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Modelling the Perspective of Agricultural Land Use Trajectories in a Peri-Urban District of Ghana

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Authors' contributions

The scheme of work was performed according to the task sharing among the authors. Author DOA conceptualized the paper and was fine-tuned in accordance with the data by authors JTB and EKF. Author JTB designed the study, and performed the statistical analysis with author DOA; while authors DOA and EKF wrote the first draft of the manuscript. Authors DOA conducted the literature searches. All three authors managed the analyses and discussions of the data. All contributing authors read and approved the final manuscript before submission.

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ABSTRACT

Aim: To analyze the perspectives of agriculture land use trajectories for 10 years due to peri-urbanization in the Bosomtwe district of the Asante region, Ghana.
Methodology: Using a triangulation of qualitative and quantitative Design, 270 household respondents were proportionately sampled from 14 selected communities on the basis of population, in the district, for questionnaires administration to collect data. The data was subjected to the Pearson's Chi-square, Nigelkerk *R* and Cramer's *V*, and step-wise binary logistic regression

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analyses embedded in the SPSS V.16.
Results: A chi-square test of association between the peri-urban land uses and agriculture land use conversions revealed that at a significant level of .05, the Pearson Chi-square value of χ^2 =17.355, 4 degree of freedom, was significant at a p-value of $p < .05$. The logistic regression model reported that at confidence intervals of (CIs) of 1.358 ≤ CI ≤ 4.517 and 1.039 ≤ CI ≤ 11.486 for the two main predictors of ground rent per plot and criteria in determining land prices, the β(EXP) > 1, rang from 2.477 to 3.455. This implies the odds of respondents being more likely to convert their land from arable uses to other uses given the appropriate grounds rent on the land market, is about 3 times whenever any of the two main predictor variables increase by one unit.
Conclusion: The increasing rate of peri-urbanization in the district is as a result of increasing demand for residential and commercial land uses at the expense of agricultural land uses. This has resulted in substantial conversion of prime agricultural lands into other land uses particularly residential and commercial. These outcomes have perceived negative implications on food security in the district. The District assembly's land use schemes should be monitored strictly to regulate physical development on agricultural lands.

Keywords: Agriculture; land use; trajectories; peri-urbanization; Bosomtwe district.

1. INTRODUCTION

Peri-urbanization is the process of rural land use conversions into near urban with characteristic traits of city lifestyles. In this regard the process invariably results from rapid urbanization which leads to the outward expansion of cities with resultant repercussions on land uses changes [1]. Peri-urban areas come about when urban residents buy up prime agricultural land for residential or commercial purposes outside the main city center ostensibly to ease the pressure in the cities [2]. Thus, access to land remain the driving force or pull factor drawing most people to settle in peri-urban areas regardless of the distance it may be in accessing the city centre [3].

The rural agricultural land is easy to access in the sense that it is relatively cheaper than lands within the city and not highly under demand according to [4]. Migrants to these areas find it easy to access these lands and quickly use them for their agricultural activities. [5], have argued that as the cities become congested and land in the urban areas attract a great deal of demand pressures, attention seem to shift to agricultural land (for the purposes of urban land uses, such as residential, commercial and recreational. This argument supports the assertion made by [6] that rural agricultural land uses are becoming converted into peri-urban land uses and ultimately urbanized at the rural-urban fringes, at rates faster than anticipated. Accordingly, a combination of factors is responsible for the emergence of peri-urbanization or urban sprawl unto the rural fringes, creating melting transitional peri-urban zones. However, the peri-urban zone definition has gone beyond, as a place with an admixture of urban and rural livelihoods, being pursued, and theorizes about the peri-urban processes [7] and cited in [8].

According to [9], there are two major driving forces for conversion of agriculture land use in the peri-urban peripheries i.e., demands for housing for the growing population and the deteriorating housing conditions and inadequate urban services [10]. Also another reason for the conversion of land was discovered by [11], as being a result of higher economic gains over the agriculture returns. With rationality of the farmers, they would go in for other activities with higher earnings other than the agriculture, in the end, subtly endorsing food insecurity in the areas. In this connection, the study sought to find out the social perspectives of agricultural land use trajectories in a peri-urban district, such as the Bosomtwe District of the Asante Region of Ghana.

1.1 Synthesis of Relevant Literature

1.1.1 Agriculture land use dynamics in Peri-Urban areas

All over the world, the process of peri-urbanization brings about changes in agriculture systems, which is mostly general in all countries, however, there are other processes that go on which are specifically related to particular countries. Distribution of population is often clustered at specific places, especially in the urban areas; this has attracted also, the overtaking of land for urban development, at the expense of sub-urban and other peripheries.

Notably, these new developments that occur as a result of increase in population pressure on the limited land resources [12].

Changes in agriculture land uses by intensification can be attributed to the increase in economic gains over agriculture. It is understood that agriculture is a sector with long term earning of money, contrary to the service sector that provides immediate money into the hands of the workers. With this development, non-farm activities that occur in the rural and peri-urban areas mostly compete with agriculture for land use purposes. [13], are of the view that much of this development and the resulting land use and lifestyle clashes occur in peri-urban areas; in most cases with agriculture relegated to the background.

1.1.2 Implication of land use changes on agriculture production

Conversion of agricultural lands to other land uses has been a concern during recent past in developing as well as developed countries, in particular where the economy is heavily dependent upon the earnings from agricultural products. When the conversion is from agriculture to more intensive land uses, the issue can be more complicated as possible negative externalities of conversion such as amenity and environmental losses may occur [14]. Decline in agricultural land can be attributed to economic hardships in most peri-urban areas.

Agricultural land use change affect economic growth tremendously; countries whose economy is mostly dependent on agriculture [14] tend to be hardest hit and affected. Ghana for instance is one country that is heavily dependent on agriculture; earnings from agricultural products constitute a greater percentage of GDP. As urban expansions alter the agricultural industry, new challenges are presented and economies of agricultural dependent countries are also affected immensely.

