

IMPLEMENTATION OF LANDSCAPE ECOLOGY IN NEW AND CHANGING CONDITIONS

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Land use/cover change and agricultural practices in the tropical environment of northern Akwa Ibom State, Nigeria

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The study attempts to assess the link between land use/cover change and agricultural practices in northern Akwa Ibom State, Nigeria over the period 1986–2003. The region, which covers an area of 1934 km² supports a population of 725,000 people and is largely rural in nature with multi-cropping through the slash-and-burn mode of field preparation the dominant pattern of cultivation. This is suspected to be the underlying driver of land use/cover change. To ascertain this, Landsat TM and ETM+ satellite images from 1986 and 2003 respectively were classified and subjected to change detection analysis in a GIS environment. A social survey of 408 households provided information concerning past and present agricultural practices and socio-economic, policy and technology indicators that were used to explain LUCC. The results of change detection analysis reveal that 47% of land has been converted to alternative uses. This is induced by slash and burn land preparation, reduced fallow period and poor policy implementation. Agricultural extension services which should help in the diffusion of agricultural innovations and sustainable land use have been inaccessible to most farmers. Consequently, if agricultural practices are brought under control, undesirable LUC change could be checked. The study recommends the establishment of agro-based small-scale industries to provide alternative means of livelihood, participatory agricultural programmes and an improvement in the infrastructure base as strategies for the sustainable use and strategic geographical targeting of land resources.

Keywords: Change Detection, Social Survey, Sustainable agricultural practices

Introduction

Information on land use/cover change (LUCC) as well as the associated drivers is very important in land allocation decisions. Man's interaction with the environment often results in alteration of the nature of the landscape with huge consequences for the ecosystem. Human activities have directly altered between one-third and one-half of the Earth's surface (Dale et al, 2000). Indeed, one of the most pervasive modes of anthropogenic change has been the transformation of land from natural ecosystems to agricultural use (Ramankutty and Foley, 1999). It is therefore crucial to understand the important factors that affect both the current and future potential land use alternatives. This assists in reaching effective solutions from the land management process.

LUCC research involves many disciplines, and often operates at the interface of the natural and social sciences (Overmars, Verburg, 2005). A theory of land use change therefore needs to conceptualise the relationship between the driving forces and human behaviour. Up till now, researchers have failed to integrate all disciplines and address the complexity of the land use system into all-compassing theory of land use change (Verburg et al., 2004). Information from maps, census data and remote sensing are often used to construct driving factors of land use change (Velkamp, 2000; Nelson et al., 2001; Pontius et al., 2001). Although spatially clear, Overmars and Verburg (2005) stress that such research lacks explicit consideration of process and human behaviour. As such, they are only valid at the pixel level and do not

directly translate into the determinants of LUCC at the household level - the level that is central in decision making. Socio-economic studies on the other hand, often focus at the household level to gain insight into the factors that influence land use decisions. These studies provide information about decision-making processes and human behaviour, but in general, lack spatial dimensionality. Walsh and Crew-Meyer (2002) and Fox et al. (2003) emphasize the importance of combining the strengths of both approaches by linking the social and geographic disciplines to provide a better understanding of the land use system. Linking household information to remotely sensed data provide great opportunities to improve our understanding of land use dynamics (Lambin, Geist, 2003).

Human–environment systems can be viewed as complex adaptive systems whereby properties, such as land use, emerge from the interactions among the various components of the entire system which themselves feed back to influence the subsequent development of such interactions (Levin, 1998; Stafford, Reynolds, 2002; Lambin et al, 2003). This means that land use is constantly changing in response to dynamic interactions between drivers and feedback from land use change to these drivers. Therefore, Lambin, et al (2003) noted that land use change is a spatial property observed at the scale of a landscape. It is the sum of many small, local scale changes in land allocation that reinforce or cancel each other. 'Such changes are the products of multiple decisions resulting from interactions between diverse agents, who act under certain conditions,

anticipate future outcomes of their decisions, and adapt their behaviours to changes in external and internal conditions. Quite often, these decisions are made without central direction, unless there are central planning systems'. Land use change is thus an intricate large-scale spatial process that emerges from the aggregate interactions of less complex agents.

In Nigeria where over 80% of the rural population uses slash and burn agricultural techniques, land use is always in a constant state of flux due to both external and internal factors resulting in land use/cover modification, conversion and/or alteration. This is especially in rural areas which lack central planning direction as a result of the freehold ownership system with little or no policy intervention from government. Therefore, change induced by agricultural practices, policy and technological variables needs careful assessment, particularly because agriculture is the largest single sector of the economy, and forms the mainstay of Nigeria's large rural population (UNEP, 2003). It also provides employment for a large segment of the work force and contributes 30–40% of the GDP. Therefore, the relationship between LUCC on one hand, agricultural practices, policy and technology indicators on the other, needs to be examined based on the interactions and feedbacks within the system.

In the light of the above, this study seeks to assess the land use/cover of the area with a view to detecting changes that have occurred between 1986 and 2003 within the existing policy and technology framework. It also attempts to gain an understanding of past and present agricultural practices and their impacts upon LUCC in order to develop strategies for the sustainable use of land resources in the future.

