TOWARDS A MODEL EXPLAINING CHANGE IN AGRICULTURAL LAND USE PATTERNS IN UTE DISTRICTS OF VANDEIKYA LOCAL GOVERNMENT AREA, BENUE STATE, NIGERIA

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Abstract

This study attempts to explain change in patterns of agricultural land use in Ute Districts of Vandeikya Local Government Area of Benue State, Nigeria from 1920 to 2009, using a multiple factors approach. Data was obtained from archives, aerial photographs, interviews, field measurements and field surveys. Principal component analysis was used to determine the main factors contributing to the change. The study indicates that size of farm plots, cycle of crop rotation and fallow period have changed during the period covered by the study. These changes, which are all towards land use intensification, are mainly explained by transformation of relations of production, improved standard of living, behavio-economic reorientation, technology, population, future security, land tenure change, liberalised access to personal income and social responsibility. The nine factors have accounted for 72.15% of variance in the data set used in the study. The study concludes that multiple factors model better explains agricultural land use change in the area than single factor models. The study recommends facilitation of commercial process through rural transport development, reform of land use intensification process and integrated role of government to sustain land use evolution in the area.

Key words: Agricultural land use, patterns, change, intensification, explanatory model.

Introduction

Of all the uses man makes of land, none is as dynamic as agriculture, and only few are as effective as agriculture in creating conspicuous patterns on rural land. Originating from the Neolithic Revolution about 10,000 years ago (Childe, 1951), agricultural land use has undergone several changes in terms of systems of land use, techniques and technology used, labour and capital inputs and yields. The essence of the changes has mainly been greater intensification involving higher frequency of cropping, increased application of inputs and new technologies. As common as change in agricultural land use is, and as far reaching as it is in its impact on socio-economic life of society and environment, it is not clearly understood in most communities. This is especially true of developing countries where virtually no records exist on agriculture-dominated rural land use. However, the need to understand the nature, dimension and forces of change in agricultural land use cannot be over-emphasised. Adequate knowledge of the phenomenon can be useful in redirecting its process towards greater benefits for mankind.

Already several attempts have been made by scholars to study and understand evolution of agricultural land use patterns. As Briassoulis (2000) notes, researchers have made efforts to understand why land use patterns evolve over time. Several approaches have been used in these efforts based on technology, population, ecology, culture, infrastructure, market and political economy. Used disparately, each approach has its merits, but none is universally applicable or seems to capture the total essence of change in patterns of agricultural land use. For they tend to focus on one factor as the primary cause of change, rather than see change as a product of a synergy of multiple factors.

An agricultural land use pattern is an aspect of agricultural production system which can be observed, described and measured. Agricultural land use patterns therefore include techniques of tillage, fallow periods, crop varieties, cycle of crop rotation, size of farm plots and distance between residences and farm plots. Over time, agricultural land use patterns undergo change, usually facilitating greater intensification of land use as a form of adaptation to changing contexts within an agro-ecosystem. Each new pattern affords the community adopting it a capability for a specific level of subsistence and economic development. This study has investigated the emerging patterns of agricultural land use in Ute Districts of Vandeikya Local Government Area (LGA) in Benue State, Nigeria, with a view to gaining greater insight into the new patterns, using multiple factors explanation approach.

The problem of the study is to explain the emerging change in agricultural land use over time in the area. The core task of the study is to explain the nature, factors and process of change in patterns of agricultural land use in Ute Districts between 1920 and 2009. The decade 1920s is considered a base decade because it was the period in which deliberate and organised wide spread initiatives at intervention into agricultural production were introduced in the area.

Theoretical framework

At the beginning of intellectual concern for shift in agricultural land use in the later part of the eighteenth century, attention was unduly given to population and technology as factors of change in patterns of land use. The German and Russian economists and geographers, on one hand, had for long held that population increase was the major cause of change in agricultural land use from extensive to intensive use. While this notion was popular among German and Russian scholars, the view in the English-speaking world explained change in agricultural land use by improved technology of food supply (Grigg, 1979). No attempt was made to develop a holistic perspective that could consider all possible factors causing change in patterns of agricultural land use. One factor explanation became a norm in subsequent discourses on agricultural land use change.

The Technology Theory

The technology theory of agricultural land use has its origin in the works of Malthus. He argued that the capacity of the earth's resource base, including food production potentials, to support increase in human population was limited (Marquette, 1997). Means of subsistence from the earth increased only at arithmetic rate while population using them increased at geometric rate. He elaborated further that positive changes in means of sustenance normally stimulated increase in population, but not the other way round. Malthus assumed that agricultural systems tended to produce at the maximal level permitted by available technology. Improvement in technology would stimulate change in agricultural land use, and consequently, population growth via improved food supply (Weeks, 1999; Stone, 2001). Malthus' view therefore assigned independent role in land use change to technology, a dependent role to population and the environment was seen as passive.

Since Malthus' views became public, they have been assessed by several scholars. Some commentators reiterate that population grows at a faster rate than the means of sustenance, and that, population is incapable of introducing change in patterns of resource production which can keep pace with rate of growth. According to them, technical innovations precede population growth to cause the required shifts in resource production. Hardin (1968), for example, argued that once technical improvements do not precede population growth, a situation which set the entire humanity ruin-bound is created. The view that presents technological transformation as happening in a void is certainly not convincing. For there can be no thought of improving technology, unless the population creating it comes under some dire need to do so. Technological evolution alone therefore, does not provide adequate explanation for shift in patterns of agricultural land use.