For Ghana, and in most African countries, with comparative advantage in agriculture, increasing agricultural production based on productivity growth is a necessary condition for food security [15]. Reduction in food production, therefore, may likely have an effect on international trade and earnings from agricultural exports such as cocoa and other farm produce. As arable lands decrease, it adversely affects food production, hence national food security. It is evident that conversion of arable lands is irreversible and would definitely affect local and national food security [16].

Economic growth increases the demand for lands for construction of industries, infrastructures and residential developments [16]; [17]. This in essence has affects the productive lands as most of the lands are converted to these development activities. In addition, agriculture activities are weakened, as farmers also move to engage in other economic activities which attract immediate livelihood goals as compared to agriculture returns [18]. This trend is likely to continue in years to come as economic growth continues to double, eventually leading to a decline in agriculture activities [19].

1.1.3 Effects of agricultural land conversions on food security

Ensuring food security, requires adequate production capacity base of the inputs; especially fertile arable land. Food prices are mostly determined by a complex combination of various factors, among them is substantial increase or decrease in agriculture production and output which are a function of land, United Nations Environment Programme [20]. The effects of food prices due to the changes in agriculture land use have not been embraced by many policy makers. The argument has been made in favour of other factors other than agriculture land use changes. However, [21] argued that no matter how insignificant the conversion of agriculture land seems to be, its role in determining food prices cannot be discounted.

In Ghana, about 60% of the rural populations engage in agriculture as their main source of livelihood. However the sector has experienced a decline over the years due to a number of factors, among which is the effects of rapid peri-urbanization on the urban peripheries [13]. In the light of this, the farmlands in these areas decline as demand for residential, industries, commercial, increase. The consequence is low agricultural productivity, low and food insecurity [22].

In conceptualizing the relationship between peri-urban land use and agriculture land use, a trade-off scenario is presented. In this regard, attempt to augment the supply of a particular ecosystem service compromises the supply of other services; thus, those other services are being traded-off [23]. Agriculture land trade-off is akin

to ecosystem services trade-off, which reduces the supply of particularly services in order to augment the supply of other services [24]. This concept has therefore been juxtaposed on agriculture land use trade-off in the peri-urban areas, and has been found a perfect fit.

Hence, the extension of urban land use to the peri-urban areas reduces the use of land for agriculture but rather increases the use of land for residential, commercial and recreational activities [25]. This has multiple implications including loss of farmlands; increase in the prices of land and above all increase the risk of food insecurity and poverty in the urban peripheries (peri-urban) and urban areas. In conclusion, the FAO's State of Food Insecurity Report [26], states among other things that;

> *"Long-term commitment to mainstreaming food security and nutrition in public policies and programmes is key to hunger reduction. Keeping food security and agriculture high on the development agenda, through comprehensive reforms, improvements in the investment climate, supported by sustained social protection, are crucial for achieving major reductions in poverty and undernourishment" (FAO, SFIR, [26], Exec. Summary p.1).*

The FAO stated that food security included four elements; food availability, food accessibility, food utilization and food system stability; these are largely a function of availability of limited productive arable land in competition with other land users, for space and utilization. To surmise, the conceptualization of agricultural land uses particularly at the urban and rural interface (peri-urban area), presents a trade-off mechanism, that can guide land use and land cover conversion and modification trends in the Bosomtwe District of the Asante Region. The modification of agricultural land use conversions into other land uses such as residential and commercial have not been studied from the socio-economic modeling perspective. The few researches available were conducted at the meso-scale of encompassing the regional and national perspectives. In this regard, the paper tries to fill this gap by putting at the disposal of local government policy makers the micro-scale dynamics of households' perspectives. This is actually what links the regional and national scopes, in influencing informed agricultural and forest land uses (AFOLU) policies in peri-urban settings.

Furthermore, what is novel about this paper is the revelation of the hitherto inherent trends in land use dynamics in the peri-urban areas. The original arguments has been the relatively affordable rent in the peri-urban areas; however, in addition to this classical reason, an emerging reason of land use changes in the peri-urban areas particularly the rural areas, as this paper espouses, is attributed to the relative lucrative gains between agriculture as a livelihood activity and the lease of arable land for other uses by local land owners. This, the study brings to bear as the point of new research entry by researchers in peri-urbanism.

2. METHODOLOGY

2.1 Profile of the Study Area

Bosomtwe District is located in the central part of the Ashanti Region. It lies within Latitude 6º 28'N—Latitude 6º 40'N and Longitudes 1º 20'W—Longitude 1º 37'W. *Kuntenase* is the District Capital. It spreads over a land area of 718km^2 (Fig. 1). The District is bounded to the North by *Atwima Nwabiagya* and Kumasi Metropolis and to the East by *Ejisu-Juaben* Municipal. The southern section is bounded by *Amansie* West and East Districts, all in the Ashanti Region of Ghana.

Lake Bosomtwe the largest natural (crater) lake in Ghana is located in the district. With the exception of the Lake which has an outer ridge that maintains a constant distance of 10 km from the center of the lake and stands at an elevation of 50 to 80m, the rest of the district has other varying unique topographical features. The drainage pattern of rivers and streams draining the Bosomtwe District is dendritic and perennial. Around Lake *Bosomtwe*, there is an internal drainage where the streams flow from surrounding highlands into the lake in a centripetal fashion. The streams form a dense network due to the double maxima rainfall regime. Notable rivers in the district are rivers *Oda, Butu, Siso, Supan* and *Adanbanwe*.

