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IMPACT OF ROAD DUALIZATION ON RESIDENTS OF OGBOMOSHO, OYO STATE, NIGERIA FOR SUSTAINABLE URBAN DEVELOPMENT

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Abstract : Road development enhances easy movement of people and vehicles. This paper aims at determining the impact of road dualization on residents of Ogbomosho town in Oyo State, Nigeria for sustainable urban development. Specifically, it examines the socio-demographic characteristics of the respondents ; identify factors that necessitate the need for road dualization ; evaluates the perception of the residents on the effect of the dualization of road on them ; and evaluates the facilities provided through road dualization project in the study area. Both primary and secondary sources of information were employed to collect data. Systematic random sampling technique was employed to select a total of 400 house hold heads. Tables, frequency counts, simple percentages and mean scores wereused to analyze the gathered data. Likert scale was also used in scaling the perceive deffects of road dualization on the residents. Findings revealed that increase in number of vehicles whichled to traffic congestion is the main factor for road dualization. Hence, demolition of buildings for road expansion has led to increase in cost of shops and living house rentage, air, noise and water pollution and reduction of socio-cultural ties. Road dualization has however provided improved transportation network (x=3.86) and provision of street light (x= 3.81) which has led to reduction in traffic congestion and lighting of the area in the night. Recommendations made include development of strategies by the government towards achieving comprehensive and more acceptable road dualization project. Public relation activities should be brought for wardin to urban and regional planning.

Key words: Residents, road dualization, road transportation, urban development and urban renewal

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INTRODUCTION

The spatial effects of landuse and transport planning on urban development have attracted the attention of urban planners. This is tied to rapid population growth and urban sprawl in most developing countries including Nigeria. According to Oyesiku (2011), infrastructural innovation and sustainable urban practice have become more difficult because most urban centers in Nigeria were planned before the establishment of regional town planning. Nigeria as a developing country is faced with a lot of problems such as rapid urbanization, poor infrastructure and ever increasing

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urban slums (Gbadegesin and Aluko 2010). Hence, the built environment in the country is fast degenerating. Osuide and Dimuna (2005) observed that the urbanization process in Nigeria is not accompanied with a corresponding supply of adequate infrastructure, houses and basic amenities. The Draft National Urban Development Policy (NUDP, 2004) noted that Nigeria towns are growing without adequate planning. Most buildings in the urban built environment are non-compliance with building bye-laws and regulations. These problems are however manifested physically, economically and socially. Physically, deteriorating urban areas exhibit poor sanitation, accumulation of refuse, effluent discharges and dust among others. From the economic perspectives, Nigerian cities are growing in population whereas the urban economic base of those cities is weak and declining. The concomitant development of urban sprawl on the fringes of any city has compounded the problem of unplanned residential neighborhoods which tend to destroy the scenic beauty of the city. From the social perspectives, urban decay deals with very high economic situations leading to prevalence of diseases, prostitution, high crime rates and violence among others. All these problems make city life insecure, thus forcing residents to flee from the city center to the fringes and countryside. In order to solve some of these problems, road dualization becomes very important. Hence, this study focuses on determining the impact of road dualization on residents of Ogbomosho, Oyo State, Nigeria. The study specifically examines the socio-demographic characteristics of the respondents; identifies factors that necessitate the need for road dualization; evaluates the perception of the affected residents on the effect of the dualization of road on them; and assesses the facilities provided through road dualization project in the study area.

Urban Development Policy and Sustainability

Mobility as well as transportation remain two important features in most Nigerian cities. Most cities in Nigeria are confronted by serious traffic congestion. To ensure good urban development that will be sustainable, easy movement of goods and people should be given priority in urban policy. In the urban development process, values, qualities and other attributes of the urban centers should be put into consideration so as to ensure sustainable development in the urban areas. Furthermore, city's identity, environmental, social and cultural concerns must be given special attention in the process of urban development (Herman, 2009a, b; Herman et al., 2017, 2018; Ilieș et al., 2013).Urban redevelopment such as road dualization means social and technical partnership based on the unification of the vision of politicians and designers. It is thus a multifaceted and complex process which should not be viewed merely as a physical and financial proposition, but as sociological, cultural, economical and political matter (Couch, 1990). According to Layard et al., (2012), town planning is the development of a local life, a regional character, a civic spirit, a unique individuality capable of improvement and development in many ways. Hence, the fundamental prerequisite to the success of any development is the complete integration of these programs with the general plan of the urban area (Miller, 1959).