Study Area

This study was conducted in the northern part of Akwa Ibom State, the south-southern fringe of Nigeria (Fig. 1). It covers a total area of 1934 km² and contained a population of approximately 725,000 based on the 1991 national headcount. Annual rainfall within the area varies between 1900 and 4000 mm with 116 to 170 rain days per year. The mean monthly temperature is $26^{\circ}\text{C} \pm 2^{\circ}\text{C}$. There are two distinct seasons; the rainy season which starts in April and ends in November, and the dry season, which begins in late November and ends in March. The area is drained by several large rivers including Kwa Iboe, Cross River, Enyong Creek, Inyang and their tributaries. It is typically rural with most people engaged in agriculture largely practicing slash and burn agriculture using locally fashioned farm implements.

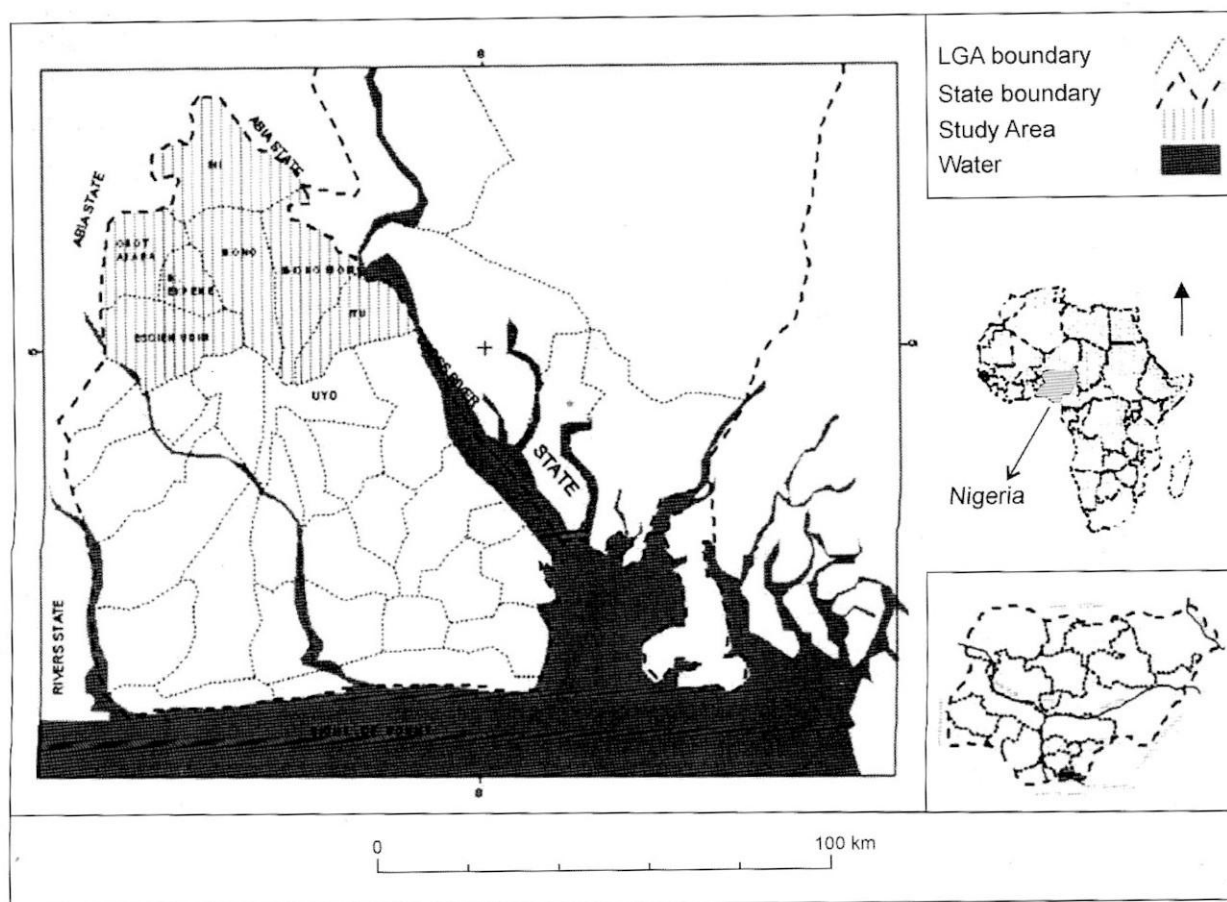


Fig. 1. Akwa Ibom State Showing Study Area.