The Population Theory

The theory postulates that agricultural land use change is caused by population growth, and the major change is intensification of land use. It further states that population growth is the major cause of innovations in agricultural technology, land tenure systems and settlement patterns. These innovations manifest in the emergence of new patterns of agricultural land use in an area. Increase in population is independent of food supply, rather it occasions shift in agricultural land use and food supply. The theory as postulated by Boserup (1965) sees change in agricultural land use in terms of intensification which refers to increasing frequency of cropping of total land available to a community.

When population density is low, only a fraction of the total land available to a community is cropped, and that, for one or two years and it is left to fallow for several years. Increase in population density leads to longer periods of cropping while fallow periods shorten. Other detailed attributes of the population theory of land use change have been specified by Boserup (1965) as shown in Figure 2. The population model assigns an independent role to population, a dependent role to environment and a passive role to technology in the process of shift in patterns of land use.

Figure 1: Population model of land use change after Ester Boserup.

S/N	Type	Cropping Length	Fallow Length	Type of vegetation	Tools in use	Fertilizer	Labour needs	Productivity
1	Forest fallow	1–2 years	20-25 years	Secondary forest	Axe, fire, digging stick	Ash	Land clearance with axe & fire	High
2	Bush fallow	1-2 years To 6-8 years	6-10 years	Small trees, bush	Hoe	Ash, Vegetation, turfs mixed in soil	Less land clearance, but some weeding	Falls as yields, falls & extra weeding needed
3	Short fallow	Not specified 1-2 years	1-2 years	Wild grasses	Plough	Manure & Human waste	Extra preparation of seed bed and carting manure	Falls as extra cultivation, extra weeding & manuring
4	Annual cropping	Continuous	A few months	Legumes& roots	Plough	Manure, Human waste, green manure	Extra cultivation, weeding	Falls as extra cultivation & weeding
5	Multi-cropping	Two or more crops each year	Negligible		Plough	Compost, silting, marling	Irrigation, water control	Manuring & irrigation are increasingly required to maintain yield

Source: Boserup, 1965.

The contestable issues embedded in the population theory of land use change are the use of one factor (population) to explain land use shift; partial notion of intensification which is a wide ranging aspect of land use, and use of insufficient empirical evidence to explain a complex phenomenon of change in agricultural land use. Other single-factor based theories of land use change include ecological theory (Moss, 1969), composite theory (Freeman, 1994), spatial equilibrium theory (Briassouli, 2000) and cultural theory (Stone, 2001).Failing to develop a unified explanatory model, the single factor perspectives render most models local and incapable of explaining land use evolution universally. This study therefore questions the adequacy of existing models because change in agricultural land use occurs within a mix of interweaving factors. In some cases the factors may have to be put end-on while in others they may have to be placed side by side before readjustment in land use can be fully understood.

Methodology

The study area

Ute Districts are located between latitudes 6º 09′ and 7º 01′ north, and longitudes 8º 22′ and 9º 11′ east. The area is found in south-eastern part of Benue State which lies in the extreme eastern part of central Nigeria. It is bordered on the east by Kwande LGA, on the north by Mbara District, on the west by Mbagbera District and in the south by Mbatyough District, all in Vandeikya LGA of Benue State. The Districts span over 124 square kilometres.

Methods of data collection

The study investigated the effect of 66 variables on patterns of agricultural land use in the area. In order to obtain data on the variables, 129 farm households together with their farm plots from 36 villages in the area were randomly selected for questionnaire survey, observation and measurement. Several other methods were also used to collect data for the study. This was necessary due to the extent of time covered, types of data required and the wide range of information required in the study. The methods are shown in Table 1.

Table 1: Summary of data collection methods

Before 1920	Between 1920 and 2009
Anthropological reports; Focused group discussion; Oral interview	Archival search; Research reports; Interviews; Topographical maps; Aerial photographs; Georeferencing; Field measurement; Questionnaire survey; Use of five-point scale to assess farmers' opinions on causes of land use shift. Personal observation
Data obtained: base data	Data obtained: change/explanation

Source: Field work, 2009.

Principal component analysis (PCA) was used to reduce the 66 variables to interpretable factors which explain change in land use patterns in the area. PCA has the advantage of reducing the dimensions of a group of data to a smaller number of abstract variables (Lesschen, Verburg & Staal, 2005). By so doing it maximises variability within the data and makes the data easier to handle. Principal components are derived using the following formula:

$$Yi = a1\ x1 + a2\ x2 + a3\ x3 + \ldots\ldots a0\ xp \qquad (1)$$

where, Yi are principal components;
a0 is the weight for observed variable 0;
xp is subject's score on observed variable p.

After the first factor that most explains variability in the data set has been extracted, the next factor that best accounts for the remaining variability is defined. The process continues until consecutive factors are extracted. Determination of the final number of meaningful components to retain and interpret is based on eigenvalues-one (Kaiser, 1960) criterion which allows one to retain and interpret any component with eigenvalue greater than 1.00.

Results and discussion

Land use patterns featured in this discussion are farm size, cycle of rotation and fallow period. Farm size is a conspicuous pattern of agricultural land use for which change can be measured. Downes (1933) reported that sizes of farm plots in the area before 1920 were small; he did not mention any specific size. But from Focussed group Discussions (FGD), dimensions of farm plots during the period were estimated from consensus opinion. Since yam heaps were, and are still, the only original tillage on a farm plot in the area, the hectareage of any subsequent crop taking over the plot from yam in the cycle of rotation would be the same. The estimates of sizes of farm plots in the area before 1920 and after 1920, based on FGD, those reported by Briggs (1941), aerial photographs (SES-Meridian, Port-Harcourt, Nigeria and Lancing, England, 1977) and field measurements (2009) have revealed change in the size of farm plots in the area. The sizes of farm plots in the area are shown in Table 2.

