EFFECTS OF CHANGE IN POPULATION, HOUSEHOLD CONDITIONS AND FARMING PRACTICES ON AGRICULTURAL LAND USE IN THE VOLTA RIVER BASIN OF GHANA, 1984–2000

With 1 figure and 8 tables

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Zusammenfassung: Auswirkungen von veränderten Bevölkerungsverhältnissen, häuslichen Bedingungen und landwirtschaftlichen Praktiken auf die landwirtschaftliche Nutzung im Volta-Becken von Ghana, 1984–2000

Das Volta-Becken Ghanas mit einer Fläche von etwa 160.000 km^2 ist eines der wirtschaftlich am stärksten benachteiligten Gebiete in Westafrika. Regenfeldbau und Bewässerungslandwirtschaft sind die Hauptbeschäftigung der Bevölkerungsmehrheit. Schnelles Bevölkerungswachstum und niedriger Lebensstandard haben gravierende Auswirkungen auf die Landwirtschaft. Hypothese dieses Beitrags ist, dass Bevölkerungswachstum, eine allgemeine Verbesserung der Lebensbedingungen und gestiegenen Investitionen in den Landbau zu einer intensiveren Landnutzung in zwei unterschiedlichen agrarökologischen Regionen Ghanas (Feucht- und Trockensavanne) zwischen 1984 und 2000 beigetragen haben. War 1984 noch Brache in der Trockensavanne weit verbreitet, so ist sie für das Jahr 2000 nicht mehr nachweisbar. Zum anderen hat der Bevölkerungsdruck auf die landwirtschaftliche Nutzfläche der Feuchtsavanne seit 1984 erheblich zugenommen. Zum Dritten: Die Verbesserung der Haushaltseinkommen hat nicht zu einer Intensivierung der Landnutzung beigetragen. Schließlich hat auch die Mechanisierung der Landwirtschaft in der Feuchtsavanne nicht zu verstärkter Landnutzung geführt; in der Trockensavanne werden bis heute einfache Subsistenzformen des organischen Landbaus praktiziert.

Summary: The Volta River basin in Ghana, which covers about 160,000 km^2, is one of the most economically deprived areas in West Africa. Rain-fed and some irrigated agriculture is the main economic activity of the majority of the population living in this region. Rapid population growth and low economic standards of living have brought in their wake a lot of consequences for agricultural land resources in this region. This paper hypothesises that population growth, general improvement in household conditions and improved inputs for farming has increased agricultural land utilisation in two agro-ecological zones (derived and dry savannahs) of the Volta River basin in Ghana between 1984 and 2000. The results show that land fallow was practised widely in 1984 but not in 2000 in the dry savannah zone. Secondly, there has been population pressure on agricultural land use since 1984 in the derived savannah zone. Thirdly, improvements in household conditions and affluence have not increased agricultural land use. Finally, even though innovations in mechanised farming had spread to the derived savannah zone, it has not increased agricultural land utilisation. In the dry savannah zone simple subsistence forms of organic farming were still being practised.

1 Introduction

Agriculture is the main economic activity of the majority of the population living in the Volta River basin in Ghana. It contributes over 40% of Gross Domestic Product and employs about 50% of Ghana's labour force (GSS 2002). As a result, much attention has been placed on sustainable management of agricultural resources in the country.

Rapid population growth and low economic standards of living have brought in their wake a lot of consequences for agricultural land resources in this region (BENNEH a. AGYEPONG 1990). As a result of rapid population growth, conflicts over land have been rife, assuming various dimensions from minor conflicts between individuals and families to large scale ones between ethnic groups (GSS 1995).

Furthermore, increase in technological capacity particularly for farming, and affluence, in terms of improvement in general household conditions, have put more pressure on agricultural land resources. This study hypothesises that, population growth, general improvement in household conditions and improved inputs for farming has increased agricultural land utilisation in the study areas between 1984 and 2000. It incorporates concepts from multiplicative (EHRLICH a. HOLDREN 1971, 1974; HARRISON 1992; COMMONER 1991, 1992) and mediating perspectives (BLAIKIE a. BROOKFIELD 1987; BILSBORROW 1987, 1992a, b) to have a holistic understanding of the population and environment nexus.