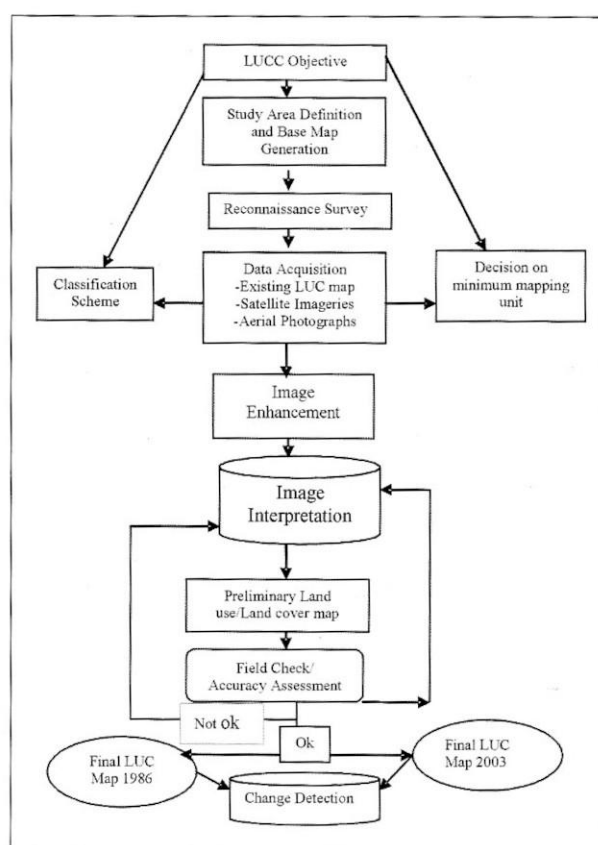


Fig. 2. Schema for Image Processing.

Land Use/Cover Classification Scheme

Northern Akwa Ibom State is a part of the Cross River basin located within the freshwater swamp forest belt of southern Nigeria. Quite an extensive land use and vegetation study has been previously undertaken by the Cross River Basin Development Authority (CRBDA). In this work, reference has been made to the land use and vegetation classification scheme which the Authority used when mapping the area in 1987. This scheme has been simplified for the purposes of this study into five land use/cover classes; compound farmland, bush fallow, imperfectly drained farmland, forest and open water. These simplified classes were utilized in order to ease interpretation since the original scheme seemed complicated when considering this study area relative to the entire area that CRBDA used for the classification.

DATA AND METHODS

Data

This study utilized both remote sensing data and survey data captured in the field.

- **Remote Sensing Data:** Landsat TM and ETM+ images captured December 1986 and January 2003 were acquired from the United States Geological Survey (USGS). Each had a spatial resolution of approximately 30 m².
- An existing land use/cover map of the area was also acquired from CRBDA. This was used as ancillary data

for training sets and accuracy assessment of the 1986 Landsat image.

- Large-scale aerial photographs of 2002 were also acquired from Akwa Ibom Ministry of Lands and Housing. These were used to assist in the selection of training areas. They were also used in the accuracy assessment of the 2003 image.

Methods

Image Processing: Fig. 2 shows the steps involved in image processing and change detection analysis. All the image interpretation processes were carried out using Erdas Imagine 8.7 software, while change detection and mapping was completed using the Spatial Analyst extension within ArcGIS 9.1. Erdas Imagine was used due to its robust and advance image analysis functionalities, while the use of ArcGIS was prompted by its flexibility in spatial data handling and analysis.

- **Image Enhancement:** In order to create subset images of the study area prior to actual enhancement and classification procedures, layer stacking and area of interest (AOI) tools were applied to both images. Since the two images were captured during the dry seasons of their respective years, distortions due to weather and season were not taken into consideration. Both images which were 100% cloud-free were subjected to principal component analysis (PCA). This is a spectral enhancement procedure which is often used to compress image data to reduce redundancy. The resultant non-redundant and uncorrelated principal component bands are considered to be easier to interpret than those of the raw images.

Image Interpretation: Supervised classification techniques were applied to derive meaningful classes from the images. Specifically, supervised signature extraction was adopted in conjunction with a maximum likelihood algorithm. Bands 4-3-2 which were found to be very useful in discriminating the land use classes were combined for this purpose. In order to assess the accuracy of the classified images, the 1986 classified image was compared to a land cover map published in 1987, while the 2003 classified image was compared to aerial survey data captured in 2002. Furthermore, a field check was also undertaken on the 2003 classified image during April and May 2006. A combination of these methods proved very reliable in generating valid land use/cover categories for the study.

Change Detection: To achieve the objectives of this study, two forms of spatial analyses were undertaken: area calculation of the land use/cover for each year and post-classification change detection. While the former involves comparison of the LUC statistics derived from the classified images, the latter is an area-specific change detection procedure (point-by-point). With these two techniques, information on the nature, location, magnitude, trend and rate of change were highlighted. Weismiller et al. (1977) considers this point-by-point method superior to other change detection techniques within image analysis systems. It also helps to maintain a finer control over the data sets (Jakubauskas et al., 1990), and offers greater flexibility in generating related classes of change (Adeniyi, Omojola, 1999).