It can be seen that farm sizes in the area have not been static since the area came into contact with change stimulating forces. Shift was most noticeable during the early decades of the period, the time we referred to as quasi-commercial phase of change.

Table 2: Evolution of size of farm plots in Ute Districts between1920 and 2009

Period	Size of farm (hectare)	Source of information
Before change (1920)	0.1880	FGD (2009)
After change: 1930s	2.2037	Briggs (1941)
1940s	1.0546	FGD (2009)
1977	0.1645	Air photographs (1977)
2009	0.1487	Field measurement, 2009

The quasi-commercial phase of change in land use was typified by a single dominant cash crop, beniseed (*Sesamum indicum*); the rest of crops cultivated were for subsistence. Under the context of unexhausted land frontiers, beniseed stimulated expansion of cultivation in the area. Reduction of size set in after 1950s due to rising population density, break up of family farms and the consequent unavoidable fragmentation of holdings. Since the 1950s, size of farm plots has been on downward trend in the area.

Change in Cycle of Crop Rotation in Ute Districts

Cycle of crop rotation has been one of the most dynamic elements of agricultural land use in Ute Districts. This is because the factors necessitating it are themselves non static. Since 1920, at least, four distinct cycles have evolved in the area as shown in Table 3.

Table 3: Change in cycle of crop rotation in Ute Districts between 1920 and 2009

Period	1st year	2nd year	3rd year	4th year	5th year
Before change (pre-1920)	Ya/Ve/Bn/Ba	Mi/Gc	Sp		
After change (1920-1950)	Ya/Ve, Ya/Ca, Ya/Me/Ve	Mi/Gc,Gn/Gc	Be/Gc, Ma/Sp	Sp	
(1960-1985)	Ya/Me, Ya/Ca, Ba/Bn, Co	Gn/Gc, Be/Gc, Gn/Ca, Ri	Sb/Gc, Ca/Sp	Sb/Gc, Sp	
(1986-2009)	Ya/Me/Ve, Ya/Ca, Ca/Sp	Gn/Gc, Ca/Sp, Gn/Gc/Me	Ya/Me/Ve, Ca/Sp, Gn/Gc/Me	Ya/Ve, Ca/Sp	Ca/Me, Gn/Gc

Source: Briggs (1941), Field work, 2009.

Ya is yam; Ca is cassava; Sp is sweet potato; Co is cocoyam; Ba is bambarra; Gn is groundnut; Gc is guinea corn; Be is beniseed; Mi is millet; Ma is Macuna; Sb is soyabean; Bn is beans; Me is melon; Ve is vegetables; Ri is Rice.

The table shows consistent change in rotation cycle in the area. The cycle is generally tending towards continuous cropping of farm plots. It is an indication that land frontiers have been reached in the Districts.

Change in Fallow Period in Ute Districts

Length of fallow period in none formally regulated land economies is a direct function of population-land ratio. In land surplus contexts long durations of fallow are permitted while land deficit contexts permit only short durations. The latter scenario has been amply demonstrated in this study. Table 4 shows the scenario.

Table 4: Evolution of fallow period in Ute Districts between 1920 and 2009

Period	Mean length of fallow period
Before change (pre-1920)	8 years
After change (1920-1950)	4.2 years
(1960-1985)	3.2 years
(1986-2009)	1.26 years

Source: Field work, 2009.

Doubtlessly, fallow period in the area has evolved over the period covered in the study, from bush fallow system to annual cropping. Individual cases of annual cropping and multicropping were reported during field investigation for the current period. It indicates increasing frequency of cropping which is non-industrial intensification of use of land in the area. With the exception of tillage pattern which has not evolved since 1920s, the investigation has revealed change in all the major patterns of agricultural land use in the area during the period under study.

Factors of Agricultural Land Use Change in Ute Districts

Though factors causing change in patterns of agricultural land use can be internal or external, the decision to alter any pattern of agricultural land use lies with individual farmers and it is taken at the farm level.

Thus farmers' responses were sought in the course of the study in an effort to explain evolution of agricultural land use patterns in Ute Districts. The relative importance of the variables in explaining change in agricultural land use in the area was determined by principal component analysis. The Statistical Package for Social Science (SPSS), Version 14.0 software was used for the analysis. The initial component matrixes for the variables revealed occurrence of redundant variables in the data set which were 'scratched out'. The 26 variables which survived the 'scratching out' are defined in Table 5.

Table 5: Variables used in principal component analysis

Variable*	Definition of variable
X1 (X3)	Population increase
X2 (X7)	Soils no longer productive for indigenous crops
X3 (12)	Need to plough to check erosion
X4 (16)	Need to build food reserve for the future
X5 X18)	Internalisation of skills for grafting tree crops
X6 (20)	Gender equity in division of farm labour
X7 (X25)	Improved personal access to production factors
X8 (X26)	Construction of bridges and culverts
X9 (29)	Expansion of periodic markets in the area
X10 (X30)	Increased access to distant markets
X11 (X31)	Increased demand for staple food crops
X12 (X32)	Provision of improved seeds by government
X13 (X34)	Willingness to accept innovations in land use
X14 (X42)	Farming to pay children's school fees
X15 (X43)	Decline of communal land tenure
X16 (X45)	Increasing importance of private land ownership
X17 (X46)	Practice of land sale
X18 (X48)	Orchard substitution for improved income and diet
X19 (X51)	Gender equity in land ownership
X20 (X53)	Increasing economic freedom for the youths
X21 (X54)	Increased travel by the people of the area
X22 (X58)	Desire to generate income to solve unforeseen problems
X23 (X59)	Desire to live in better housing
X24 (X62)	Monetisation of economy
X25 (X63)	Commercialisation of farming enterprise
X26 (X64)	Existence of a landless group in the area

*Numbers outside bracket are value-free serial numbers; those in bracket are the numbers of the variables as seen on the original list of 66 variables.