The district falls within the equatorial zone of climate with a rainfall regime typical of the moist semi-deciduous forest zone of the country. There are two well- defined rainfall seasons. The main season occurs from March to July and September to November with mean annual rainfall of about 1,900 mm. The mean monthly

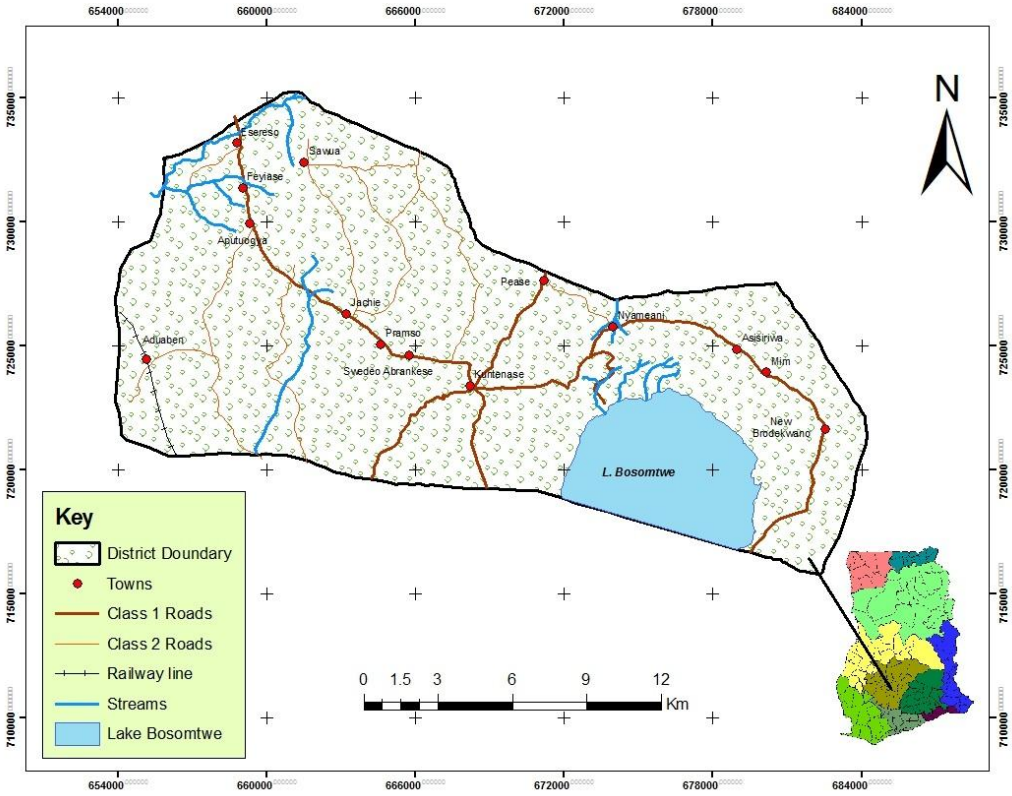

Fig. 1. Map of the Bosomtwe district showing the study communities in Ghana

temperature is about 36°C with a relative humidity of between 60 to 85%.

The natural vegetation of the area falls within the semi- deciduous forest zone of Ghana, which is characterized, by plant species of the *Celtis-triplocheton* association. However, due to extensive farming activities in the area, the original vegetation has been degraded to mosaic of secondary forest, thicket and re-growth with abandoned farms of food crops and vegetables.

The physical growth of settlements in the district is influenced by distance between the settlement and the Kumasi Metropolis. Further, the presence of infrastructure, socio- economic activities, the tourism sector improvements value additions to various land uses and cover, has made the district one of the boisterous in the Ashanti Region.

2.2 Methods, Data and Modeling

The study analyzed agriculture land use conversion trajectories resulting from interactions among the land use decision making agents; i.e. male and female- headed households. These respondents were sampled from 14 communities located on the map, as shown in (Fig. 1), in the Bosomtwe district of the Ashanti region of Ghana. The respondents were to demonstrate their response to the conditions that have and could influence their land use decisions in the district. A sample size of 270 household respondents aggregated by gender were sampled purposively and data solicited from them using a structured partially pre-coded questionnaire, administered proportionately according to the community population sizes as given by the 2010 District Assembly Scalogram of socio-demographic characteristics.

The quantitative data gathered were subjected to Logistic Regression analysis, Pearson's Chi-square, Cramer's *V* statistics and Nigelkerk's tests of association and strength and correlations coefficient explanations respectively, all embedded in the Statistical Package for Social Science(SPSS) version 16 and results displayed in tables, charts and graphs. The diagrams generated in the SPSS, were exported to excel for editing for better visual presentation. Open-

ended qualitative responses were integrated in the discussions under the various thematic treatments of the sections of the paper.

2.3 Fitting the Model

Using a log transformation of the probability *p*-values to a log distribution makes it possible to relate the bi-variate regression model to the normal regression model. The log transformation of the probability p is called the logit of *p* or *logit (p)* [27]. This predicts the logs of the rate of success as against the rate of failure. The *Logit*(*p*) is the log (to base *e*) of the *odds ratio or the likelihood ratio* that the dependent variable DV is 1. Mathematically, the *logit (p)* model is expressed as:

$$\log it(p) = \log\left[\frac{p}{1-p}\right] = \ln\left[\frac{p}{1-p}\right] \quad \textit{Eqn. 1}$$

Whereas *p* can only range from 0 to 1, *logit*(*p*) scale ranges from negative infinity to positive Infinity ($-\infty \leq logit(p) \leq +\infty$) and is symmetrical around the *logit* of .5 (which is zero). The model Eqn. 1 can be rewritten in the form of the normal linear regression model ($y= a + b_1X_1+b_1X_2$ …etc.), as shown in eqn. 2

$$\log it[p(x)] = \log\left[\frac{p(x)}{1-p(x)}\right] = \ln\left[a+\beta_1 X_1+\beta_2 X_2+\beta_3 X_3 \ldots\right] \quad \textit{Eqn. 2}$$

Instead of the *least-squared deviations* criterion for the best fit, in normal regression, the logistic regression uses a *maximum likelihood approach that* maximizes the probability of getting the observed results, given the fitted regression coefficients derived by the analytical model in this case, the Statistical Package for Service Solution version (SPSS *v.17*). A as a result, the goodness of fit and overall significance statistics used in logistic regression are different from the ones used in linear regression. The probability *p* can be calculated by rearranging Eqn. 2, as;

$$p = \left[\frac{e\{a+\beta_1 X_1+\beta_2 X_2+\beta_3 X_3+\ldots.\}}{1+e\{a+\beta_1 X_1+\beta_2 X_2+\beta_3 X_3+\ldots.\}}\right] \quad \textit{Eqn. 3}$$

Where,

p = the probability that a case is in a particular category for the response variable,
e = the base of natural logarithms (*approx. 2.72*),
a = the constant of the equation an particularly explicit in step-wise models, and
β = the coefficient of the predictor variables.