2 Materials and Methods

The study used information from longitudinal household survey undertaken between November 2001 and February 2002 among 252 households each in the dry and derived savannah zones. A multiple regression model used in the study is stated below and table 1 gives the description of variables and methods of aggregation.

3 Study Area

The dry savannah zone mainly found in the Upper East and Upper West regions with a population of 1,496,672 in 2000 (GSS 2002) and the derived savannah zone with a population of 776,941 in the Brong-Ahafo and Ashanti regions of Ghana, are the two study areas used. The dry savannah zone is 83% rural and the derived savannah zone is 66% rural. Figure 1 is a zone map of Ghana, showing the locations of the two study zones.

The dry savannah zone lies within the geographical area of Ghana with a single maximum rainfall regime. Areas within this rainfall regime, experience only one rainy season from about May to August, when the sun is overhead or almost so, on the Tropic of Cancer in the northern hemisphere, followed by a long dry season. The zone experiences a mean annual rainfall of 1,150 mm (DICKSON a. BENNEH 1995). The derived savannah zone, however, experiences a double maximum rainfall regime, where there are two rainy or wet seasons. The two wet periods occur from May to August and from September to October, with a mean annual rainfall of 1,430 mm. The differences in the rainfall regimes have implications for agricultural production in the two study areas.

With regard to vegetation, the dry savannah zone belongs to the mid dry savannah vegetation type in Ghana. The zone is characterised by few and scattered trees such as the baobab (*Adansonia digitata*), locus bean tree (*Parkia biglobosa*), acacias (*Acacia spp.*) and the shea tree (*Butyrospermum parkii*), which have adapted to the environment. Grasses grow in tussocks and can reach a height of 3 meters or even more. Marked changes in the plant life of the zone are experienced during different seasons of the year. During the rainy season, the vegetation is very green. Trees blossom and grasses shoot up very quickly. However, immediately after the rains recede, leaves begin to change colour from green to yellow and trees begin to shed their leaves. Regular burning, the grazing of livestock and cultivation have left only few trees still standing and rendered the vegetation to be open and dominated by short grasses.

The vegetation in the derived savannah zone can be described as wet savannah and is composed of short branching trees, many less than 15 meters high, which

Table 1: Description of variables and aggregation method used in the model

Variablen und Aggregationsmethode des Modells

$CA_{ij}=\alpha+ß_1E_{ij}+ß_2MF_{ij}+ß_3EL_{ij}+ß_4OF_{ij}+ß_5ON_{ij}+ß_6F_{ij}+\ldots+ß_nP_{ij}$

Abbrev.	Description	Aggregation Method
CA	Total cropped area by household (in acres) – dependent variable	Mean
E	Educational level of household	Mean
MF	Proportion of major farmers in household	Mean
EL	Presence or otherwise of electricity in household	Mode
OF	Household income from off-farm activities	Mean
ON	Household income from farm activities	Mean
F	Household expenditure on food	Mean
A	Household affluence (measured by ownership of car, motorcycle, bicycle, TV & radio)	Mean
AL	Household affluence (measured by ownership of livestock)	Mean
LT	Land tenure system in households	Mode
T	Proportion of household members who use tractor on their farms	Mean
I	Proportion of household members who use inorganic fertiliser on their farms	Mean
S	Proportion of household members who use improved seed variety on their farms	Mean
LF	Number of years allowed for land to fallow in household	Mean
D	Household distance travelled to furthest farm	Mean
EX	Recent extended farm lands (in acres) (Extensification)	Mean
HS	Household size	Mean
P	Population of locality	Absolute
i	Locality	
j	Years (1984 & 2000)	

do not usually form a closed canopy and are often widely scattered. The ground flora consists of apparently continuous layers of grass, some species of which reach a height of about 4 meters.