Source: Field work, 2009.

As a first step, the 26 variables were correlated to produce a matrix shown in Table 6. The correlation matrix involving the 26 'surviving' variables has shown that generally, variables in the data set correlate with one another. The correlation scores range between .003 and .733 for positive correlations; and between -.001 and -.495 for negative correlations. The Table shows that some items correlate strongly among themselves while others correlate only weakly. It is the variables that show strong correlation that are useful in explaining land use change in the area.

Table 6: Lower triangle of correlation matrix for 26 variables

X1	1.000																									
X2	.210	1.000																								
X3	-.194	.015	1.000																							
X4	-.105	-.097	-.261	1.000																						
X5	-.059	-.001	-.156	.199	1.000																					
X6	.501	.060	-.044	-.127	-.267	1.000																				
X7	.191	.132	-.052	-.068	.121	-.133	1.000																			
X8	.171	.290	.151	-.041	-.219	.042	.427	1.000																		
X9	.031	.009	.188	-.080	-.236	.238	-.183	-.082	1.000																	
X10	.079	.348	-.165	.032	.082	-.086	.581	.118	.031	1.000																
X11	.214	.133	.276	-.006	-.044	.166	.220	.366	.019	.156	1.000															
X12	.046	.106	-.194	.249	.535	-.322	.391	-.087	-.052	.495	.110	1.000														
X13	-.170	.233	.282	.060	.005	-.071	.140	.366	-.071	.356	.264	.171	1.000													
X14	-.072	.066	-.232	.171	.069	-.084	-.146	-.083	-.092	-.073	.050	.096	-.055	1.000												
X15	.137	-.209	.032	-.085	-.007	-.042	.020	-.025	-.400	-.088	.259	-.002	.095	.168	1.000											
X16	-.039	.270	-.194	.052	-.017	-.232	.438	.284	.041	.311	.039	.316	-.071	.100	-.069	1.000										
X17	-.001	.212	-.124	.160	.099	.044	.192	.191	.152	.034	.050	.084	-.160	.073	-.355	.143	1.000									
X18	-.193	-.175	.208	.131	-.009	-.389	.183	.188	-.152	-.003	.227	.142	.252	.105	.247	.136	-.243	1.000								
X19	.356	.171	-.110	-.022	-.070	-.078	.046	.144	.015	.280	.033	239	-.035	-.100	-.006	.080	-.062	-.197	1.000							
X20	.074	.011	-.008	.286	.207	-.030	-.103	.008	-.177	-.209	-.035	-.029	-.125	.106	.151	-.087	.052	.145	-.070	1.000						
X21	-.111	,071	.019	.324	.156	-.204	-.043	-.133	.023	.074	-.225	.105	.172	-.152	-.286	.106	.131	-.260	.072	-.033	1.000					
X22	.087	-.443	-.084	-.255	.113	.072	.098	-.082	-.244	-.325	.031	-.002	-.075	.157	.409	-.225	.088	.155	-.184	.056	-.126	1.000				
X23	-.033	-.204	.286	-.052	.049	-.121	.060	.148	-.149	-.038	.298	-.024	.259	.011	.172	-.013	.031	.555	-.152	.002	-.136	.223	1.000			
X24	.187	.265	-.250	-.132	.030	-.147	.684	.474	.049	.553	.173	.375	.059	-.115	-.169	.570	.162	.002	.271	-.051	-.003	-.116	-.227	1.000		
X25	.094	.214	.075	-.054	.015	-.107	.411	.331	-.105	.407	.205	.434	.590	-.018	.060	.145	-.214	.307	-.067	.022	.053	-.025	.048	.332	1.000	
X26	.104	.163	.034	.001	-.155	-.159	.504	.378	.230	.272	.285	.153	.111	-.209	.057	.519	.037	.214	.138	-.200	-.049	-.246	.091	.487	.116	1.000

A further step of this analysis is calculation of component loadings and eigenvalues of components. The distribution of eigenvalues among the 26 components (variables) is shown in Table 7. It is clear from Table 7 that, initial components showing eigenvalues above 1.000, number from 1 to 9. Using eigenvalue-one criterion therefore, the study derives nine principal components from the analysis for interpretation. This enables the study to explain 72.15 % of variance in the data set.

GTable 7: Distribution of eigenvalues and related variances among the 26 variables

Component	Initial Eigenvalues		
	Total	% Variance	Cumulative %
1	4.376	16.829	16.829
2	2.961	11.389	28.218
3	2.542	9.777	37.996
4	2.050	7.884	45.880
5	1.668	6.416	52.296
6	1.524	5.861	58.157
7	1.301	5.005	63.162
8	1.185	4.558	67.720
9	1.151	4.426	72.146
10	0.990	3.808	75.953
11	0.957	3.680	79.633
12	0.803	3.087	82.720
13	0.769	2.956	85.676
14	0.685	2.636	88.312
15	0.536	2.063	90.374
16	0.486	1.870	92.244
17	0.424	1.631	93.876
18	0.387	1.487	95.363
19	0.364	1.401	96.764
20	0.260	0.998	97.762
21	0.198	0.760	98.522
22	0.124	0.478	99.001
23	0.105	0.403	99.404
24	0.073	0.279	99.683
25	0.053	0.203	99.887
26	0.029	0.113	100.000

Source: Field work, 2009.