3. RESULTS AND DISCUSSION

3.1 Drivers of Peri-Urbanization and Land Use

All over the world, there are a number of factors that influence or determine urbanization and peri-urbanization for that matter. These factors include social, cultural, economic and natural influences [9]. However, in the Bosomtwe District, the occupational activities, historically is dependent on agriculture. However, there are also formal influences driven by processes of urban expansionary shifts towards the peri-urban areas, as held by the Organization for Economic Corporation and Development [28]. A place qualifies as a peri-urban fringe, when there is evidence of admixture of land uses, particularly the conversion of arable lands to residential and commercial land use [29]; [16]. This is situation is not different as observed in the Bosomtwe District of the Asante Region.

3.2 Human Activities Altering Peri-Urban Land Use and Land Covers in the Bosomtwe District

It was There is no doubt that there are certain human activities that have land use land cover change and modification tendencies to affect peri-urban land uses and cover change (PULUCC). These, as have been espoused by [29], have also being identified in the Bosomtwe district (Fig. 2). Form the results, expansion in residential and commercial land uses were identified as the main human drivers of peri-urban land uses, constituting about 52% of the responses. The next in relevance was the increased subsistent agriculture with close to 45%. In this wise the residents are seen to wield the rudimentary forms of land cultivation. These processes and methods include slush and burn method of tillage with its consequences of tree cover and soil quality degradation [30]. Recreational and light industrial land use activities with only 3%, was not seen as a popular land use activity in the district; therefore the respondents did identify with these human land use activity that has the tendencies to alter the land use and cover considerably in the peri-urban area [31].

Also of critical consideration were the main factors that determine land use and land cover change (LULCC) in peri-urban areas *a priori*. These are factors identified as *de facto,* to have followed as a matter of course, in areas where

land use competition tends to be keener in response to various human economic-driven activities [32,7,33]. However, the degree of intensities to respond to the factors, depend largely on the social, economic, geographical and the ecological conditions of the area under completion. In the Bosomtwe district, a typical peri-urban area, these driving factors of land use competition were identified as; the easiness of the potential tenants to access land with 29% of the respondents indicating that; changing demand trend in land uses identified by 34% of respondents. These factors may have other sub-drivers by other intrinsic factors [34]. Majority of respondents (37%) indicated that deteriorating livelihoods of land holders, land owners and land lords, is the main driver which push them to yield their lands for certain land use activities for which economic incentives and motivations enticements are in return (Fig. 3).

3.3 Determinants of Land Use and Land Cover Changes in the Bosomtwe District

The other determining factors that drive land use and land cover conversion and modification in the district at the household level were myriad. These were; easy access to land in due to relaxed tenural arrangement; lower average grounds rent per plot of land and the changing demand trends in land use, for which reason, land use types are being dictated by this trend. All these could be subsumed in the three key reasons offered for the changing trends (Fig. 3).