Lixisols are soil types found in both the dry and derived savannah zones. In the derived savannah, the normal profile consists of about 30 cm of dark brown to brown, fine sandy loam overlying, from 30–152 cm, reddish brown to reddish yellow, fine sandy loam to fine sandy clay loam. They are moderately well supplied with organic matter and nutrients. Moisture holding capacity is moderately good and the soils are easily tilled by machines and by hand. They are mainly utilised for the production of yam (*Dioscorea divaricata*), maize (*Zea mays*), cassava (*Manihot esculenta*), groundnut (*Arachis hypogaea*), cowpea (*Vigna unguiculata*), tobacco

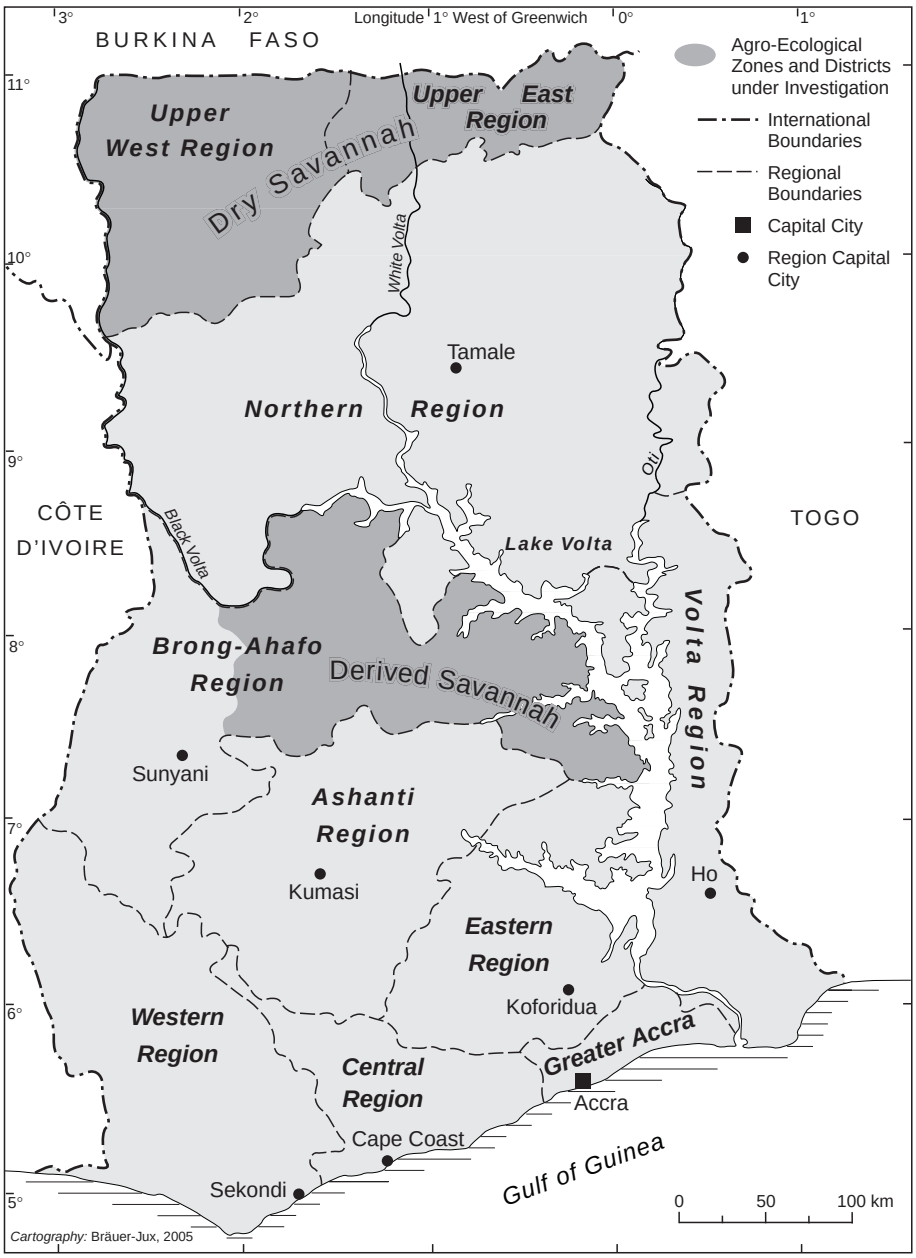

Fig. 1: District Map of Ghana showing the two agro-ecological zones
Verwaltungsgliederung Ghanas und die beiden agro-ökologischen Untersuchungsgebiete

(*Nicotiana andicola*), cotton (*Geossypium herbaceum*) and vegetables but are, however, subject to moderate erosion (ADU a. MENSAH-ANSAH 1995).