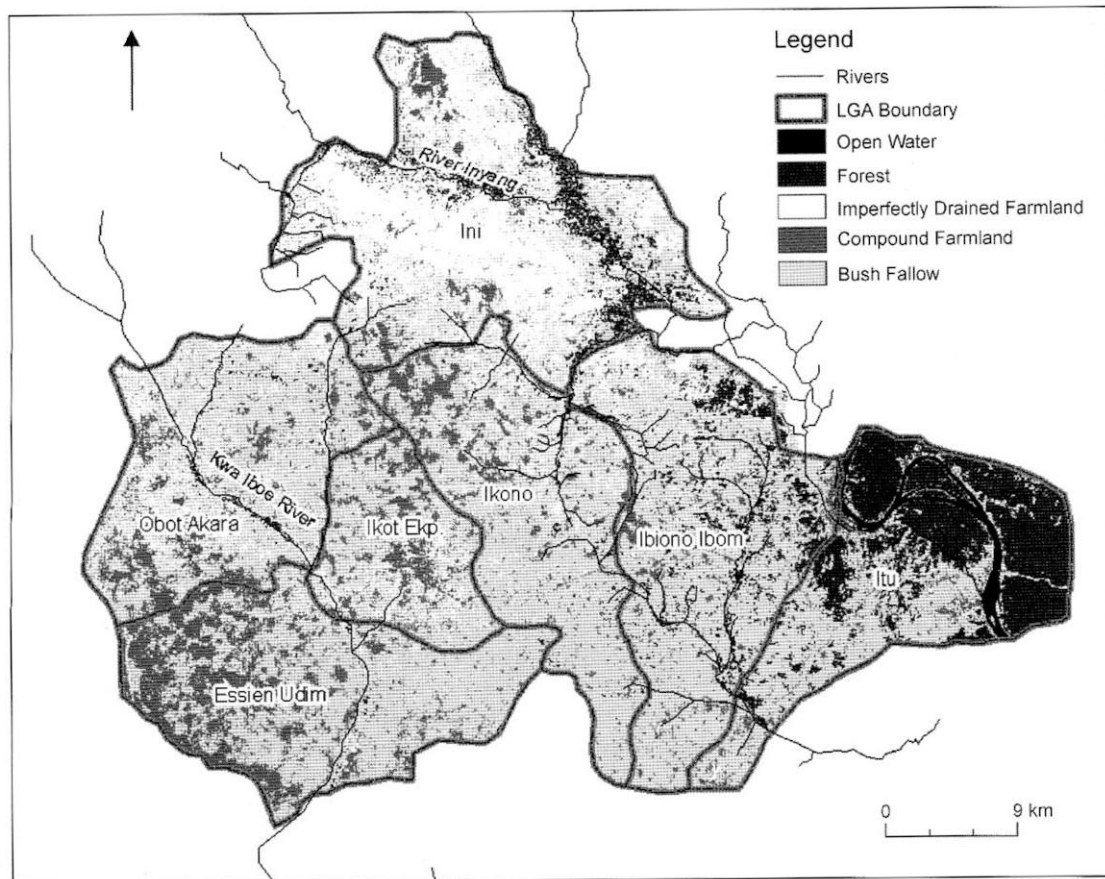


Fig. 3. Land Use/Cover for 1986.

Social Survey: Sampling Procedure

A household survey was conducted in April and May 2006 using structured questionnaires, interviews and focus group discussions with farmers, community leaders and organizations. This provided primary data on socio-economic conditions, agricultural practices, policy indicators and land management options in the rural areas of this region. In order to ensure equal coverage of the households over the study area, both stratified and systematic sampling procedures were utilized for data collection. Consequently, the area was stratified into zones on the basis of the seven Local Government Areas (LGA) in the study area. Ten villages were systematically selected from the sampling frames of the respective LGA. In each selected village, six households were also systematically visited for data collection. This resulted in a total of 68 sampled villages out of 671 in the entire study area (10%). In this way, a total of 408 households were visited.

RESULTS

Land Use/Cover Change Detection

The results of the image analysis and change detection are presented in this section. Fig. 3, 4 and Tab. 1 indicate the land use/cover status for the years 1986 and 2003

respectively, while Fig. 5 highlights the direction change that has occurred between LUC classes as well as within zones. In order to capture changes that have occurred between land administration zones, the data generated from the analysis has been summarized in tables and charts for clarity.

• Point-by-Point Change Detection: Between Classes and Zones

Changes between land use/cover classes on one hand and that between the land administration zones (LGA) in the study area were also examined. Regarding this, each land use/cover type was analysed for the nature and pattern of changes and their distribution in the zones as summarized in Tab. 1 and Fig. 5.

Open Water: This category was highly stable in size throughout the seven zones and between the two periods. However, a slight decrease of -0.4% was observed in Itu zone. A cursory look at the LUCC matrix in Tab. 2 shows that of this reduction, 0.41 km² was converted to imperfectly drained farmland and 0.28 km² to bush fallow. At the same time, this class has gained 0.61 km² and 1.42 km² from imperfectly drained farmland and bush fallow respectively. This occurs at the land-water fringe along Cross River in Itu, the only zone with a large volume of open water.

Forest: Over 60% of forests in the study area occur in Itu Zone. This area has experienced about a 3.6% reduction