The Study Area

The study area of this research work is Ogbomoso which is one of the urban centers in Oyo State. Ogbomoso is located between latitude 8°8'0″ North of the equator and longitude 4°16'0″ East of the Greenwich meridian (figure 1). It is 140 km North East of Ibadan, 58 km North West of Osogbo, 57 km South West of Ilorin and 53 km North East of Oyo (Oyo State Ministry of Land and Survey, 2016). It is located on the high way connecting North and South of Nigeria on the West flank (Adetunji et al., 2018). Ogbomosho is the second largest city in Oyo State and the 12th largest city in Nigeria (Kabiru et al., 2014). Ogbomoso has a tropical climate. In winter, there is much less rainfall than in summer. The average annual temperature in Ogbomoso is 26.2 °C while average annual rainfall is 1216 mm.[1]The rainfall ranges between 1000 and 1500 millimeters. The

[1]*http://en.climatedata.org/location/399286/*

relative humidity is 60% on the average and the mean annual temperature range is wider about 5°C (Kuponiyi et al., 2010). As a matter of fact, Ogbomoso town forms part of the Western upland of Nigeria. It has an elevation of about 600 meters above sea level. The relief of the area is moderate with low forested hills but occasionally very steep sided ridges rise abruptly from the surrounding country. The main water shed is located at about 20 km North and 10 km East of Ogbomoso. South west of this water shed is "Oras" river with its tributaries flowing southwards and runs only west of Ogbomoso (Adetunji et al., 2018).

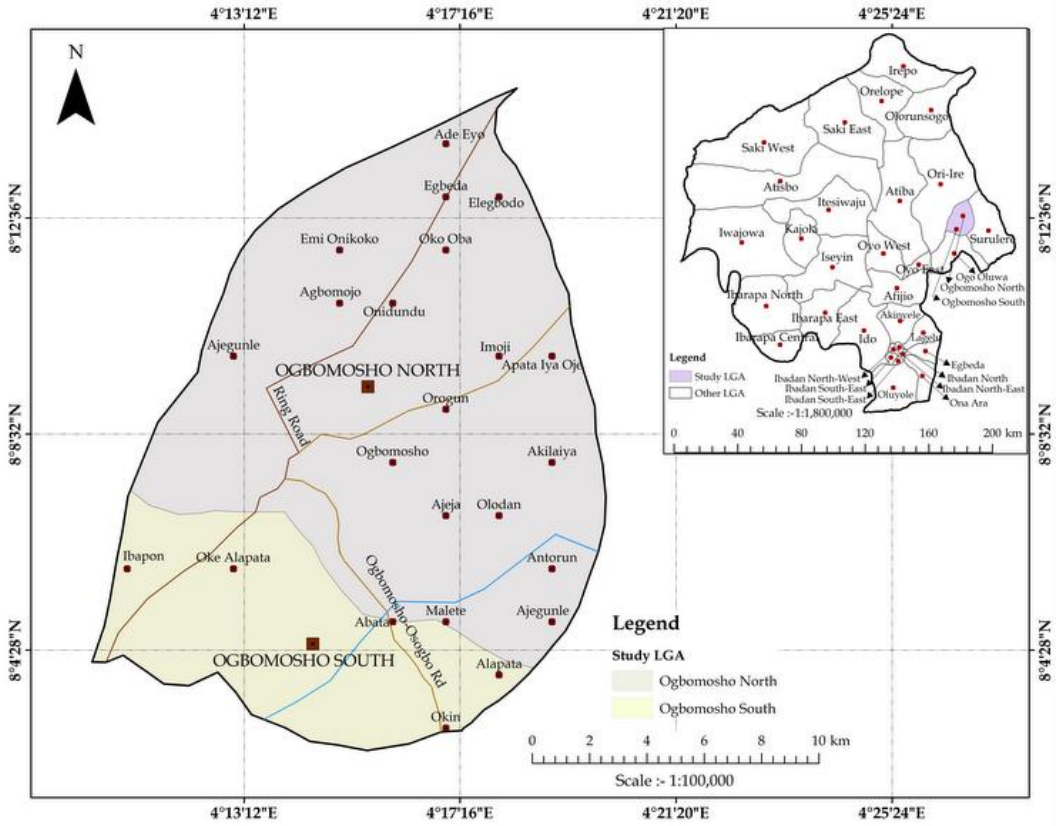

Figure 1. Map of Ogbomoso (Inset: Map of Oyo State Showing the Study Area)
Source: Oyo State Ministry of Lands and Survey, 2016

The vegetation shares some characteristics with Guinea Savannah. The city of Ogbomoso comprises Ogbomoso North and Ogbomoso South inhabited by a significant proportion of the urban population in the state, which according to National Population Commission (2006) was put at 299,535. The people of Ogbomoso engage in various economics activities of which the major one is trading and farming.

Materials and Methods

Primary and secondary sources of data generation were employed to gather the needed data for the study.These include questionnaire administration and personal observation. In Ogbomosho, the 2014 voters registration put the total number of registered voters to be 56,693 and 81,792 (INEC, 2014) in Ogbomosho North and South respectively. Sample size was however determined with the: N=population size; e= level of significance (0.05); thus n=400

use of Yamane (1967:886)'s formula cited in Isreal (1992):

$$n = \frac{\mathrm{N}}{1 + \mathrm{N}\,(\mathrm{e})2}$$

Where:
n= required sample size
N=population size
e= level of significance (0.05)
thus n=400

Hence, a total of 400 respondents were sampled with copies of questionnaire. Systematic random sampling technique was used to select every fifth building on the main road under dualization. Household heads were the target until a total of 400 house heads were sampled. Simple percentages, bar charts and likert rating scale (mean scores) were used to analyze the collected data to achieve stated objectives.