A second measure used to decide on the number of components to retain is the scree test. By this test eigenvalues have been plotted against their respective components to show possible break between components with relatively large eigenvalues and those with small eigenvalues. Components which have appeared above the break have been retained for interpretation and those below it have been considered unimportant and not retained. The scree plot is shown in Figure 1.

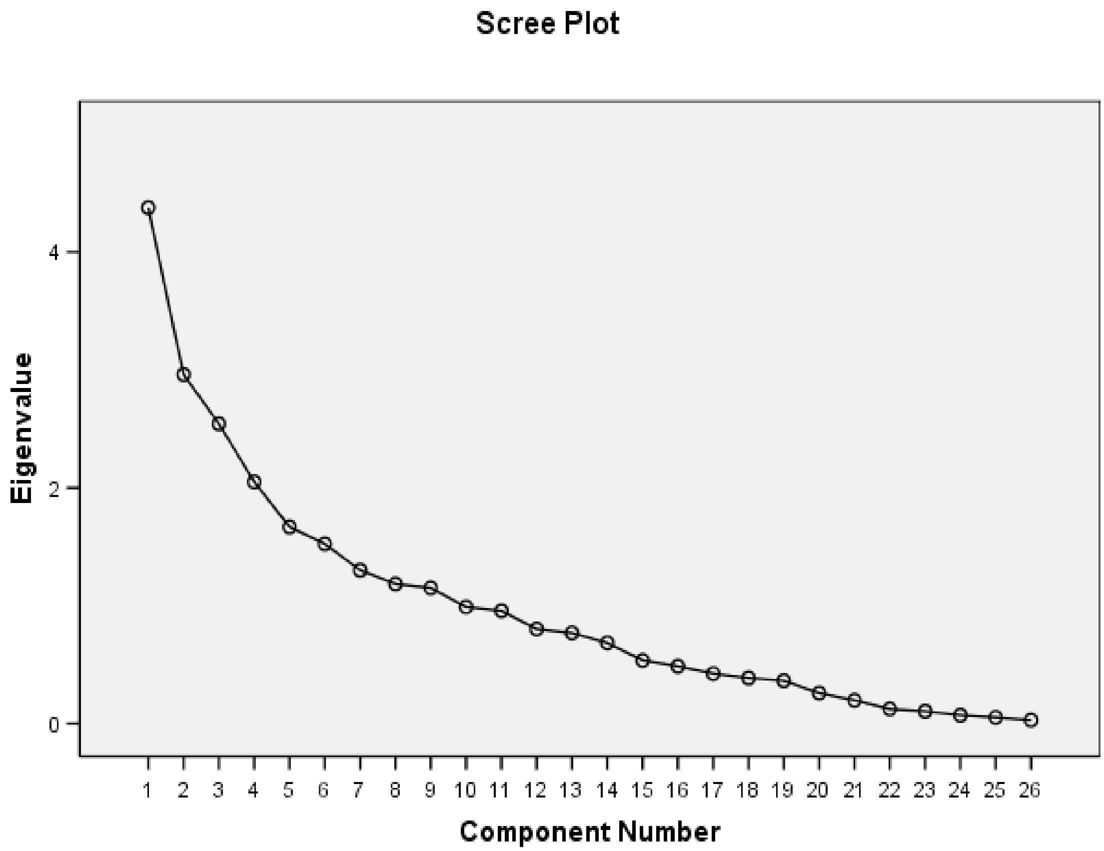

Figure 1: Scree Plot for Principal Components retention

A further solution in the analysis is to construct a component matrix to show the structure of the retained components. The component loadings, their eigenvalues and the variances they account for are shown in the component matrix in Table 8. It can be seen that while component1 has been loaded upon meaningfully by eight variables, component2 by three variables and component3 by four variables, other components show only two significant loadings and components seven and eight do not show any significant loading at all. The matrix therefore does not display sufficient structure.

Table 8: Component matrix and eigenvalues

Variables (X)	Components								
	1	2	3	4	5	6	7	8	9
X1	.175	-.166	-.366	.633*	.282	.124	.008	.306	.004
X2	.454	-.309	-.147	-.069	.283	.332	-.219	-.276	-.027
X3	-.065	.367	-.399	-.537*	.079	.066	.117	.177	-.077
X4	.024	-.076	.533*	-.126	.022	.450	-.316	.335	.110
X5	.068	.048	.669*	.136	.158	.100	.342	.172	.018
X6	-.217	-.237	-.583*	.320	.275	.263	.143	-.028	.172
X7	.786*	.089	.018	.183	-.153	-.073	.235	-.025	-.173
X8	.560*	.188	-.398	.015	-.103	.350	-.082	-.097	-.354
X9	.000	-.391	-.358	-.331	-.171	.034	.116	.146	.503*
X10	.733*	-.137	.106	-.020	.264	-.167	.066	-.042	.220
X11	.350	.397	-.357	.128	.063	.332	.043	.225	.297
X12	.550*	.026	.567*	.130	.180	-.095	.192	.160	.320
X13	.390	.416	-.058	-.423	.504*	.118	.049	-.133	.024
X14	-.108	.131	.300	.265	-.086	.287	-.294	-.437	.461
X15	-.086	.602*	-.019	.448	.099	-.199	-.241	.080	-.005
X16	.620*	-.142	.138	.025	-.472	-.041	-.189	-.130	.019
X17	.130	-.335	.083	.061	-.347	.598*	.445	-.046	-.031
X18	.198	.759*	.121	-.144	-.264	.006	-.180	.066	.088
X19	.284	-.302	-.073	.220	.220	-.225	-.258	.457	-.039
X20	-.148	.143	.264	.213	.052	.468	-.296	.148	-.340
X21	.059	-.321	.361	-.413	.209	.079	.148	.196	-.265
X22	-.311	.431	.055	.474	-.084	-.059	.470	-.108	-.076
X23	.023	.663*	-.072	-.122	-.188	.179	.219	.244	.099
X24	.804*	-.212	-.017	.221	-.178	-.117	.070	-.106	-.158
X25	.572*	.344	.043	-.093	.445	-.029	.045	-.275	-.019
X26	.663*	.024	-.241	-.074	-.426	-.123	-.133	.259	.059
Eigenvalues	4.376	2.961	2.542	2.050	1.668	1.524	1.301	1.185	1.151
% variance	16.83	11.39	9.78	7.88	6.42	5.86	5.01	4.56	4.43
Cumulative %	16.83	28.22	37.99	45.88	52.30	58.16	63.16	67.72	72.15

