation, Utilization and Change in Rotating SUSU Saving in Ghana", Institute of Statistical, Social & Economic Research (ISSER) (1996)

10 Environmental Protection Agency, "State of Environment Report 2004", Environmental Protection Agency (April 2005)

11 Ernest Aryeetey, "Globalization, Employment and Poverty Reeducation: A Case Study of Ghana", Institute of Statistical, Social & Economic Research (ISSER), (2005)

12 Ernest Aryeetey and Lemima W. Senbet, "Essential Financial Market Reforms in Africa", Institute of Statistical, Social & Economic Research (ISSER), (May2004)

13 Ernest Aryeetey and Ravi Kanbur, *The Economy of Ghana* (WOELI Publishing Service, 2008)

14 Ernest Aryeetey and Ravi S. Kanbur, "Macroeconomic Stability, Growth and Poverty Reduction in Ghana", Institute of Statistical, Social & Economic Research (ISSER) (2004)

15 Ernest Aryeetey and Victor Nyanteng, "Agricultural Market Access in Ghana", Institute of Statistical, Social & Economic Research (ISSER) (April 2006)

16 Ernest Aryeetey, Jane Harrigan, and Machiko Nissanke, *Economic Reforms in Ghana: The Miracle and the Mirage* (Africa World Press, Inc., 2000)

17 Ernest Aryeetey, Ramatu M. Al-Hassan, Samuel Asuming Brempong, and D.K. Twerefou, "The Organization of Land Markets and Production in Ghana", Institute of Statistical, Social & Economic Research (ISSER) (2007)

18 Felix Ankomah Asante, Kwadwo Asenso Okyere, and Anthony Kusi, "The Economic Impact of The Burden of Malaria in Ghana", Institute of Statistical, Social & Economic Research (ISSER) (December 2005)

19 Ghana Statistical Service, “2000 Population & Housing Census of Ghana: The Gazetteer 1-3”, Ghana Statistical Service (2005)
20 Ghana Statistical Service, “Ghana Population Data Analysis Report: Volume 1, Socio-Economic and Demographic Trends”, Ghana Statistical Service (2005)
21 Ghana Statistical Service, “Ghana Population Data Analysis Report: Volume 2, Policy Implications of Population Trends”, Ghana Statistical Service (2005)
22 Ghana Statistical Service, “2000 Population & Housing Census of Ghana: Demographic, Economics and Housing Characteristics: Total Country”, Ghana Statistical Service (2005)
23 Ghana Statistical Service, “1984 Population Census of Ghana: Special report on Localities by Local Authorities: Ashanti Region”, Ghana Statistical Service (1989)
24 Ghana Statistical Service, “2000 Population & Housing Census of Ghana: Analysis of District Data and Implications for Planning: Ashanti Region”, Ghana Statistical Service (2005)
25 Ghana Statistical Service, “Economic Survey 2001-2005”, Ghana Statistical Service (2007)
26 Guy Arnold, *Africa: A Modern History* (Atlantic Books, 2005)
27 ISSER, “The State of The Ghanaian Economy in 2007”, Institute of Statistical, Social & Economic Research (ISSER) (August 2008)
28 ISSER, “The State of The Ghanaian Economy in 2006”, Institute of Statistical, Social & Economic Research (ISSER) (August 2007)
29 ISSER, “The State of The Ghanaian Economy in 2005”, Institute of Statistical, Social & Economic Research (ISSER) (July 2006)
30 ISSER, “Annual Report 2006/2007”, Institute of Statistical, Social & Economic Research (ISSER) (2007)
31 Isaac Osei-Akoto, Irene Ampaabeng, and Ama Pokuaa Fenny, “Customary Land Tenure Practices, Investment and Agricultural Production in Ghana”, Institute of Statistical, Social & Economic Research (ISSER) (August 2008)
32 Jacqueline Vanderpuye-Oragle, “Economy and Poverty In Ghana In The 1990's: A Review”, Institute of Statistical, Social & Economic Research (ISSER) (2004)
33 John K. ANARFI, “Achieving and Managing Demographic Transition In A Changing Economy”, Institute of Statistical, Social & Economic Research (ISSER) (September 2001)
34 Joseph Godson Amamoo, *Ghana: 50 Years of Independence* (Pak Limited, 2007)
35 Kwadwo Assenso-Okyere, “Transforming Agricultural Production and Productivity for Sustained Rapid Growth and Development”, Institute of Statistical, Social & Economic Research (ISSER) (September 2001)
36 Kwame Arhin, “The Political Systems of Ghana”, Historical Society of Ghana (2002)
37 Lennox Agbosu, Mariama Awaumbila, and Dzodzi Tsikata, “Customary and Statutory Land Tenure and Land Policy”, Institute of Statistical, Social & Economic Research (ISSER) (2007)
38 Luara Hessburg, Kofi Awusabo-Asare, Akwasui Kumi-Kyereme, Joana O. Nerquaye-Tetteh, Francis Yankey, Ann Biddlecom, and Melanie Croce-Galis, “Protecting the Next Generation in Ghana: New Evidence on Adolescent Sexual and Reproductive Health Needs”, Guttmacher Institute (2007)
39 Marcus Goldstein and Christopher Udry, “The Profits of Power: Land Rights and Agricultural Investment in Ghana”, Institute of Statistical, Social & Economic Research (ISSER) (May2006)
40 Paul W.K. YANKSON and Marshall KALA, “Access to Land, Tenure Security and Growth within the Informal Economy in the Urban and Peri-Urban Areas

of Ghana", Institute of Statistical, Social & Economic Research (ISSER) (May2008)
41 Peter Quartey, "Migrant Remittances and Household Welfare in Times of Macro-Volatility: The Case of Ghana", Institute of Statistical, Social & Economic Research (ISSER) (October2006)
42 PPAG, "Planned Parenthood Association of Ghana: 40 Years of Excellent in Sexual and Reproductive Health Service Provision", Planned Parenthood Association of Ghana
43 S.T. Addo and Alex B. Asiedu, "Fragmentation, Climate Change, and Non-Modernization of Agricultural System as Promoters of Land Degradation in the Environment: Land Tenure Nexus at Dawa Ogome in Manya Krobo District of the Eastern Region", Institute of Statistical, Social & Economic Research (ISSER) (August 2008)
44 UNFPA and Government of Ghana, "State of Ghana Population Report 2003: Population, Poverty and Development", UNFPA and Government of Ghana, (2004)