Results and Discussion

Socio-demographic Characteristics of Respondents

The study consists of 55.3% males as against 44.7% females (see table 1). This may be attributed to the fact that larger percentage of males drive vehicle than their female counterparts. This is similar to Adebayo (2005)'s report that larger percentage of males drive vehicle than the females. The result on table 1 further shows that 63.7% of the sampled respondents are married, 17.8% divorced, 12.5% single, 3.7% widowed, and 2.3% separated. This means that majority of the sampled respondents are married with family to move on daily basis either to work, market, school among others.

The age distribution as shown on table 1 reveals that majority (95.8%) of the sampled respondents are within the age bracket of 18-48 years which is the economic active age group hence, the need to move to carry out their economic activities on daily basis. The level of education as depicted on Table 1 shows that 96.8% of the respondents are educated while only 3.2% do not have formal education. The occupation structure of the sampled respondents includes civil servants (36.5%), artisans (21.3%), self-employed (20.0%), retirees (15.5%), and students (1.7%) (table1). The structure of the occupation depicts that the study area is fast urbanizing. This is in support of Harvey (2000) who submits that urbanization means heterogeneity of occupation. Income level of the sampled respondents reveals that 88% of the respondents earn less than N 50, 000 per month.

Table 1. Socio-demographic Characteristics of the Respondents
(Data sources: Authors' fieldwork 2016)

Characteristics	Frequency	Percentage	Cumulative Percentage
Sex			
Male	221	55.3	55.3
Female	179	44.7	100.0
Total	400	100.0	
Age of Respondents			
18-27 years	64	16.0	
28-37 years	125	31.3	47.3
38-47 years	194	48.5	95.8
48- and Above	17	4.2	100.0
Total	400	100.0	
Marital Status			
Married	50	12.5	12.5
Single	225	63.7	76.2
Divorced	71	17.8	94.0
Separated	15	3.7	97.7
Divorced	9	2.3	100.0
Total	400	100.0	
Level of Education			

No formal education	44	11.0	11.0
Primary Education	56	14.0	25.0
Secondary Education	287	71.8	96.8
Post Secondary Education	13	3.2	100.0
Total	400	100.0	
Occupation			
Retired	62	15.5	15.5
Self Employed	80	20.0	35.5
Civil Servant	146	36.5	72.0
Artisan	85	21.3	93.3
Trader	20	5.0	98.3
Others	7	1.7	100.0
Total	400	100.0	
Monthly Income			
Below 10,000	40	10.0	10.0
10,100-30,000	199	49.8	59.8
30100-50,000	113	28.2	88.0
50100-Above	48	12.0	100.0
Total	400	100.0	

Factors responsible for Road Dualization

The study reveals that 35.5% of the respondents indicated traffic congestion as a result of increase in number of vehicles is the most pressing factor that necessitated the need for road dualization in Ogbomosho. This is in support of Gbadegesin and Aluko (2010) that rapid expansion of cities and improper planning (figure 2) has led to serious traffic congestion in most Nigerian cities.

Figure 2. Taki Road and the Drainage System before the road dualization (Improper planning)

Figure 3. Demolished building for road expansion

Furthermore, other factors indicated by sampled respondents include: 22.8% indicated housing congestion, limited infrastructure was selected by 19.8% of the respondents, 19.0% also indicated decay of the available road facilities while others such as economic factors and modernization were indicated by only 3.0% of the sampled respondents. Hence, demolition of buildings (figure 3) for road expansion has led to increase in cost of shops and living house rentage, air, noise and water pollution and reduction of socio-cultural ties.

Perception of the residents on the effect of road dualization

From the study, the effects of road dualization on residents and the environment are both positive and negative. However, it was observed from the respondents that the positive impacts are more than the negative impacts. Table 2 depicts the perception of the residents on the effect of road dualization (figure 4) on them and the environment. From the table, larger percentage

(87.5%) strongly agrees that it has improved transportation network in the area with a mean value of 3.86. There is an improvement in transportation network in the sense that there is no traffic congestion again in the area. Also, 81.3% strongly agrees it has led to provision of street light (figure 5) with a mean value of 3.81 (table 2). This means the area has no street light before road dualization. Furthermore, 68.5%, 67.5% and 66.3% strongly agree that it has assisted in the quality of buildings (housing) with a mean value of 3.70, beautification of the environment with a mean value of 3.63 and construction of drainages with a mean value of 3.63 respectively (see table 2).

Figure 4. Road under construction

Figure 5. The dualized road with street light, drainage, and other facilities

Other factors perceived by respondents as effects of road dualization on the residents and environment include: Improved security (x=3.52), Social ties (x=3.32), increment in the cost of shop and house rentage (3.18), disruption of economic activities (x=3.09), Homelessness (x=2.98) and pollution through air, noise and water (x=2.81).