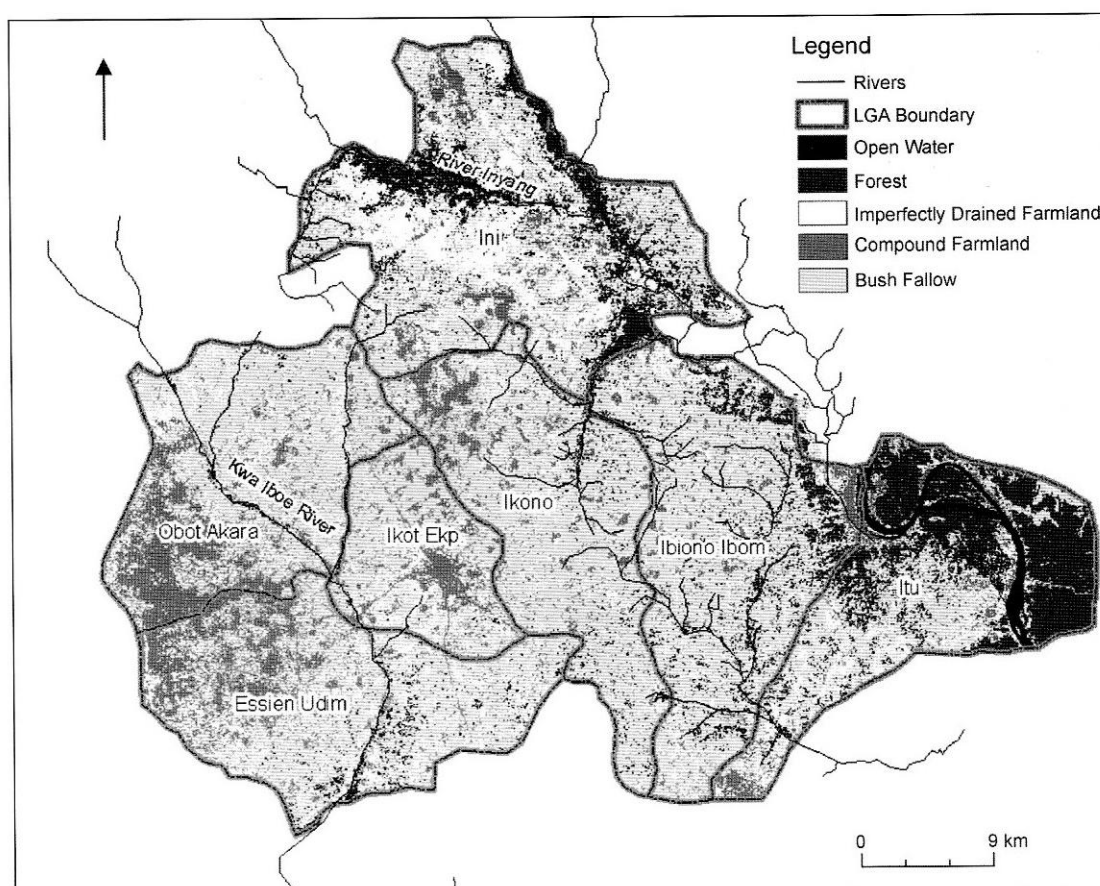


Fig. 4. Land Use/Cover for 2003.

Tab. 1. Land Use/Cover Change Statistics.

Classes	1986 (ha)	2003 (ha)	Change (ha)	Change (%)	Change/yr (ha)
Open Water	1,722	1,607	-115	0.60	-6.76
Imperfectly					
Drained Farmland	43,916	35,926	-7990	42.36	-470
Compound	26,887	30,914	+4,029	21.35	+237
Farmland					
Bush Fallow	101,171	99,843	-1,328	7.03	-78
Forest	20,234	25,640	+5,406	28.65	+56

in forestry over the study period, with decline elsewhere much lower in comparison. All other zones with small patches of forest have experienced slight increases. Fig. 5 summarizes the direction of change in classes across zones within the study area. In Ini zone, there has been an expansion of about 10% in forest.

Imperfectly Drained Farmland: The change matrix (Tab. 2) shows that this LUC class experienced change to bush fallow, compound farmland, forest and open water. Also, it has gained from these classes. Such conversions occur mainly in Ikono, Ini and Obot Akara zones. This of course does not occur by chance since the gradual drying up of the existing wetlands has been confirmed by farmers who utilize the area for wetland rice farming. In Essien Udim, Ibiono Ibom and Itu Zones, there have been increases. Again, the recent effort by government aimed

at integrated wetland resource development in those zones by government indicates that areas not previously used for wetland farming are likely to be converted. This result consequently indicates a trend of land conversion to agricultural use.

Compound farmland: This represents areas largely used for continuous cultivation of a variety of crops. 112 km² and 20 km² of this category have been converted to bush fallow and imperfectly drained farmland respectively. Such conversion occurs mainly in Essien Udim and Ikot Ekpene zones. On the other hand, compound farmland has gained significantly from bush fallow by about 172 km². Other LUC classes this has gained from are forest and imperfectly drained farmland. Such expansion is undoubtedly largely caused by population increase which has grown by a factor of 2.8 per year.