The derived savannah zone also has patches of Plinthosols. It has poor humus fine sandy loam topsoil approximately 12 cm or less in thickness, over brown to light yellowish brown fine sandy loam containing abundant ironstone concretions and large boulders or iron pan. The soils are poorly drained and medium to light textured and subject to seasonal water logging or flooding for varying periods, but generally become thoroughly dry during dry seasons. The dry savannah also has patches of Leptosols, which consist of about 10 cm of brown slightly humus sandy loam topsoil overlying hard massive rock. Frequently, ferruginized rock brash and fragments of stones are incorporated in the topsoil. It has little agricultural value.

4 Results and Discussion

4.1 General Household Conditions

General household conditions were measured by educational level of households and occupation of household members, availability of electricity as a source of energy and expenditure on food. Educational level was considered due to the fact that the quality of a population, with regard to its educational attainment is very important and can influence agricultural land use in any community. In communities with low educational attainment, there is the tendency for its members not to be able to find employment in the highly skilled labour sectors and therefore engaging in unskilled labour especially subsistence farming. This scenario has implications for land use as more people may seek farmland to utilise.

Also, the availability of electricity in a community can be argued to be one of the factors that engineers technologies, which can be used to transform land cover. The study therefore made enquiries into households with electricity in the two study areas, and the time electricity was installed in the houses in the two study areas, to ascertain whether electricity was introduced into the communities early enough to make a marked contribution to agricultural land use.

In typical agrarian systems like the ones being considered by this study, households might want to minimise their expenditures on food by putting more land under cultivation to feed the household. The ideal situation would therefore be to have no costs for food. The amount of money a household spends on food can thus influence the total land area cropped by this household. It is assumed that households with high expenditures on food will have smaller areas of cropped land. Information was gathered on the households' expenditures on food items, namely, grains, beans, roots and tubers, fruits, vegetables, meat and dairy products.

Table 2 shows that 44.2% and 34.6% of the respondents in the dry and derived savannah zones, respectively, had no formal education. Also, the majority of the population (71.9% and 72.7% in the dry savannah zone, and 69.9% and 72.1% in the derived savannah zone for 1984 and 2000, respectively) in both zones have farming as their major occupation.

As far as electricity is concerned, only one out of ten houses in the dry savannah zone had electricity in 2000, a marked difference from what pertains in the derived savannah zone, where six out of ten houses had electricity installed. Only few households in both zones did not spend money on food.

4.2 Affluence

To determine the wealth of household members, enquiries were made into ownership of the household items, namely, bicycle, car, motorcycle, radio and television as well as the ownership of livestock, specifically cattle, sheep and goats, shown in table 3. This determination was made against the background that some of these items are sold out by household members to help resolve economic problems.

Monthly household off-farm income, defined as income from non-farm activities earned by households, and income from sale of farm produce were also used as proxies to measure household affluence (see Tab. 3). This is very significant, because households that earn additional money from non-farm activities may be in the position to invest more in their farms and may increase their farm holdings as opposed to households with little or no income from non-farm activities. The same is true for income from sale of farm produce. However, on the other hand, households may tend to produce only for their consumption, since other financial obligations may be met by the additional income accruing from off-farm activities.

There is not much disparity between monthly off-farm incomes in the two zones, however, the analysis shows that 44% and 49.8% of the households in the dry and derived savannah zones, respectively, have members who engage only in farming and thus, have no income from non-farm activities.