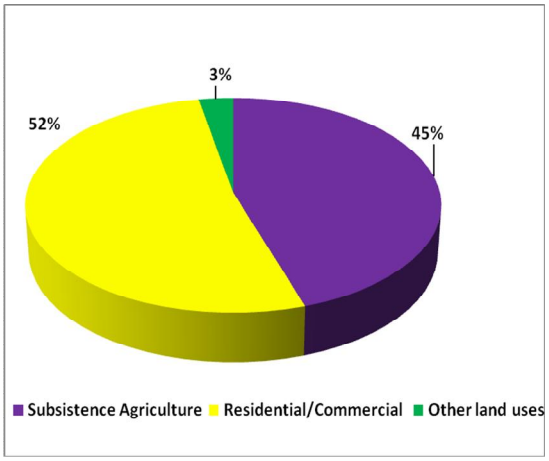

Fig. 2. Main human activities that alter peri-urban land use and land covers

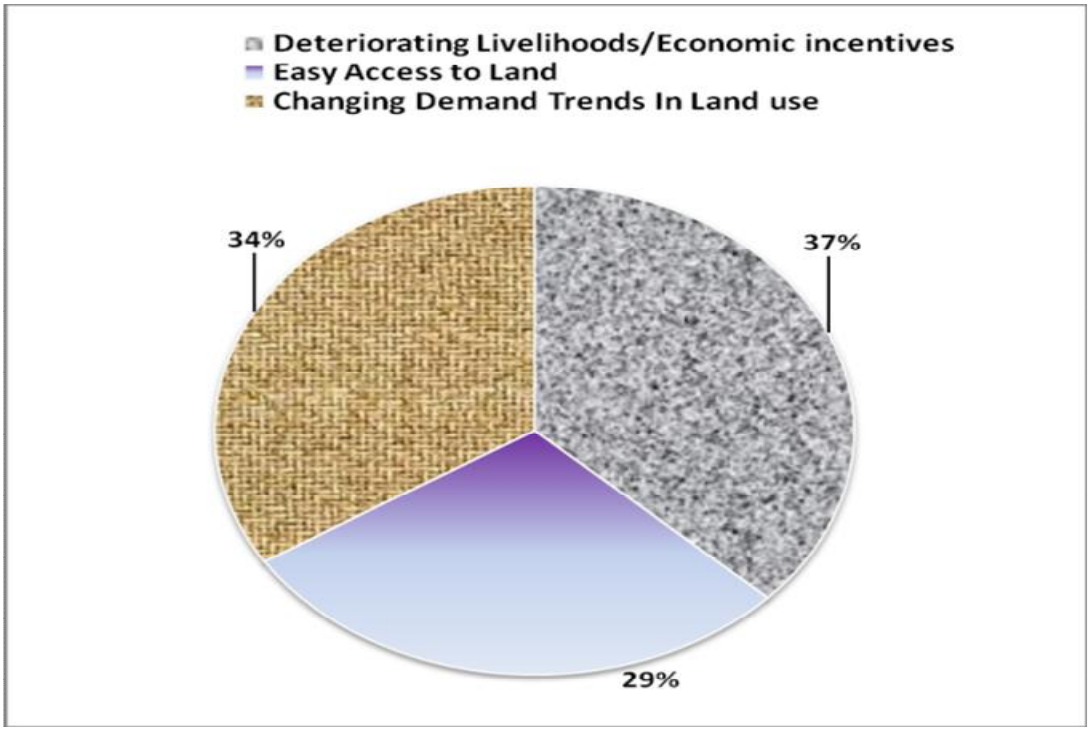

Fig. 3. Main factors driving land use and land cover changes

The study therefore sought to ascertain the association between the main determinants of peri-urban land use and cover changes and household decisions that influenced peri-urban land use changes, (particularly, that which pertains to the conversion of arable agricultural land to other land uses) in the district. This is against the backdrop of some of the responses given to the extent that some land owners claim to have land in excess for which reason, leasing part for other uses, may not pose any land scarcity problems. Again, they opined that, changing demand trends and economic incentive for leasing land were their motivation. This standpoint is in agreement with [35] who argued that in the event of land use decisions human rationality is usually brought to bear, so that a structural model describing the individual's discretionary choice of land use can be developed.

It was necessary to establish whether there were any associations between the nominal variables used. In the event of some relationships established, it was again important to determine, the extent of these associations and their relevance in explaining the relationships between the variables used in the research. A chi-square test of association between the determining variables revealed that at a significant level of .05, the Pearson Chi-square results showed a value of χ =17.355, at degrees of freedom *df* = 4, with a p-value of $p < .05$. There is therefore, a significant relationship between the determining factors and the consequential influences on the households to convert their agriculture lands to other uses. However, the Cramer's *V* of 0.179, indicate a very weak association, based on the scale of 0—30 = no relationship to weak relationship, 0.31—0.70 = moderate relationship and 0.71—1.0 = strong relationship [36]. In that case, there may be other factors baffling that might have effects on the determining factors to cause changes in land uses in the district.

3.4 Past Peri-Urban Land Use Conversion and Modifications Patterns in the District

A time series of peri-urban land use dynamics was socially constructed based on the respondents perceived and observed changes in land use patterns over the past 10 years and their expectations of land use conversion and modification trend, for the next 10 years. Over the past 10 years, it was observed that residential, commercial, industrial (low to medium) and recreational land uses are have expanded at the expense of agricultural and forest land uses (AFOLUs) and cover. From (Fig. 4), the pattern of land use changes and conversions are in the direction of residential, commercial and low to medium industries, with respective response rates of 85%, 48% and 38% respectively, indicating the increasing trends of these land uses.

On the land use and cover types that were seen as decreasing, agricultural and forest land uses were identified as dwindling in extent and intensity of use with 71% and 60% respondents respectively. Other respondents were of the view that some of these land uses have remained considerably unchanged in the realms of patterns of use; in that the reduction in agriculture land use for in instance is not experiencing any increment likewise the other land uses like residential which gained momentum over the past 10 years have remained continuously increasing without any signs of reduction in their intensity and use. (Fig. 4) further depicts this seeming stability on trends of use with 30% and 63% of the respondents indicating that forest land use and recreational land uses have remain unchanged over the period under consideration. In addition, the social attitudinal changes toward the agricultural sector in the peri-urban areas, many former full-time farmers are rather seeking stronger relations to nearby urban areas; this is due to little incentive for farmers to invest fully in any conservation measures, particularly with land tenure insecurity [37,38]. The response of human agents to the changing conditions of the social and environmental determines to a larger extent the concrete drivers of peri-urban land use and land cover change. This will trend considerably into the future.

In the next 10 years to come, the study also sought to project the land use trend from households observations considering the rates identified and perceived over the past 10 years. The responses did not deviate much from the past perceived trend of land use change in the district. From (Fig. 5), agriculture and forest land use/cover, according to respondents, are expected to continue on the decreasing trend, with 62% and 59% respectively. The pattern of land use changes and conversions into the next 10 years will still be in the interest and directions of Residential, Commercial and Industrial land use. These are represented by their respective response rates of 80%, 66% and 38% respectively; indicating the increasing trends of

these land uses into the future, at the expense of Agriculture and Forest Land Use (AFOLU) in the Bosomtwe district, barring any policy interventions. Some of the respondents did not foresee any change in the patterns of use in the future; in fact, some respondents thought that the situation could be worse as one respondent indicated that;

> *"For over ten years of my living in this community Esereso, there has been residential housing expanding, we now have 'new site' in this area with new residential buildings. The main occupation here is not agriculture, but trading and other commercial activities; this is because there are no jobs here I am pleading with the government to invest in infrastructure in this community to help us her" (Interviewee, Esereso, May, 2014)*.

Apart from the economic gains of converting land uses in the Bosomtwe District from one type, say, agriculture to residential and sometimes residential to commercial, it can be conjectured to expand the future conversion spectrum to embrace the dimensions of all spatial and temporal as well as exogenous drivers that serve as both positive (desirable) and negative (repulsive) incentives and influences of land use conversion in dynamic urban areas [39], especially in the peri-urban Bosomtwe area (Fig. 6).