Table 2. Perception of the residents on the effect of road dualization
(Data sources: Authors' fieldwork 2016)

Perception	Strongly Agree	Agree	Disagree	Strongly disagree	Undecided	Mean	Rank
Improved transportation network	350 (87.5%)	45 (11.2%)	5 (1.3%)	0	0	3.86	1st
Provision of street light	325 (81.3%)	75 (18.8%)	0	0	0	3.81	2nd
Improvement in housing quality	274 (68.5%)	113 (28.2%)	13 (3.3%)	0	0	3.70	3rd
Beautification of the environment	270 (67.5%)	1 10 (27.5%)	20 (5.0%)	0	0	3.63	4th
Construction of Drainages	265 (66.3%)	130 (32.5%)	0	0	5 (1.3%)	3.63	5th
Improved security	265 (66.3%)	79 (19.8%)	56 (14.0%)	0	0	3.52	6th
Social ties	230 (57.5%)	95 (23.8%)	50 (12.5%)	23 (5.8%)	2 (0.5%)	3.32	7th
Increment in cost of Rentage	188 (47.0%)	109 (27.3%)	89 (22.3%)	13 (3.5%)	0	3.18	8th
Disruption of Economic Activities	168 (42.0%)	112 (28.0%)	109 (27.3%)	11 (2.8%)	0	3.09	9th
Homelessness	107 (26.8%)	191 (47.8%)	87 (21.8%)	15 (3.8%)	0	2.98	10th
Pollution (air, noise & water)	84 (21.0)	184 (46.0%)	105 (26.3%)	27 (6.8%)	0	2.81	11th

Note: Strongly Agree=4; Agree=3; Disagree= 2; strongly disagree=1; Undecided=0

Facilities provided through road dualization project in Ogbomosho

Various facilities were provided through road dualization in the study area. According to Aderamo (1990), road facilities are drainage, parking, road signs, street lights, traffic lights, pedestrain crossing among others. From the study, it was discovered that the following facilities were provided through the dualization project. These include: drainage facilities which help in reducing flood, parking facilities to control traffic congestion and road accidents, road signs which direct the road users especially the drivers, street light to provide illumination and security against different crimes like kidnapping, robbery and provision of traffic wardens within the segments of the roads.

CONCLUSION

The study has been able to establish the fact that road dualization is an activity that contributes to rapid urbanization and development process in the area. Although, in the course of road dualization, buildings consisting of houses and shops along the road to be dualized were demolished but the positive impacts outweighs the negative impacts. It can therefore be concluded that for any redevelopment scheme or project to be successful, the stakeholders (residents, government and contractor) have a great role to play. It is based on this study that the following recommendations were made: strategies should be developed by the government towards achieving comprehensive and more acceptable road dualization project that is sustainable. Public relation activities should be brought forward into urban and regional planning. This type of road dualization should be replicated in other urban areas experiencing heavy traffic congestion in Nigeria.

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URBAN TRANSPORT SECURITY: ANALYSIS OF TRANSIT CRIME IN OSOGBO, NIGERIA

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Abstract : The paper assesses transit crimes in Osogbo, Nigeria. Six political wards were selected across the residential areas of the town and a questionnaire was administered on 450 respondents. Data were analysed using percentages, the Relative Importance Index (RII) and Chi-Square tests. The study found that pickpocketing, armed robbery, and assault and battery were among common transit crimes in Osogbo, and that transit crime vulnerability varied by mode. A significant relationship was found between transit crime experience and socioeconomic characteristics. Poor policing, economic hardship, poor street system and the absence of CCTV topped the chart of causes of transit crimes. The commercial motorcycle was the least secure transport mode, while official vehicles were the most secure mode. Furthermore, security agencies were rated very low in transit security provision. Based on the findings, policy recommendations are proffered to enhance urban transport security in the city.

Key words: transit crime, transport security, okada, korope, Osogbo

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INTRODUCTION

Urban transport security is arguably one of the most important factors that influence a lot of decisions about urban dwellers' travel behaviour. This is because in many cities of both developed and developing countries of the world, many intra-urban travellers have been victims of transit crime. Crimes such as rape, kidnapping and/or abduction, robbery, carjacking, car theft and even terrorism are perpetrated in transit. Indeed, at times, even fellow passengers perpetrate these criminal acts as not everyone that boards a vehicle is a genuine traveller. Experience has shown that criminals sometimes pose as travellers with the ulterior motive of victimising co-passengers. Little wonder then that security issues have been identified among the major challenges facing urban transport (Mercier-Handisyde, 2009).

Security issues in transit involve intrusion or attack, that may or may not include physical harm, that travellers are susceptible to in the course of their trip (Korver et al., 2012). There is also the place of safety in security considerations as security issues could degenerate into varying degrees of safety issues. For instance, the crime of unlawful driving practices can raise safety concerns, especially when accidents result. Besides, in an attempt to outsmart waylayers, the driver can end up involving the vehicle in an accident which then becomes a safety issue. Also, according

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to Omidiji and Ibitoye (2010), crime and criminalities contribute to road traffic crashes in public transportation. This is the main rationale for discussing urban transport safety and security issues jointly (Olojede et al., 2017). In many developing countries, studies on transport security have recorded a noticeable upsurge in the incidences of urban transit crime, particularly in the last two decades. In cities across most developing societies, the risk to lives and properties are becoming regular features on transport routes and terminals. Routine trips using public transit infrastructure can result in being mugged, robbed, or kidnapped (Ajayi and Ajayi, 2014). Harassments, murder, assaults, injuries, as well as loss of lives and properties, among other risks, are also identified by Odufuwa (2012a) as being among the persistently experienced transit crimes. It is such that crime incident is one of the greatest challenges facing public transport system in both developed and developing countries (Uittenbogaard, 2014).