Furthermore, the two study areas did not differ much as far as ownership of household items is concerned. With regard to livestock ownership, a contrasting picture was revealed. While ownership of cattle, sheep and goats was very high in the dry savannah zone, the situ-

Table 2: Percentage distribution of respondents by general household conditions and study area, 1984 & 2000

Anteil der Befragten nach Haushaltsgruppen und Untersuchungsgebieten, 1984 und 2000

General conditions	Dry savannah 1984	2000	Derived savannah 1984	2000
No schooling	–	44.2	–	34.6
Major farmers	71.9	72.7	69.9	72.1
Availability of electricity	3.0	9.9	1.0	60.3
No expenditure on food	–	4.0	–	2.8

Source: Field Survey, 2001 & 2002

ation was different in the derived savannah zone. Also, while ownership of cattle and sheep decreased between 1984 and 2000 in the dry savannah zone, ownership of goats increased. However, as far as the derived savannah zone is concerned, there were increases in ownership of all categories in livestock between the period.

4.3 Farming System, Practices and Inputs

The type of farming system used, be it slash-and-burn, shifting cultivation, crop rotation, land fallow etc.; the inputs, whether they are tractors, improved seed varieties, inorganic fertilisers, the type of land tenure, be it customary/communal, tenancy, family or individual ownership, may all play a role in affecting agricultural land use in any community.

The type of land tenure predominant in any community plays a significant role in the agricultural system, and can greatly influence the total agricultural land cropped. This assertion is being made as a result of the fact in communities where there are flexible land tenure systems, members may put more land under cultivation.

However, members may be frustrated and land accessibility may be difficult in areas with very stringent land tenure systems or in situations where land may be rented. The study considered two kinds of land tenure systems, namely, tenancy and individual ownership (customary/communal and family).

Furthermore, the practice of leaving land to fallow in an agricultural system can be said to be interrelated to the availability of land in the system. This is due to the fact that in systems and periods where land is available, there is a tendency for land to be left to fallow. However, the opposite is the case in areas and during times where there is pressure on the land. The study investigated whether land fallow was being practised in any of the study areas and, if so, to what extent did it play a role

Table 3: Percentage distribution of household by affluence and study area, 1984 & 2000

Anteil der Haushalte nach Besitzständen und Untersuchungsgebieten, 1984 und 2000

Items	Dry savannah 1984	2000	Derived savannah 1984	2000
Bicycle	30.7	32.5	17.9	19.0
Car	0.6	0.5	0.7	1.1
Motorcycle	2.8	2.9	0.5	0.4
Radio	26.0	27.3	26.8	27.7
Television	2.4	3.2	8.7	9.1
Livestock				
Cattle	53.0	50.0	4.0	7.0
Sheep	56.0	52.0	18.0	20.0
Goat	67.0	75.0	25.0	31.0
Affluence				
Farm income	–	48.8	–	97.6
Off-farm income	–	56.0	–	50.2

Source: Field Survey, 2001 & 2002

in the total cropped area in the two study areas for the two study years.

The distance travelled to a farm is related to land accessibility and availability. In agricultural systems where there is less pressure on land, farmers may travel shorter distances to their farms. However, as land availability decreases as a result of pressure on land, people may travel longer distances to their farms. An investigation was carried out in this study to determine the average distance travelled by household members to their furthest farms in the two districts.

Finally, the availability of additional arable land for the households can encourage agricultural extensification, since households would turn to those lands to increase productivity during times of soil fertility decline in cultivated areas. This scenario can play a role in the total agricultural land cultivated. The household heads were asked whether they had farmed new lands within the preceding five years and, if yes, how large (in acres) the area was (Tab. 4).

In table 4, 11% of the farmers in the dry savannah zone are tenant farmers whereas twice that number (22%) are tenants in the derived savannah zone. The derived savannah zone has more tenant farmers because of its status as a migrant area.

The use of all three farm inputs was much higher for both 1984 and 2000 for the derived savannah zone when compared to the dry savannah zone. Secondly, in each zone, the use of the three inputs was higher in 2000 when compared to 1984. In both study areas, the percentage of farmers who practised land fallow decreased slightly, i.e., from 25.5% to 23% in the dry savannah zone and from 43.2% to 41.3% in the derived savannah zone. Average fallow years allowed in both zones decreased use between 1984 and 2000. A sizeable number of farmers in both zones travel a distance of 10 kilometres or more to their further farms and finally, while 52% of the farmers in the derived savannah zone cultivated new lands within the last five years, only 10% of their counterparts in the dry savannah zone did that.