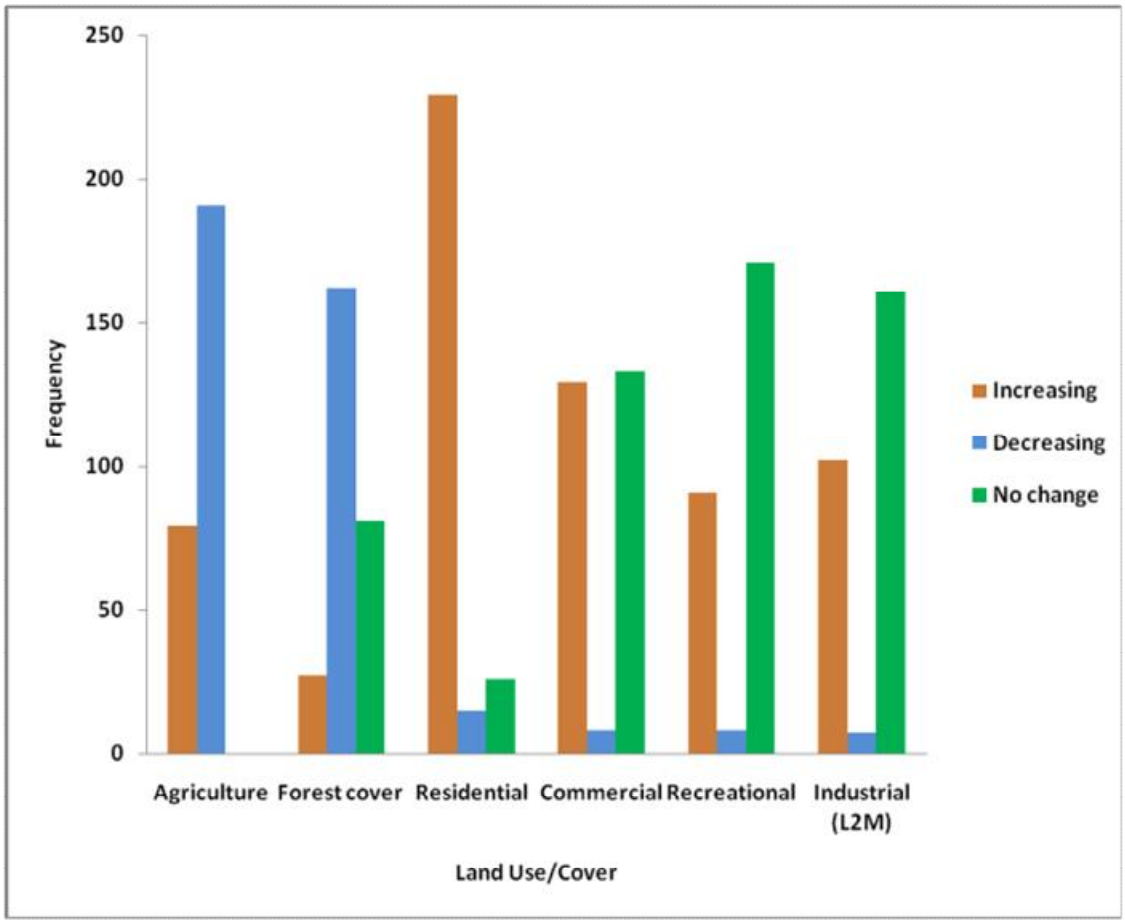

Fig. 4. Land use activity trend over the past 10 years

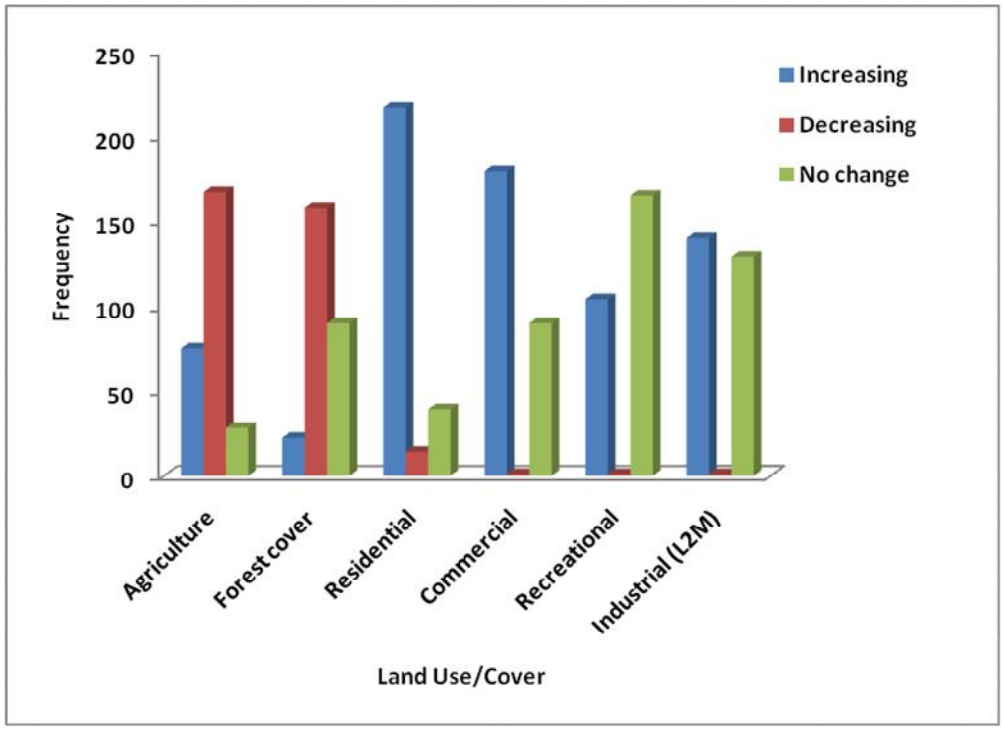

Fig. 5. Expected land use activity trend for the next 10 years

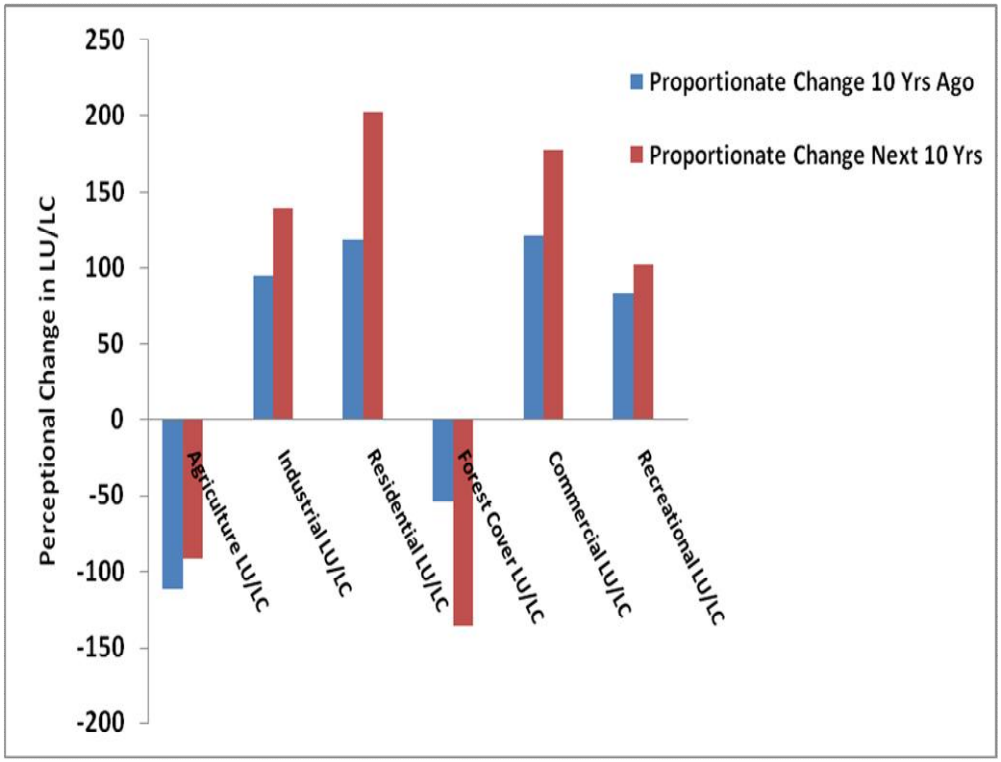

Fig. 6. Expected land use activity trend for the next 10 years

3.5 Patterns of Land Use Conversion and Perceived Speculative Future Land Use Trends

The study identified as displayed in Table 1, various land use conversion permutations as; from agricultural land use to residential land use (ALU to RLU) and from forest land use to residential and commercial land uses (FLU to R/CLUs) and any other conversions (though not of much importance to this objective). Respondents indicated that land use conversions were in respond to the major factors accounting for speculative demand for land in the district; as has been espoused elsewhere by [40]. The respondents were of the view that potential land owners/tenants were motivated to convert their land from agriculture to residential and commercial land uses because of the expected booming commercial activities in the district with 30 respondents.

The relatively cheaper grounds rent and easy access to land in the district, motivated 50 and 67 respondents each for their observed patterns of conversion. In the interest of conversion from forest to residential and commercial land uses, the respondent indicated that the speculative demand due to cheaper grounds rent and easy access to land was their observation with 23 and 26 respondents respectively. On the whole, the observed patterns of land use conversion in the Bosomtwe district is motivated largely by speculative demand; where 43%, 29% and 28% respondents indicated Easy access to land, relatively cheaper grounds rent and the expected booming commercial activities as the main drivers of the conversion trends respectively, this has been supported by [23,41] in earlier studies, as being the case in mostly peri-urban fringes.

To ascertain the association between the two nominal variables, a Pearson's Chi-square test of association was performed. The results indicated that there is a significant relationship between the observed patterns of land use conversion and the speculative demand for land in the district. At a .05 significant level, the chi-square value was $\chi^2 = 17.516$ at a degree of freedom $df = 4$. The probability value of establishing the association, *p-value* was $p < .05$. A Cramer's *V* test of strength of the association however indicated a weak link with a value of $V = .180$.

This implies that there may be other unknown reasons that could affect the land use trend observation or the speculative demand for land in the Bosomtwe district. It can be conjectured that land could be acquired not for their use sake, but for the satisfaction of holding them; this situational viewpoint is usually akin to large-scale land acquisition. Accordingly, large scale land acquisition, aside their intended primary motives of enhancing food security [42], is also aims at securing land rights for future higher production of commodities with consistent demand and inelastic supply, which could be bio-fuel [43].