Source: Field work, 2009.
*Significant variable loadings

In order to make the factor pattern bring out simple structure and ease interpretation, the component matrix is rotated by varimax method. The rotated component matrix in this analysis is shown in Table 9. The rotated component matrix shows that most of the components have been loaded upon distinctly by, at least, two variables. In other words, there is no variable redundancy in the component matrix. There is therefore clearer component structure. The components, hereafter referred to as factors, are defined by the variables which load significantly on them.

Table 9: Rotated component pattern matrix for the nine extracted components

Variables (X)	Components								
	1	2	3	4	5	6	7	8	9
X1	.142	-.059	-.035	.033	.856*	-.057	-.081	.106	-.047
X2	.241	-.266	.497	-.153	.216	.348	.229	.068	.136
X3	-.229	.497	.246	-.319	-.114	.068	.018	-.144	-.385
X4	-.096	.122	-.110	.393	-.102	.578*	.141	.392	.152
X5	-.061	-.007	.019	.748*	-.090	-.124	.146	.213	-.028
X6	-.276	-.090	.023	-.286	.698*	-.102	.204	-.169	.080
X7	.775*	.096	.252	.192	.069	-.194	.077	.015	-.122
X8	.524*	.253	.362	-.394	.180	.013	.200	.275	-.090
X9	-.045	.083	-.161	-.126	.131	.370	.272	.656*	-.011
X10	.477	-.117	.467	.369	.121	.169	-.076	-.273	.003
X11	.158	.618*	.241	-.016	.438	.048	.026	-.045	.128
X12	.324	.035	.221	.815*	.009	.072	-.065	-.088	.106
X13	-.045	.293	.820*	.045	-.095	.095	-.060	-.026	-.112
X14	-.099	-.006	.015	.092	-.073	.020	.026	.111	.855*
X15	-.028	.287	-.017	.008	.158	-.319	-.597*	.281	.198
X16	.761*	-.038	-.043	.025	-.194	.188	.074	-.026	.197
X17	.190	.017	-.155	.117	.092	-.032	.853*	.067	.055
X18	.183	.680*	.105	.014	-.349	-.041	-.280	.160	.175
X19	.249	-.194	-.088	.162	.420	.330	-.342	.015	-.255
X20	-.125	.068	-.079	.036	.067	.119	.059	.741*	.082
X21	-.105	-.229	.120	.305	-.234	.300	.253	.106	-.444
X22	-.164	.189	-.164	.145	.069	-.788*	.000	.127	.094
X23	-.038	.772*	.029	.046	-.089	-.179	.021	.043	-.046
X24	.853*	-.178	.176	.099	.119	-.038	.082	-.038	-.051
X25	.236	.086	.784*	.148	-.021	-.090	-.150	.024	.027
X26	.718*	.313	-.076	-.102	.036	.249	-.078	-.193	-.115
Eigenvalues	3.534	2.317	2.285	2.142	2.030	1.787	1.665	1.595	1.403
% variance	13.59	8.91	8.79	8.24	7.81	6.87	6.40	6.14	5.40
Cumulative%	13.59	22.50	31.29	39.53	47.34	54.21	60.61	66.75	72.15

Source: Field work, 2009.

The Explanatory Factors

Nine principal factors emerged from the analysis as drivers of change in patterns of agricultural land use in Ute Districts. They are:

1. Transformation of relations of production. This factor is defined by variable 7 (improved personal access to production factors), variable 16 (increasing importance of private land ownership), variable 24 (monetisation of the economy) and variable 26 (existence of a landless group). Monetisation of the economy has the highest loading (0.853); the other variables show similar high scores. All together the component contributes a total eigenvalue of 3.534 explaining 13.59% of variance in the data set. The variables loading on this component relate to improvement of personal access to, and control of factors of production in the area such as farming implements, seeds and money; rising popularity of private land ownership rather than family land ownership; and use of money in trade exchange.

2. The desire for improved standard of living. This factor is defined by variable 11 (increased demand for staple food crops), variable 18 (orchard substitution to improve income and diet) and variable 23 (desire to live in better houses). The factor contributes a total eigenvalues of 2.317 and accounted for 8.91% of variance in the data set. The factor was stirred by the influence of European Christian missionaries and agricultural experts from Agricultural Experimental Centre at Yandev.

3. Behavio-economic reorientation factor. The factor is defined by variable 13 (willingness to accept innovations in agriculture) and variable 25 (commercialisation of farming). The component shows an eigenvalues of 2.285 and has accounted for 8.79% of variance in the data set.