Basically, transport insecurity is vulnerability to intentional criminal or antisocial acts suffered by those engaged in trip making. This could be property crime, violence (assault and threat), rape, sexual harassment, insult, murder, kidnapping and vandalism (Uittenbogaard, 2014). Also, according to Litman (2014), crime statistics may include violent crimes, all crimes against passengers and employees, or all transit-related crimes, a major portion of which involves trespassing, transit property vandalism and fare evasion. Extant literature and previous studies on transit crime have done justice to the exploration of the foregoing.

In a study by Uittenbogaard (2014) on crime in underground stations in Stockholm, Sweden, it was found that there were temporal dimensions to the occurrence of crime by type: theft was most common in the afternoon, vandalism in the evening, and violence at night. Furthermore, frequency of crime occurrence seems to be closely related with routine activities of individuals. Another important aspect of urban transport security has to do with drivers, as they have been found to be at a height of insecurity and vulnerability to transit crimes. Drivers in this context comprise the drivers of commercial and/or public, professional drivers (those who drive fleets and company vehicles), as well as private vehicles, chauffeurs inclusive. On a daily basis, they are exposed to such transit crimes as carjacking, car theft, robbery, aggression, abduction, and even murder. Cases abound of drivers being killed in the course of transit crime. Literature is replete with studies on drivers' security with the conclusion that they stand a high risk of transit crime (Couto et al., 2009, Klima, 2011; Lauer, 2005; Stanley, 2015; U. S. Department of Labor Occupational Safety and Health Administration, 2000).

Odufuwa (2012b) explored the gender perspective of criminal activities in public transport in Lagos metropolis, Nigeria. Among other things, the study addressed and discussed the question of how women are affected by insecure public transportation services as manifested in injuries, harassment, rape and other forms of assault experienced by women when using public transport. Ajayi and Ajayi (2014) also examined the trend analysis of crime incidences and crime vulnerability differentials on urban transport facilities in Ibadan, Nigeria. They analysed the temporal pattern of crime incidences across five selected bus stops and the variables that may likely determine the chances of becoming crime victims in the city. The research also examined the nature of criminal activities prevalent in the bus stations, analyzed the pattern of crime victim targeting in the selected bus stations, and made comparative analyses between the incidences and the nature of criminal activities in and around the stations. They found, among other things, that the risks of a passenger becoming a crime victim were heightened as a female. They also found that the time of the day when a travel is embarked on goes a long way in determining how secure the trip maker can be.

In their trans-regional study that traversed the three states of Kwara, Kogi and Ekiti in Nigeria, Omidiji and Ibitoye (2010) found, among other things, that transit crime (armed robbery, specifically) often leads to crashes. The study also revealed that criminals board vehicles along with unsuspecting passengers, at times disguising as clergymen who would start by preaching the gospel before suddenly unleashing havoc on passengers on board. Consequent upon this, commotion ensues leading to loss of vehicle control and ultimately resulting in road

traffic crashes. In addition, it was found that mechanical deficiencies in vehicles, potholes and other poor road conditions, apart from causing road traffic crashes, also enhance the operations of the hoodlums on the highways.

Olojede, Daramola and Olufemi (2017) examined the safety and security of intra-urban transport in Ilesa, Nigeria. They found, among other things, that the vulnerability of trip makers to transit crime varied by mode. It was also found that owners of private cars were the most secure group of trip makers, while commercial motorcycle passengers and pedestrians were found to be the most vulnerable groups to transit crimes. Furthermore, the agencies responsible for traffic control and management were found to be wanting in some key functions with implications for urban transport safety and security. However, inasmuch as the study combined safety and security issues certain significant issues that could enhance our understanding of transport security were not explored. For example, while the study was able to assess the efficiency of traffic control and management agencies in the study area in terms of transport safety. However, almost nothing was reported on the efficiency of security agencies.

From the foregoing, it is clear that transport security is mostly influenced by such factors as gender, time of the day, road condition, travel mode, route condition, and human factors, among others. The aim of this study was to examine the extent to which these factors influence urban transport security in Osogbo, a state capital in Nigeria. The paper constitutes an attempt at bridging part of the existing gap in previous studies. It also examines the extent to which the findings of the previous studies were replicated in the city. A good understanding of the phenomenon of urban transport security in Osogbo would no doubt help in engendering efficient urban transport not only in the city but also in cities of comparable status.

STUDY AREA

Osogbo is the capital city of Osun State in Nigeria, a status it attained on the 27th August, 1991. However, even before gaining its current status as a state capital, Osogbo had been an important centre of administration, trade and commerce for so many years. Osogbo is situated between latitudes 7.4°N and 8.0°N, and between longitudes 4.3°E and 4.4°E of the Greenwich Meridian. The city seats the headquarters of both the Osogbo and Olorunda Local Government Areas. However, being a state capital, its territory is fast encroaching on a number of abutting local government areas. By road Osogbo is about 88 kilometres northeast of Ibadan the Oyo State capital, 100 kilometres south of Ilorin the Kwara State capital, and 115 kilometres northwest of Akure the Ondo State capital. By virtue of its regional centrality Osogbo is easily accessible from almost any part of the state. The city has a population of about 156 694 people, according to the figures of the 2006 national population and housing census, with an annual growth rate of 3.5%.