3.6 Modelling the Perspectives of the Agricultural Land Use Conversion

A logistic regression was also run on the determining the effects the factors as the drivers as the independent variables (IV) or the predictors have to influence the dichotomous dependent variable (DV) or the response. The dichotomous responses to the dependent variables were that "whether the respondents would convert their arable land from present use to a different use? They were to respond as 1= "Yes, would convert" and 0= "No, would not convert". These were predicted by the conditional statements of the independent variables as: what if there are changes in the grounds rent per plot of land in the district; the major human activities that affect land use and land cover in the district; the income category of the people who predominantly settle in the peri-urban areas of the district and the criteria used in determining the price/rent of a plot of land in the district as the independent variable.

The analysis was conducted using a case-wise binary logistic regression in SPSS to ascertain the likelihood of respondents taking a decisions *to convert* or *not to convert* their land to any other uses. These actions are taken in the form of the probability of the action occurring or not occurring as either 1 or 0 in binary logistic modeling [44].

From the earlier analysis of the logistic regression model, we fit the outcome of the data in Table 2, the logistic regression table to determine the probability of conversions given the various independent variables. It is also to determine which of the predictor variables has the highest degree of influence in predicting the outcome of the land use conversion by the household agents. By fitting the logistic regression model to the variables, using the formula in (Eqn. 1), we fitted the logistic model to calculate the respective odd ratios of the

independent variables in predicting the outcome using Eqn 3.

During the analysis, the null hypothesis stated that without the independent variables the model is a good fitting model. Alternatively, the other hypothesis was that the model is not a good fit without the inclusion of the independent variables in the model. At the case step 0, which is the beginning method the overall predicted percentage is 57.9%; this is a measure of the fitness of the model when y = the constant. The overall significant of the model without the independent variables was $p < .000$. However with the inclusion of the independent variables (grounds rent per plot of land, major human activities, income category of settlers and criteria for determining rent of a plot of land), the overall significance of the model was also $p < .000$ at a chi-square value of 24.453, at a 4 degree of freedom.