Evidently, the variables loading on this factor relate to behavioural and economic reorientation in the area. Initial efforts by colonial authorities to introduce change in agricultural land use in the area were stubbornly resisted (Ward, 1931; cited in MINAGRIC: 4960 VoL. 1, Kaduna, 1931-56, p. 7). The relentless campaign mounted by colonial agricultural experts against traditional agricultural customs and practices dissolved the resistance and created willingness to accept innovations in land use and exchange.

4. The technology factor. Defined in the study by variable 5 (internalisation of skills for grafting citrus and mangoes) and variable 12 (provision of improved seeds by government agency), the technology factor has contributed eigenvalues of 2.142 to the total eigenvalues of the data and has explained 8.24% of variance in the data set. See Table 13. Modern innovations in agricultural land use technology originated from Agricultural Experimental Centre, Yandev and were gradually accepted by farmers in Ute Districts, just as they were accepted in other districts in southern Tivland. They eventually internalised in the area such that at the time of this study, many farmers cross-breed citrus and mangoes themselves to produce improved varieties.

5. The labour surplus. This factor is defined by variable 1 (increase in population) and variable 6 (gender equity in division of labour). The component has an eigenvalues of 2.030 and accounts for 7.81% of variance in the data set. The variables relate to population growth and increased fairness in work distribution between women and men on the farm. Both contexts have facilitated shift in agricultural land use in Ute Districts. Population in the area has increased steadily as shown in Table 10; and has changed labour context since the early decades of change in agricultural land use in the area. The table gives the abridged data on population increase in the area.

Table 10: Population growth in Ute Districts since 1938

Year	Population	Density per square kilometre
1938	9,548	77
1952	12,772	103
1963	32,428	261.52
1991	50,575	407.86
2009	88,851	716..54

Source: NAK/MAKPROF/4540, NPC, 1965, 1994 and projections.

Rising population density in Ute Districts has imposed short supply of land on the area. On the other hand, it has created a labour surplus situation as well as dilution of gender-based division of labour in the area. This factor has been critical to land use shift in Ute Districts.

6. Future security factor. The future security factor is defined by variable 4 (to build food reserve for family) and variable 22 (desire to generate income to solve unforeseen problems). It shows eigenvalues of 1.787 and accounts for 6.87% of variance. Variables loading on this factor clearly betray a tendency to produce surplus to secure the future for the family. This component indicates a departure from what obtained at the threshold of change in the area when "the people live by the moment, not bothering about what happens tomorrow" (Ward, Superintendent of agriculture, Yandev Experimental Centre, 1931; cited in MINAGRIC; 4960, vol 1, p. 7).

7. The Land tenure factor. Variable 15 (decline of communal land tenure system) and variable 17 (practice of purchasing land) loaded on this factor, showing score values of -.597 and .853 respectively. The component shows an eigenvalue of 1.665 and has explained 6.40% of variance in the data. It is clear that the defining characteristics of the component point to change in land tenure system in the area which has shifted from at least extended family holding to nuclear family and even individual holding in some cases. This has paved way for change in sizes of farm plots and establishment of citrus orchards as permanent farm plots.

8. Liberalised access to income. Variable 9 (improvement of periodic markets) and variable 20 (increased economic freedom for the youths) define the liberalised access to personal income factor (component 8 on the matrix). The factor shows eigenvalues of 1.595 and explained 6.14% of variance in the data set as shown on Table

9. The variables loading meaningfully on the factor both relate to the ease with which personal income can be acquired in the area by all those participating in agricultural land use. The freedom for the youths to own farm plots and produce crops that belong entirely to them which they can sell and own the money as personal wealth has encouraged innovation adoption in agricultural land use in the area.

9. The social responsibility factor. The factor has one variable loading significantly on it. That is variable 14 (farming to pay children's school fees), loading with a score of .855. The component has eigenvalues of 1.403 and explained 5.40% of variance in the data set. The variable defining this factor relates to efforts by farmers to fulfil social responsibility to their children through agricultural production.

These factors together provide 72.15% of the explanation for land use change in Ute Districts over time. By combining multiple factors which represent real life situation, they provide a superior explanation to the single factor explanations commonly seen in the literature. The multiple- factor explanatory model is shown in Figure 4.