Even though a railway line traverses a part of the city, there is no intra-city train shuttle service. Also, despite the fact that River Osun, the non-navigable river after which the state is named, passes through Osogbo, the city is landlocked with no possibility of inland water transport. As such, Osogbo can be said to be a mono-modal city as road is the only operative mode of transport at present. There is no conventional mass transit system in Osogbo. Instead, two major types of paratransit systems are available in the city: korope (a small jitney that has the capacity of conveniently conveying about seven passengers), and ọkada (a popular local name for a commercial motorcycle). The koropes ply the major paved roads, while okadas are quite ubiquitous on both major and local roads.

The majority of residents in Osogbo travel by foot. However, walkways are conspicuously non-existent in the city. It is thus evident that provision is hardly ever made for pedestrians in transportation facilities investments in Osogbo. Also, there are no cyclist lanes in the city. A similar finding was made in Ilesa, a close by town, in an earlier study by Olojede, Yoade and Olufemi (2017). As such, vulnerable toad users (pedestrians and cyclists) share the transit corridors with motorists. To a large extent, on-street parking is controlled during working hours. However, the moment traffic workers close for the day, on-street parking becomes rampant.

SAMPLING PROCEDURE

The sampling employed for this study was household based. Inasmuch as neither the number of houses nor the number of households in the city is available, the ward delineation popularly used for administrative convenience, pioneered by the Independent National Electoral Commission, was employed. According to this delineation, there are 19 wards in Osogbo. These 19 wards have been grouped by the town planning authorities in the two main local government areas in the town into the low-, medium- and high-density residential areas. There are six wards in either of the low- and high-density areas, while the medium-density area is made up of the remaining seven wards. From each group of wards, one of four (25%) was randomly selected without replacement. Thus, two wards were selected from each of the residential density groups to give a total of six wards. From each ward, 75 households were randomly selected without replacement. Thus, 450 households were covered by the study. In each selected house a household was randomly conveniently picked and any available adult was surveyed. Of the 450 questionnaires administered, 432 were deemed usable by the study. This made the response rate to be 96.0%.

DATA ANALYSIS

Data obtained from the study were analysed using percentages and the Relative Importance Index (RII), which was employed to analyse, operationally, three different variables with a view to measuring either their relative importance or frequency. These variables are the Relative Security Index (RSI), used to assess residents' perception of the relative security index of each transport mode; the Relative Efficiency Indicator Index (REII) used to assess respondents' perception of the relative efficiency of security agencies in the performance of their duties, and the Transit Crime Cause Relative Frequency Index (TCCRFI) used to assess respondents' perception of the relative frequency index of each cause of transit crime in the city. These parameters were selected based on a synthesis of indicators or factors found in the reviewed literature as those determining or influencing urban transport security.

The indices were computed following a process similar to that of RII. Similar uses of the RII are obtainable in such studies as Afon (2000 and 2006), Sambasivan and Soon (2006), Olojede, Daramola and Olufemi (2017), and Olojede, Yoade and Olufemi (2017). The respondents were asked to rate each of the variables of interest following the principle of the Likert Scale (Likert, 1961). In each case, the scale was from 1 to 5 in a descending order of significance (Very High, High, Average, Low, and Very Low) or frequency (Always, Very Often, Often, Rarely, Never), as the case may be. The Total Weight Value (TWV) for each variable was obtained through the summation of the product of the number of responses for each rating of the variable and the respective weight value. This is mathematically expressed as follows:

$$TWV = \sum_{i=1}^{5} NiWi$$

where:

N_i = the number of respondents rating a particular variable, and

W_i = the average weight value assigned to the variable by the respondents.

Thus, for example, the TCCRFI for each transit crime cause was computed by dividing the summation of the respondents' responses to each of the five ratings on the cause by the product of the highest weight attached to the value and the number of respondents. This is mathematically expressed as follows:

$$TCCRFI = \frac{TWV}{\sum_{i}^{5} A \cdot Ni}$$

The closer the TCCRFI of a cause is to 5, the stronger the respondents' rating of such a cause as of transit crime in Osogbo, and the farther it is from 5 the weaker the rating of respondents of such a factor as a cause of transit crime in the study area. Other variables were measured in a similar way, and are interpreted as accordingly.

RESULTS AND DISCUSSION

Socio-economic Attributes of Respondents

The socioeconomic attributes of the respondents are as presented in table 1.