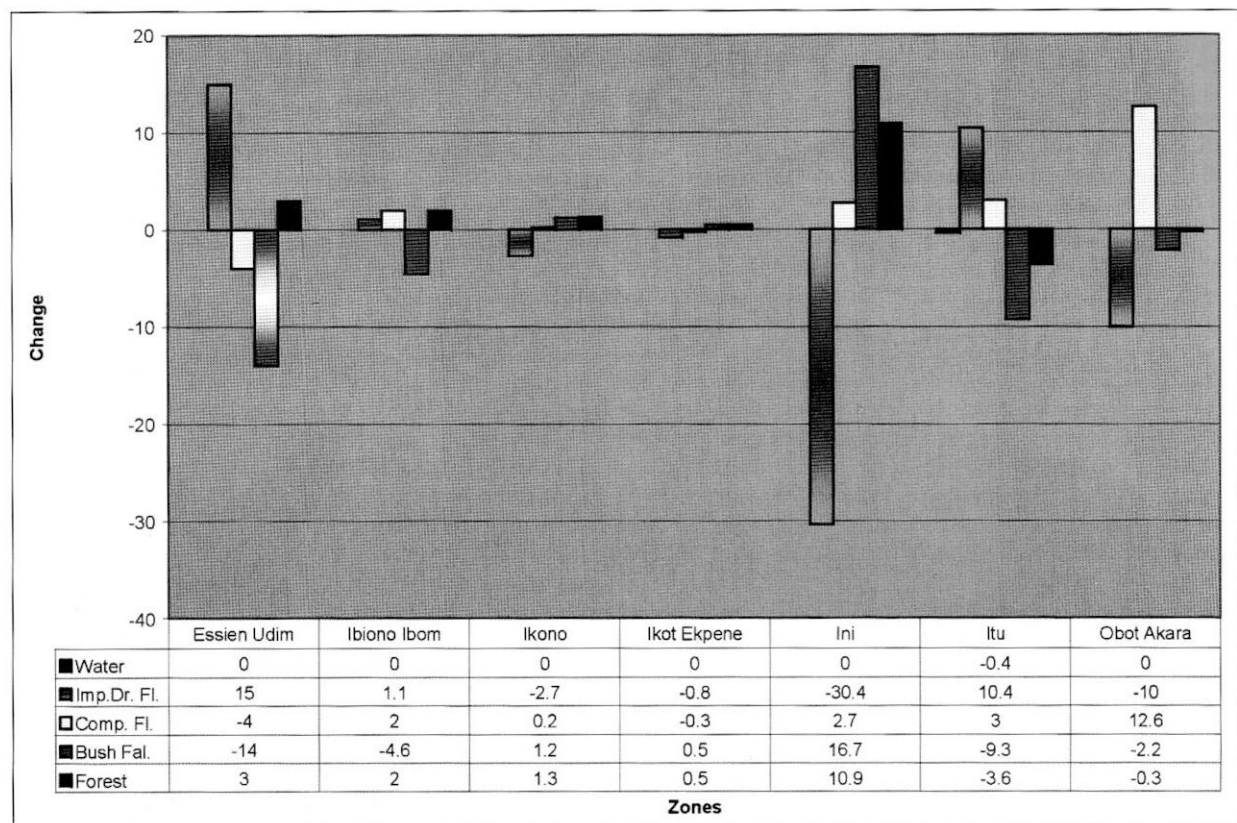


Fig. 5. Direction of Land Use/Cover Change.

Tab. 2. Land Use Change matrix (km²).

1986 Land Use/Cover	2003 Land Use/Cover				
	Open	Forest	Imperfectly	Compound	Bush
	Water	Drained Farmland	Farmland	Fallow	
Open	No				
Water	Change	0.00	0.41	0.00	0.28
Forest		No			
	0.00	Change	27.31	61.00	73.16
Imperfectly			No		
Drained			Change		
Farmland	0.61	11.00		48.02	141.00
Compound				No	
Farmland	0.00	0.00	0	Change	112.04
Bush					No
Fallow	1.42	83.33	153.57	171.60	Change

Bush Fallow: It is interesting to observe that this land use type has lost to all other LUC classes, but significantly to compound farmland. It has also witnessed less proportionate gains from all other classes. In Essien Udim, Ibiono Ibom, Itu and Obot Akara zones this change is very obvious. In Ini, during a field visit, the researcher came to the conclusion that the population had yet to recover from massive losses caused by the Nigerian civil war between 1967 and 1970 where many individuals were either killed or displaced. Therefore, the trend is likely that this zone

continue to be stable over the years, except within the imperfectly drained farmland which has witnessed serious human occupation induced by assistance from both Federal Government and International donor agencies.

On the whole, the land use/cover change index has shown that about 47% (905 km²) of the entire area has undergone significant change for the period 1986-2003. Most change has occurred within agricultural land use classes. Non agricultural lands have been relatively stable in comparison.

Social Survey

Socio-economic Characteristics

Information was collected on household basis, but owing to the difficulty of linking household data with the associated pixel information in the classified images, the available data was aggregated at administrative zones. Hence, each zone represents land administration units with many fields of similar biophysical conditions. As such, socio-economic information on the zones is a composite of households and therefore provides a good representation of the household level which is critical in land use and agricultural decisions.

The result of the social survey revealed that, of the 401 households visited, 40% had no formal education of any sort. The study further revealed that 73% of the rural population is dependent on agriculture followed by trading 19% and civil service 7%. This shows that the rural economy is undoubtedly driven by subsistence agriculture. Households are typically large, with 84% occupied by more than 7 persons per household. Despite this, income levels remain incredibly low with 23% of the farmers earning less than ₦21.00 a month and about 48% earning ₦25.00-₦42.00 a month.

Agricultural Practices

Information on past and present agricultural practices was also collected. The data clearly indicates that most rural dwellers undertake arable farming techniques. Although almost every household in the study area owns farm animals such as goat and sheep, it is never regarded as a serious business except for a very few commercial farmers with poultry or pig farms. The number of farm holdings per household was also examined, and the data suggests that about 58% of households have above 5 holdings, while 35% and 6% have between 3-4 and 1-2 farm holdings on an annual basis. On average most plots range from 0.5 to 2 hectares in size. By implication therefore, the land is highly fragmented – a factor that seriously inhibits farm mechanization in the area.