4.4 Fertility, mortality and migration

Average annual per cent growth rate in births was higher in the derived savannah zone than in the dry savannah zone. However, there were more deaths in the dry savannah zone compared to the derived savannah zone. Furthermore, there was more out-migration from the dry savannah zone than from the derived savannah zone and, probably as a result of this, there was more in-migration to the derived savannah zone than to the dry savannah zone within the period 1997–2001 (Tab. 5).

4.5 Household size

Household size is the other demographic variable used in this study. In table 6, household size varies greatly in the two study areas. While the dry savannah zone had about 4.2% single households in 1984, only 0.5% of the households in the derived savannah zone were single member households. The situation, however, changed considerably for both zones in 2000, with no single member households. On the whole the derived savannah zone has bigger household sizes compared to the dry savannah zone.

4.6 Spatial factors determining agricultural land use

Years allowed for land to fallow and proportion of major farmers were significant predictors of cropped area in the dry savannah zone in 1984 (Tab. 7). Land fallow is positively correlated with cropped area in the model, which implies that the more land people left to fallow, the more land area they had cropped. Farmers who allowed an additional year of fallow in 1984 had 6 more acres of farmland than their counterparts.

However, the situation changed in 2000, since land fallow not only ceased to be a significant predictor of cropped area in the dry savannah zone, but also had a negative relationship. Since there is evidence of a population increase between 1984 and 2000 in the dry savannah zone, this scenario can be said to conform to the Malthusian theory, as modified by MORTIMORE (1993), which stated among other things that an increase in population density brings about the shortening of the fallow period that is needed to rejuvenate soil fertility. Also, each additional major farmer in the dry savannah zone in 1984 increased total cropped area by 0.1 acre.

In the derived savannah zone, a demographic indicator, i.e., population of the locality, was a significant predictor of cropped area in 1984. Each additional person added to the locality resulted in an increase of almost an acre farmland. This could imply that, as far back as 1984, population pressure was being felt on agricultural land in the derived savannah zone, but not in the dry savannah zone.

Finally, none of the agricultural technological indicators (use of tractor, fertiliser and improved seed variety for farming) were predictors of agricultural land use in both areas in 1984.

This gives a strong indication that innovations in mechanised forms of farming had not spread to any part of the study area in 1984, and simple subsistence forms of organic farming were still being practised.

With regard to 2000, distance to furthest farm, off-farm income, and extensification, were predictors of

cropped area in the dry savannah zone, while the population of the locality again predicted cropped area in the derived savannah zone. Distance to furthest farm in the dry savannah zone has a positive correlation with agricultural land use, which was an unexpected outcome. This means that the further the people travelled to their farms, the more land they cropped. In fact, every extra kilometre a farmer travels to the farm resulted in 2 acres of additional farmland cultivated. This result may, therefore, indicate that longer distances travelled to farms in the dry savannah zone do not necessarily result in smaller cropped areas.

It is surprising to note, that income from on-farm activities, does not play any significant role in agricultural land use in any of the zones. This is due to the fact that enormous disparities existed between the income pat-

Table 4: Percentage distribution of respondents by farming practices, implements used and study area, 1984 & 2000

Anteil der Befragten nach Bodenbewirtschaftung, Geräteeinsatz und Untersuchungsgebieten, 1984 und 2000

	Dry savannah		Derived savannah	
Farming	1984	2000	1984	2000
Tractor	10.3	19.8	58.1	77.4
Inorganic fertiliser	21.4	31.5	58.4	87.3
Improved seed variety	4.1	12.5	21.1	57.9
Land tenure (tenancy)	–	11.0	–	22.0
Practice of land fallow	25.5	23.0	43.2	41.3
Mean fallow years	2.5	2.3	3.4	2.7
Extensification	–	10.0	–	52.0
Distance to farms (10 kms+)	–	6.0	–	9.3