Table 1. Socioeconomic Attributes of Respondents
(Data source: Author's Field Work, 2017)

Socioeconomic Attribute	Freq.	%	Socioeconomic Attribute	Freq.	%
Gender			*Occupation*		
Male	182	42.1	Schooling	22	5.1
Female	250	57.9	Civil Service	166	38.4
Marital Status			Artisanship	126	29.2
Single	142	32.9	Business	105	24.3
Married	288	66.7	Senior	13	3.0
Widowed/Divorced/Separated	2	0.4	*Private Vehicle Ownership*		
Education			Yes	154	35.6
Primary Education	13	3.0	No	278	64.4
JSS Education	28	6.5	*Household Income (₦)*[1]		
SSS Education	72	16.7	<50,000	35	8.1
ND/A-Level/NCE	84	19.4	50,000-100,000	159	36.8
HND/First Degree	183	42.4	101,000-150,000	120	27.8
Postgraduate	52	12.0	151,000-200,000	78	18.1
Religion			>200,000	40	9.2
Christianity	203	47.0	*Age (in years)*		
Islam	229	53.0	<21	15	3.5
Household Size			21-30	102	23.6
≤ 4	139	32.2	31-40	120	27.8
5 – 6	235	54.4	41-50	123	28.5
7 – 8	53	12.3	51-60	55	12.7
≥ 9	5	1.1	61-70	17	3.9

According to table 1, 42.1% and 57.9% of the surveyed residents in the study area were male and female respectively. Information obtained on their marital status indicates that 32.9% were single, 66.7% were married, while the remaining 0.4% were widowed, divorced or separated. As for their education, 3.0%, 6.5%, 16.7%, 19.4%, 42.4% and 12.0% had a primary education, junior secondary education, senior secondary education, an A-Level equivalent, higher national diploma/first degree, and a postgraduate qualification respectively. A cursory look at the education background of the respondents is a pointer to the fact that they should be able to prioritise transport security and its ramifications.

Table 1 also provides an insight into the religious inclination of the respondents. According to the table, 47.0% of the respondents were Christians while 53.0% were of the Islamic faith. The occupational distribution of the respondents indicates that 5.1% were students, 38.4% were civil servants, 29.2% were artisans, 24.3% were engaged in business, while the remaining 3% were retirees/pensioners. Hence, it can be seen that there are more civil servants than any other category of workers in Osogbo. In addition, as presented in the table, 35.6% of the respondents had personal vehicles, while 64.4% did not have private vehicles. This shows that the majority of the respondents were captive riders as private vehicle ownership in the town is rather low.

Further analysis of table 1 reveals that the majority of the respondents' households belonged to the 50,000 - 100,000 naira monthly income category, just over 9% earned over 200,000 naira per month, while 8.1% of the households earned less than 50,000 naira monthly. The age distribution of the respondents shows that there is almost a balanced spread. Except for 3.5%, 3.9% and 12.7% of the respondents who belonged to the less-than-21, 61-70 and 51-60 age brackets respectively, each of the other age groups had over 20% of the respondents.

[1] As of 10th September, 2018, a US dollar (US$1) exchanged for Nigerian 363.44 naira (₦[2] 363,44) officially.

Respondents' Latest Experience of Transit Crime in Osogbo

Both the firsthand and secondhand latest experiences of the respondents as far as urban transit crime was concerned were as presented in table 2. In this context, a firsthand experience is one the respondent was a direct victim of, while a secondhand experience is one to which the respondent was a witness.

Table 2. Respondents' Latest Experience of Transit Crime
(Data source: Author's Field Work, 2017)

SN	Type of Crime	Latest Experience			
		Over 6 months	Last 6 months	Last 3 months	Last 1 month
1.	Pickpocketing	8.2%	4.4%	10.5%	21.1%
2.	Armed Robbery	3.2%	1.9%	2.4%	1.1%
3.	Assault and Battery	1.6%	2.2%	6.6%	5.7%
4.	Rape/Sexual Harassment	2.3%	4.1%	12.1%	8.5%
5.	Kidnapping/Abduction	9.4%	6.6%	5.5%	2.3%
6.	Carjacking/car theft	1.1%	2.3%	1.2%	1.4%

According to table 2, 8.2%, 3.2%, 1.6%, 2.3%, 9.4% and 1.1% of the respondents had witnessed or been victims of such transit crimes as pickpocketing, armed robbery, assault and battery, rape or sexual harassment, kidnapping or abduction, and carjacking or car theft respectively over the past six months; 4.4%, 1.9%, 2.2%, 4.1%, 6.6% and 2.3% had either witnessed or been victims of these transit crimes in the last six months; 10.5%, 2.4%, 6.6%, 12.1%, 5.55 and 1.2% had witnessed or been victims of transit crimes in the same order in the last three months; while 21.1%, 1.1%, 5.7%,8.5%, 2.3% and 1.4% of them had witnessed or been victims of the transit crimes in the same order in the last one month.

Another look at the table reveals that pickpocketing was the transit crime experienced most in the last one month (21.1%), rape or sexual harassment was the most experienced transit crime in the last three months (12.1%), kidnapping was the transit crime experienced most in both the last six months (6.6%) and over six months prior to the time of the survey (9.4%). Moreover, armed robbery was the transit crime least experienced in both the last one month (1.1%) and the last six months (1.9%), while carjacking or car theft was the least experienced transit crime both in the last three months (1.2%) and over six months prior to the time of the survey (1.1%). There was no report of such transit crimes as fare evasion, murder, terrorism, and vandalism over the period among the respondents. Thus, it is obvious that these categories of transit crime are quite rare in the study area.