In terms of mode of land preparation, 95% of respondents stated that they adopted slash and burn techniques relying largely on family labour. This is a system whereby the farm plots are cleared using machete, cutlass, etc. during dry season and the chaff burnt to prepare the land for cropping at the onset of the rainy season usually around March. Interviews with government officials revealed no

conscious effort to restrict this form of land preparation despite acknowledging its negative environmental impacts. Information was also sought on the length of past and present fallow periods so as to determine the frequency of land use especially with the dominant slash and burn mode of land preparation. The general trend in all the zones indicates a reduction in fallow periods as is shown in Fig. 6. Population increase and land conversion to agriculture are largely responsible for such change in fallow periods.

Land Tenure and Policy Regulation

The system of land ownership more or less determines access to land and conditions of use. Over 90% of the respondents have individual ownership, but with patches of communal plots which are leased out to farmers during farming seasons. However, further findings from interviews and focus group discussions indicate that such community owned lands are relatively small or even non-existent in many communities. Therefore, land is mainly owned and controlled by individual families and regulated by heredity without central planning direction. Consequently, when the family head dies, the available landed property is shared amongst male children. This underlies the highly fragmented but multiple nature of farm holdings common in the area.

On land registration with the Local Government authority in charge of land matters as provided by the 1978 Land Use Decree, the results of this survey reveal that 'registration is not their usual practice'. The respondents stated that the rural dwellers manage their lands according to their needs with little or no interference from Government. When asked why this was the case, it transpired that the provisions of the land use decree was only invoked when the government required land for development purposes. Lack of good roads has been seen to present accessibility problems to most villages and therefore barriers to innovation diffusion and policy implementation. This has also been found to constitute a major problem to marketing of agricultural produce.

Technology Indicators

This is an indication of the use of techniques related to agriculture. The use of irrigation facilities, inorganic fertilizer application (as a measure of yield improving technique) and agricultural extension services were considered factors that could encourage agricultural intensification. This therefore, may help in explaining the relationship between land use change and agricultural practices in the area. Regarding use of irrigation facilities, it was noted that agriculture in the study area was entirely rain fed, hence subject to the vagaries of climate. Although attempts have been made around Ini zone and a few other places, to provide irrigation facilities for wetland rice cultivation, this has not progressed beyond the construction stage in most instances. Consequently, this has no significant contribution in intensifying agricultural activities in this area since farmers do not use the technique although there is need for it in the rice growing areas.

In terms of fertilizer application, although this was introduced into the area many years ago, the extent of adoption and actual use by majority of the farmers as

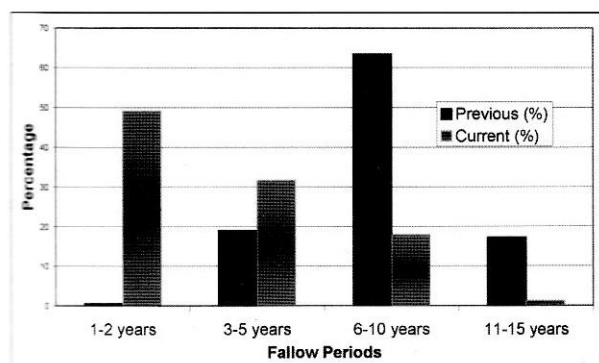


Fig. 6. Previous and Current Fallow Periods.

a yield improving technique is still very low. Information obtained from the survey revealed 77% non-application by local farmers. Follow up questions revealed that farmers would be willing to apply fertilizers to improve yield, but had not done so on grounds of cost and affordability. It was also widely acknowledged that government subsidies do not always reach the intended beneficiaries.

On access to agricultural extension services, about 75% of respondents indicated that they did not have access in any shape or form. The implication here is that, if most of the farmers do not have access to extension services despite recent investment by government, the likelihood is that they still rely on old methods and techniques only relevant when population did not bring to bear much pressure on land and resources. A previous study by Ituen et al. (2006) also reveals this trend indicating that farmers in remote areas have yet to benefit from such services. Even so, the only alternative means of livelihood which is trading still hinges on farm produce. At the final analysis, the farmers must keep on tilling the soil and extend cultivation to new areas whether there is commensurate yield or not.

Discussion

The results of the LUCC detection analysis suggest that compound farmland, which is primarily used for agricultural activities has expanded in all 7 zones, while bush fallow declined in most zones with a conversion to a range of other land use/cover categories (See LUCC matrix in Tab. 2). The gains of compound farmland over bush fallow and forest confirm the social survey result of reduction in fallow period with a range of 1-5 years across all zones. It is also clear that these two land use classes are annually subjected to slash and burn modes of land preparation with an encroachment on forest. Since about 77% of farmers do not apply fertilizer to their crops, they must be relying on natural sources of nutrient replenishment. In the face of highly reduced fallow period, nutrients are not being replenished before another round of slash and burn. This leaves the soil highly impoverished and exposed to erosion hazards and other agents of land degradation with very poor trade-off from investment. The only option left for the farmers is to extend cultivation to areas hitherto not used for agriculture. This often results in multiple holdings by individual farmers. The gradual process of agricultural extensification prevalent in the area, coupled with the discussed mode of land preparation is the underlying reason for the rapid land use change so detected. In non-agricultural LUC categories such as forest and open water, where this form of land preparation is not practiced, change has been very slow and the area relatively stable. An example is within Itu zone where about 60% of the forest in the study area occurs, with over 90% of this stable over time.