The overall percentage predictive accuracy of the step 1 model is 77.6% as against the 57.9% of the null (constant only) model. Three out of the four independent variables were of much significance in predicting the outcomes of household respondents. These were the grounds rent per plot of land in the district, the major human activities that affect land use and land cover in the district and the criteria used in determining the price/rent of a plot of land with probabilities of $p < .003$, $p < .011$ and $p < .043$ respectively, which is less than the significant level of $\alpha = .05$. The model however was able to explain this prediction at only 37%., at the Nagelkerke $R^2 = 0.37$. There may, therefore, be other inherent explanations beyond the scope of the model to explain the relationship. Possible reasons could be the fact that the independent variables predicting the response variables, are not measured as categorically as the dependent variable in a ratio and/or interval scales to yield the exact numeric predicted outcomes, for which the model can succinctly explain.

The confidence intervals of (CIs) of $1.358 \leq CI \leq 4.517$ and $1.039 \leq CI \leq 11.486$ for the two main predictors of the outcome, and a $(EXP)\beta > 1$, ranging between 2.477 and 3.455 means that the odds of respondents being more likely to convert their land from original uses to other uses given the appropriate grounds rent on the land market, is higher (Table 1). The probability of conversion is about 3 times when any of the two main predictor variables increase by one unit. Also, they would convert their land on condition that demand for their land meets the criteria of prospective tenants and buyers who are looking out for some criteria upon which the grounds rent is based.

Table 1. Relationship between land use conversion patterns and speculative demand for land in the district

	Expected booming commercial activities	Relatively cheaper grounds rent	Easy access to land	Total
Agric LU to residential / commercial LU	35	50	67	152
Forest cover to residential/recreational LU	15	23	26	64
All other conversions	26	6	22	54
total	76	79	115	N = 270

Table 2. Variables in the step-wise binary logistic regression equation

	β	S.E.	Wald	df	Sig*.	Exp(β)	Lower	Upper
The grounds rent/plot *(X_1)*	.907	.307	8.753	1	.003	2.477	1.358	4.517
Income category of residents in peri- urban areas *(X_2)*	.479	.396	1.458	1	.227	1.614	.742	3.509
Major human activities on land uses/cover changes *(X_3)*	-1.694	.665	6.482	1	.011	.184	.050	.677
Criteria determining grounds rent *(X_4)*	1.240	.613	4.091	1	.043	3.455	1.039	11.486
Constant	-1.239	1.809	.470	1	.493	.290		

**Test is significant at .05*

The assumption is that if the location of the land meets some or all of the price-fixing criteria, land owner would be in the position to convert it to other uses particularly residential uses. The probability of the case outcome of land use conversion based on the independent variables can be expressed in the general equation from Eqn. 4 as follows:

$$p = \left[\frac{e^{\{(0.907\,Rg)+(1.240\,Dr)+(0.479\,I)-1.239\}}}{1+e^{\{(0.907\,Rg)+(1.240\,Dr)+0.47I)-1.239\}}} \right] \quad \textit{Eqn. 4}$$

Discussing further from the logistic regression results, with references to the odds for the likelihood of a change in any of the independent variables in predicting the dependent category can thus be determined from the odds ratio or the *logit of probability (p)* function above. The grounds rent/plot *(Rg)*; Income category of residents in peri- urban areas *(I)*; Major human activities on land uses/cover changes and the Criteria determining grounds rent *(Dr),* have significant determining influences on the respondents to convert or not their land from agriculture land use particularly into others, such as residential land uses (Eqn. 4).

Peri-urbanization as the name suggest, is the development of urban peripheral into urban areas. Once people become integral part of this setting, their household decisions become align with the most immediate rational reactions, all things being equal, to convert land into other uses from their original, in most cases agriculture and forest land uses (AFoLUs). Ultimately, the conversion of arable lands into urban land uses [45], become the new trend. This therefore reduces the amount of arable lands available in the rural to the peri-urban periphery [12]. The consequential effects of this will be food insecurity and related effects in the peri-urban areas [16].

In the light of this, migrants who are individual-oriented rather than communal-oriented come with better and challenging ideas on how to use the lands, the farmers seeing it as economically wise, sell their lands to them. In a related way, [46] observed that incomes accrued from lease of lands to private and estate developers are generally higher than for agricultural purposes hence, the preference of landowners to lease out lands for purposes other than agriculture.

4. CONCLUSION

There are a number of factors that influenced peri-urban populace in the Bosomtwe District to convert their lands to other uses. It is clear from the study that economic reasons are major factors. Low earning from agriculture produce has made the sector less lucrative, deterring subsistent farmers and other people from engaging in agriculture. In all these assertions, the connotations of peri-urbanization reveal that peri-urbanization involves a transformation in the demographic structure and infrastructure in the urban periphery [47].

Peri-urban lands available for agriculture are relatively low due to the fact that other land uses are increasingly becoming dominant relative to agriculture. However, due to urbanization characterized by increased in population and its associated demand for land, the conversion of agricultural lands to other land uses and built-up environments (residential, commercial and recreation) in high [47,13], as was observed in the Bosomtwe district.

Easy access to land and the gradual deterioration of economic livelihoods are some key determinants of agricultural land use conversions in the District. Therefore, the economic incentives expected from the conversion of agricultural land into residential and commercial land uses are the motivating factors for change. Agriculture as an economic activity is gradually losing its profitability among peasant households. The conversion of agriculture land uses into other uses has become more lucrative in the short term to subsistence agriculture. Government should make strenuous investment efforts in the agricultural sector. This would enhance the household livelihoods of subsistence farmers to maintain and cultivate their agricultural and forest lands. These agricultural promotion programmes should be implemented to make agriculture more lucrative. This would ensure that the agriculture land conversions are done at regulated rates, much slower that it pertains currently in the District. In the end, these outcomes would have positive implications on food security in the district.

Conversion of lands cannot be avoided, especially considering the changing demand for land for other uses other than agriculture. Population increases have put considerable pressure on the households' economic conditions, which has necessitated some conversion of land from arable to commercial uses. The Town and Country Planning Department (TCPD) should introduce new and/or implement existing land use planning schemes

and zoning plans respectively. This is to ensure effective allocation of lands earmarked for particular purposes to be put to use without encroachments. In this regard, the implementation and/or introduction of zoning schemes should gear towards the protection and regulation of prime agricultural lands, as physical development cannot be avoided entirely.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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