Source: Field Survey, 2001 & 2002

Table 5: Average annual per cent growth rate of selected demographic indicators in households by study area, 1997–2001

Durchschnittliche jährliche Veränderungsraten demographischer Indikatoren nach Haushalten und Untersuchungsgebieten, 1997–2001

Indicator	Dry savannah	Derived savannah
Births	4.0	6.2
Deaths	1.2	0.8
Out-migration	3.0	2.4
In-migration	0.8	1.2

Source: Field Survey, 2001 & 2002

Table 6: Percentage distribution of household size by study area, 1984 & 2000

Prozentuale Verteilung der Haushaltsgrößen nach Untersuchungsgebieten, 1984 und 2000

	Dry savannah		Derived savannah	
Household size	1984	2000	1984	2000
1	4.2	–	0.5	–
2	12.6	4.8	20.6	2.4
3	28.9	5.6	18.4	2.8
4	13.2	15.5	12.6	6.7
5–9	37.9	58.2	42.1	63.9
10–14	3.2	11.9	4.2	17.8
15–19	–	4.0	0.5	3.6
20 & above	–	–	1.1	2.8

Source: Field Survey, 2001 & 2002

terns from this source between the two zones. It was expected that at least income gained from the sale of farm produce would be channelled into farming in the derived savannah zone, but that is not the case. With regard to income from off-farm activities, the analysis shows that extra income earned off-farm is not necessarily invested into farming activities, since the variable has an inverse relationship with farmland. Finally, expenditure on food also did not play any role in the utilisation of agricultural land contrary to expectation. It was anticipated that the more expenditure households incur on food, the more land would be put under cultivation, but this does not seem to be the case in either zones.

Finally, the agricultural extensification variable included in the model only affected agricultural land use in the dry savannah zone. It was presumed that there would be extra land available to households to turn to in times of scarcity. However, this does not seem to play any role at all in total acreages cropped by households in the derived savannah zone. The irony of the situation is the fact that agricultural extensification plays a greater role in the dry savannah zone. Farmers there have, on average, 30 more acres of land to extend to than their counterparts in the derived savannah zone. It was observed during the field study that a lot of households over-cultivate the same piece of land around their compounds, which is a form of agricultural intensification. Thus, if so much land is available in the zone, the question then remains, why is compound farming so widespread there? One possible answer to this question may be that households simply do not have the capacity both technologically and financially to practice extensification, even though arable lands may be available.

4.7 Spatio-temporal analysis of agricultural land use

Spatio-temporal differences between the dependent and the independent variables are considered. Firstly, the analysis shows that land tenure arrangement (whether ownership or rental), the presence or otherwise of electricity as a source of household energy, affluence (items and livestock ownership), the use of tractor, inorganic fertiliser, and improved seed variety for farming as well as household size did not influence agricultural land use in both zones and in both years. The non-significance of electricity as a predictor of agricultural land use was buttressed by the analysis in the opening sections of this paper, which shows that electricity was not widely utilised in both zones and years.

Secondly, technologically improved techniques of farming such as the use of tractors, inorganic fertilisers and improved seed varieties have not made much head-

Table 7: Results of stepwise multiple regression showing significant predictors of cropped area by zones and years

Ergebnisse schrittweiser multipler Regression mit signifikanten Vorhersagen für Anbauflächen nach Regionen und Jahren

Variables	Unstandardised Coefficients Beta (β)	Standard Error	t
Dry savannah, 1984			
Constant	–4.12	2.79	–1.48
Fallow	6.29	0.89	7.11
Major Farmers	0.08	0.04	2.35
R = 0.92	R^2 = 0.85	Adjusted R^2 = 0.82	
Derived savannah, 1984			
Constant	7.29	1.12	6.52
Population	0.01	0.01	5.04
R = 0.89	R^2 = 0.78	Adjusted R^2 = 0.75	
Dry savannah, 2000			
Constant	–3.19	1.27	–2.51
Furthest Farm	2.19	0.33	6.57
Off-farm income	–0.01	0.01	–5.12
Extensification	29.61	8.80	3.37
R = 0.95	R^2 = 0.90	Adjusted R^2 = 0.85	
Derived savannah, 2000			
Constant	11.18	0.98	11.46
Population	0.01	0.01	6.66
R = 0.93	R^2 = 0.86	Adjusted R^2 = 0.84	