Many local farmers interviewed have argued that the slash and burn mode of land preparation have been in place for hundreds of years, and based on this, the system is sustainable. But evidence from this research points to pressure from population leading to increased need for land which obviously results in a reduced fallow period. It is important to note here that the only land management

option employed here is bush fallowing during which soil regains its nutrients. This works well when land is left fallow for a long period of time, but works badly during very short fallow periods as is increasingly the case in northern Akwa Ibom State.

Another big question is the level of illiteracy with over 40% of the population without formal education of any sort. This may work against adoption of agricultural innovations made possible by the agricultural extension unit of the ministry of agriculture. The high rate of inaccessibility to this very important service is therefore not a surprise. The ability to use a technique depends largely on an understanding of how it works and the benefits to be gained from adopting it. This should provide the motivation for the adoption of such technique. Also, with good educational background, the dangers of a given technique could be easily evaluated by farmers and the technique adjusted or changed as necessary. Local understanding is good, but not in isolation of scientific knowledge of the LUCC patterns and processes. Consequently, a combination of both helps meet new challenges and solve problems brought about by past practices.

On land use policy framework, likely policy indicators diagnosed reveal that the area should be regulated largely by the land use decree promulgated by the Federal Government of Nigeria in association with agricultural policies concurrently legislated upon by the three tiers of government. Under the land use decree, land ownership, registration, use and transfer, etc. are clearly defined. However, field evidence shows that this fails at the implementation stage. Policies on land use are therefore loosely applied. Land owners do transfer ownership, convert to different uses and utilize whatever techniques best suit their needs with disregard to sustainability and also with little or no regulation from government. The rural areas here lack central planning direction, hence the unfolding rural planning problems. Government only gets involved when land is needed for location of projects. This has implications for land use/cover change. First, absence of serious regulation of land use means land owners can adopt any technique or rather use their plots as they like without recourse to repercussions. Second, since most farmers live below the poverty line and with large families to support, they may be under pressure to make outright sales thus transferring ownership to panic buyers who need land within rich agricultural areas for purposes other than agriculture. The undue flexibility of the policies therefore leads to land conversion. This in part explains huge expansion detected in areas used for compound farmland in most of the zones studied.

Conclusions

Without doubt, land use/cover change in the area is mainly due to agricultural practices particularly induced by a combination of reduced fallow period and slash and burn mode of land preparation. Over 70% of the rural population depends on this, most of who live below poverty line and without alternative means of livelihood. If agricultural practices are brought under control, undesirable LUC change could be checked.

Agricultural extension services, which should help in the diffusion of agricultural innovations and sustainable use of agricultural lands, have been inaccessible to most farmers. In view of the illiterate status of most of these farmers and the poor conditions of roads and other basic amenities, any investment on such extension services without first and foremost improving the infrastructure base in the rural areas may have little or no impact. Again, further increases in population (as seem imminent in view of the current growth rate) without deliberate intervention is likely to have multiplier effect on land with repercussions on the farming population.

From field evidence, land use and agricultural policies have been found to be loosely enforced and therefore fail to regulate against unauthorised use, modification and conversion leading to land use/cover change which often results in severe degradation. Moreover, this trend is likely to continue and at a faster rate since nothing is being done by related agencies to take advantage of the availability of remote sensing data and analytical capabilities of GIS in understanding land use/cover change scenarios and the associated driving forces in this area.

Recommendations: Towards sustainable agriculture

Based on the numerous problems identified in this area which hinge on sustainable rural development, efforts should aim at rural transformation through the development on infrastructure base that will help diversify the rural economy and ease pressure on land. Currently, the rural population depends solely on agriculture which, with the present rate of low productivity results in agricultural extensification.

Secondly, agro-based small-scale industries should be established to provide alternative means of livelihood to the rural poor. With the current level of poverty, individual farmers are however not likely to be able to pursue this. As such, formation of cooperative societies would help in this respect. Such cooperatives will also act as centres for the diffusion of the much needed agricultural innovations and extension services, and in addition facilitate acquisition of credit facilities.

Agricultural programmes designed to meet the needs of rural populations should be more participatory both in principles and practice. The present top-down approach clearly fails to reach the intended beneficiaries before such programmes collapse. If the intended beneficiaries are part of the programme from inception, they can lay claims, and as such know how best to protect and make it grow for their benefits. In the same way, effective monitoring and feedback mechanisms on land use and agricultural policies, programmes and projects will be effective in boosting our rural economy and by so doing help stem the tide of undesirable land use/cover change in order to deliver a sustainable landscape.

Finally, remote sensing and GIS should be integrated into land use planning process in view of huge benefits derivable from such techniques. With these techniques, a combination of information from LUCC, land suitability assessment and social survey such as demonstrated by Ituen, et al. (2006) proves quite useful in land allocation decisions as well as managing future growths in land use.

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