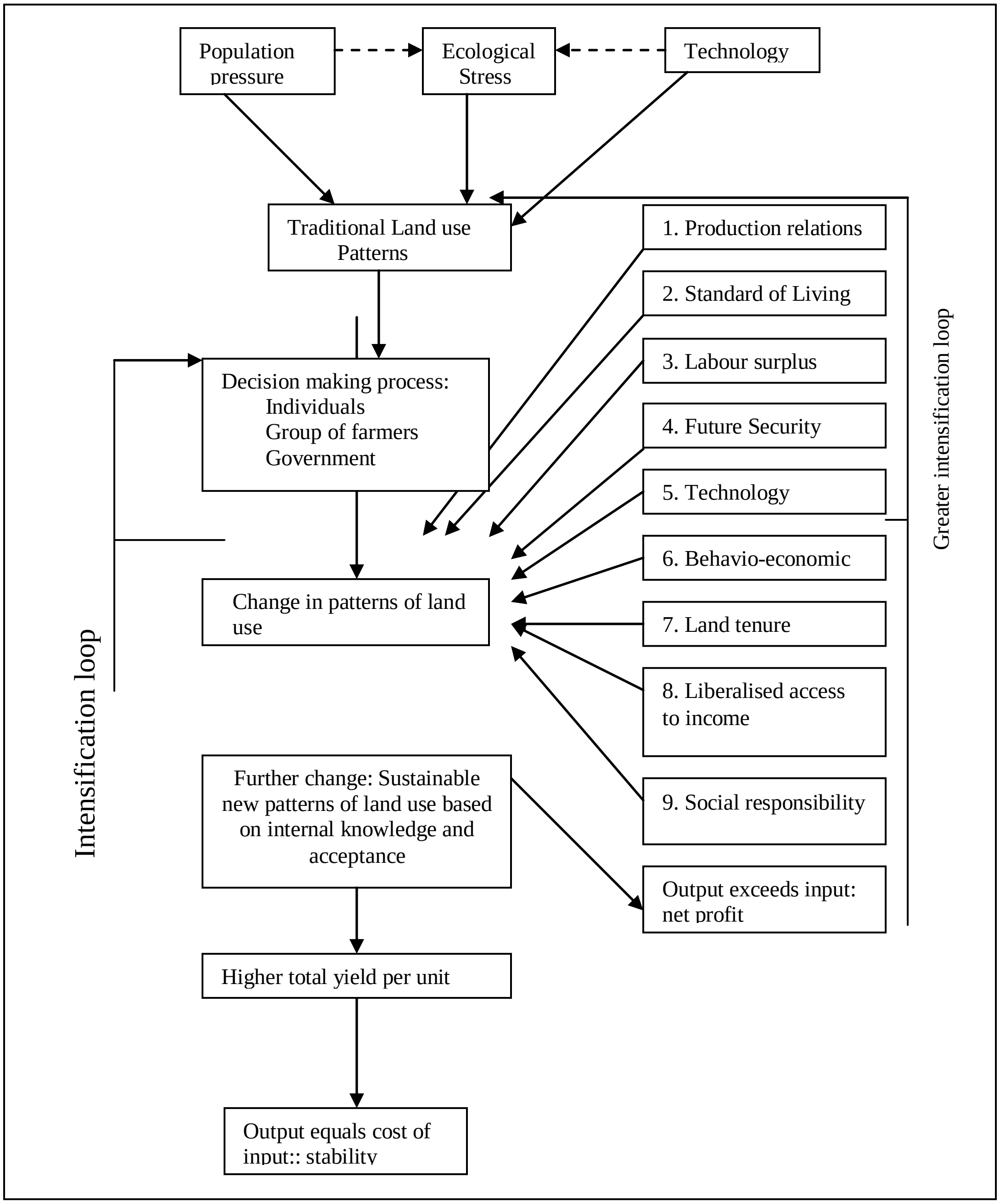

Fig. 4: Model of current change in agricultural land use in Ute Districts

It can be seen that the stable intensification loop originates from the stable output-input box, goes to further change and back to the balanced output-input ratio box. Farmers do not therefore make extra effort to move on into greater intensification loop that requires fundamental reorganisation of land use system and land use policy. It is in this sense that the current changes in agricultural land use in the area appear unsustainable.

Findings of the Study

Several issues have come to the fore bordering on the nature of change, process of change, factors of change and the sustainability of change in land use in the area. The main findings of the study on the basis of which suggestions have been made are as follows:

1. Patterns of agricultural land use in Ute Districts such as size of farm plots, cycle of crop rotation and fallow period have undergone change during the period between 1920 and 2009. Size of farm plot and length of fallow period have reduced while cycle of crop rotation has widened. Generally, the evolution of the patterns is towards intensification of agricultural land use in the area.
2. The current change in agricultural land use in Ute Districts is driven mainly by social and economic factors, rather than factors conventionally cited in this regard. Of the nine factors emerging from the analysis, only technology is not of social and economic origin.

Implications of Agricultural Land Use Change in the area

The most obvious implication of agricultural land use shift in Ute Districts is on land tenure which at the time of the study tends towards privatisation of land. At present, the dominant land tenure system is the one that places land in the hands of extended families. Under such land holding system, annual crops are conveniently cultivated as the cultivating member of family may leave it for other members of the family after a full cycle of crop rotation. However, some of the new land use patterns, especially tree crop production must be undertaken on freehold land since it is a permanent land use. Similarly, the growing importance of lowland (swamp) rice which is cropped multiply on same plot in a single year in the area makes swamp land to assume higher value. In this way, people who have access to it want to maintain their exclusive hold on it.

The general implication of the study on policy is that there needs to be a definite formal policy, a plan of action which spells out ideals to be pursued in agricultural land use in the area. This need is provoked by the study as it has shown that land use change in the area is an unplanned process which with time may not be socially responsible. Specifically, the study implies the need to encourage farmers in the area to diversify livelihood in order to relieve pressure on the land. A situation in which agricultural land use on extremely small holdings dominates means of livelihood causes stress on such holdings. Farmers can diversify from agriculture by taking to trade, handicraft and services.

Conclusion

Patterns of agricultural land use are highly dynamic features of a cultural landscape. Just as they are dynamic, factors causing them to change are similarly evolutionary. The findings of the study have shown that, change in agricultural land use is a multi-faceted phenomenon which can be adequately accounted for by multiple-factors model. In Ute Districts, social and economic factors are the most prominent factors of land use change. One main lesson to draw from these findings is that, in planning for change of agricultural land use, attention must be broad-based to cover all issues relating to land use and not just a single factor. That is to say, orderly and sustainable shift in agricultural land use in rural areas can only be achieved through an integrated approach. The study recommends facilitation of commercial process in the area through rural transport development and reform of intensification process through increased use of organic inputs in the area.

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