Table 8: Results of stepwise multiple regression showing significant predictors of cropped area – all zones, 1984

Ergebnisse schrittweiser multipler Regression mit signifikanten Vorhersagen für die Anbauflächen insgesamt, 1984

Variable	Unstandardised Coefficients Beta (β)	Standard Error	t
All zones, 1984			
Constant	–3.88	1.99	–1.95
Fallow	3.86	0.83	4.66
Household size	1.72	0.48	3.61
R = 0.89	R^2 = 0.80	Adjusted R^2 = 0.78	
All zones, 2000			
Constant	–9.64	4.14	–2.33
Improved Seed Variety	0.18	0.04	4.30
Household size	1.87	0.60	3.14
R = 0.87	R^2 = 0.76	Adjusted R^2 = 0.73	

way in these areas. The result do not fully complement the view of BOSERUP (1965) in her neo-classical model of land use. Among other things she states that in highly populated areas, there would be the need to sustain a large growing population and that this will culminate in the adoption of more intensive farming methods, which would require additional labour inputs per unit area. The derived savannah zone might not have experienced the sort of population density BOSERUP describes in her model to warrant the use of more intensive farming techniques. The study shows that the population factor has played a role in agricultural land use since 1984.

Furthermore, the amount of land left to fallow and the proportion of major farmers in the households were significant predictors of agricultural land use in the dry savannah zone in 1984. In 2000, these predictors were distance travelled to furthest farm, off-farm income and extensification.

Finally, both in 1984 and 2000, the demographic indicator, i.e. population of the locality, was a significant predictor of agricultural land use in the derived savannah but not in the dry savannah zone. The fact that this variable did not influence agricultural land use at any point in time in the dry savannah zone gives ample evidence that the area did not experience any population pressure as far as agricultural land use is concerned. This, therefore, throws more light on the fact that from 1984 onward the zone has experienced continuous out-migration of mainly the youth to the urbanised as well as the farming and mining communities of the basin. Also, the analysis confirms the status of the derived savannah zone as a migrant-receiving area as mentioned above.

4.8 Determinants of agricultural land use in the Volta River basin in Ghana

To provide an explanation for agricultural land use in the Volta River basin, all relevant factors were introduced by combining the two study areas and years. The results are shown in table 8.

Unlike the individual years in the respective study areas, some new variables emerge as significant predictors of household total cropped area. These include improved seed variety and household size. The importance of household size in the overall model emphasises the importance of the demographic factor for agricultural land use. Any additional member added to the household in 1984 and 2000 resulted in an increase of almost 2 acres of farmland. Also, with regard to the overall model, between 1984 and 2000 the use of improved seed variety, an agricultural technological variable, became significant and any farmer who used this increased his/her farmland by almost 0.2 acres. Thus, the use of technologically advanced forms of farming is gradually becoming prominent in the study areas even though it is not on a massive scale.

5 Conclusion

The paper has revealed that several variables operate at the household level to influence agricultural land use. Secondly, these variables do not have the same characteristics for every zone and year. It clearly emerges that time and space differentials account for whether a variable turns out to be a significant predictor of agricultural land use or not. As the level of analysis changed

from the aggregate level to the specific study zones and years, some of the variables that were seen to be significant predictors at the aggregate level lost their significance. Finally, part of the unexplained variance in the utilisation of agricultural land observed among the study zones and years can be attributed to other factors, such as physical, natural or environmental and political, which this paper did not deal with.

The hypothesis that population growth has increasing agricultural land utilisation is confirmed in the derived savannah zone but not in the dry savannah zone. However, the other two hypotheses namely, that increase in technological capacity particularly for farming, and affluence, in terms of improvement in general household conditions, have put more pressure on agricultural land resources were both nullified.

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