Further, the results of Chi-square tests carried out shows that there was a significant relationship between transit crime experience and such socioeconomic characteristics of Osogbo residents as age ($\chi^2 = 32.713$, $p < 0.001$), gender ($\chi^2 = 17.401$, $p = 0.001$), household income ($\chi^2 = 20.235$, $p = 0.002$), private vehicle ownership ($\chi^2 = 80.709$, $p < 0.001$), and occupation ($\chi^2 = 27.174$, $p < 0.001$). However, no significant relationship was found between transit crime experience and household size ($\chi^2 = 13.329$, $p = 0.071$), religion ($\chi^2 = 24.717$, $p = 0.101$), education ($\chi^2 = 35.115$, $p = 0.093$), and the marital status ($\chi^2 = 29.575$, $p = 0.173$) of the residents of the city.

Transit Crime by Mode in Osogbo

In table 3, an attempt is made to categorise transit crime by mode in Osogbo. Information obtained on types of crime usually associated with different transport modes in the study area is presented. Respondents were asked to rate the transit crime vulnerability by transport mode in the city. According to the opinions of the respondents as presented in the table, korope passengers were the most vulnerable group of travellers to both pickpocketing and assault and battery, private car occupants were the most vulnerable group to armed robbery, while okada passengers were the most vulnerable group to both rape or sexual harassment and kidnapping or abduction in Osogbo.

Table 3. Transit Crime Vulnerability by Mode
(Data source: Author's Field Work, 2017)

SN	Type of Crime	Mode					
		Foot	Okada	Private Motor-cycle	Korope	Private Vehicle	Official Vehicle
1.	Pickpocketing	8.3%	6.4%	0.3%	29.7%	0.7%	0.0%
2.	Armed Robbery	1.4%	37.9%	3.7%	6.1%	11.8%	8.8%
3.	Assault and Battery	7.4%	7.8%	2.1%	9.8%	0.6%	1.1%
4.	Rape/Sexual Harassment	6.5%	18.1%	0.0%	17.3%	1.2%	0.8%
5.	Kidnapping/Abduction	0.8%	14.6%	1.8%	5.3%	11.3%	9.5%

Further, the opinion poll has it that occupants of official vehicles were not vulnerable to pickpocketing; pedestrians were the group of travellers least vulnerable to both armed robbery and kidnapping or abduction; private car occupants were the least vulnerable group to assault and battery; while private motorcyclists/passengers were not in any way vulnerable to rape or sexual harassment. A closer look at the table reveals that all in all okada passengers are evidently the most vulnerable group of travellers in Osogbo as their vulnerability index to any of the transit crimes is either the highest or one of the highest. Conversely, occupants of official vehicles were deemed the most secure group of travellers as their vulnerability index to any of the transit crimes is either the lowest or one of the lowest. Occupants of private vehicles came after those of official vehicles in this regard.

The foregoing results have shown that no group of travellers was essentially predominantly vulnerable to all the categories of transit crime. However, it has been shown that passengers of different modes were vulnerable to different categories of transit crime. This compares favourably with the finding of Olojede, Daramola and Olufemi (2017). However, the finding on Ilesa revealed that pedestrians were the most vulnerable group of travellers, which happened not to be the case in Osogbo as found by this study.

Causes of Transit Crime in Osogbo

The ranking of the causes of transit crimes in Osogbo in order of frequency as rated by respondents is as shown in table 4.

Table 4. Relative Frequency of Transit Crime Causes in Osogbo
(Data source: Author's Field Work, 2017)

SN	Cause	N	TWV	TCCRFI	Rank
1.	Economic hardship/recession/poverty	432	2035	4.63	2
2.	Joblessness/unemployment	419	1743	4.16	8
3.	Substance abuse/Illicit drug use	432	1896	4.39	5
4.	Poor policing/under-policing	432	2000	4.71	1
5.	Absence of CCTV and streetlights	412	1874	4.55	4
6.	Poor street system/urban planning	422	1924	4.56	3
7.	TV violence	431	1810	4.20	7
8.	Peer group influence	430	1874	4.36	6
9.	Family breakdown	426	1695	3.98	9

As shown in table 4, poor policing/under-policing was seen as the strongest cause of transit crime in Osogbo. This was followed by economic hardship/recession/poverty. Poor street system/urban planning and the absence of closed-circuit television (CCTV) ranked third and fourth respectively, while substance abuse/illicit drug use and peer group influence ranked fifth and sixth respectively. TV violence ranked seventh, while joblessness/unemployment and family breakdown were ranked the eighth and ninth strongest causes of transit crime in Osogbo.

Transit Security Indices of Urban Transport Modes in Osogbo

In table 5, the Relative Security Index (RSI) was employed to assess the security of urban travellers in Osogbo.

Table 5. Security Indices of Urban Transport Modes in Osogbo
(Data source: Author's Field Work, 2017)

Mode	Security Index			
	N	TWV	RSI	Rank
Foot	430	1716	3.99	5
Ọkada	432	1365	3.16	6
Private Motorcycle	432	1931	4.47	3
Korope	431	1784	4.14	4
Private Vehicle	432	2026	4.69	2
Official Vehicle	429	2094	4.88	1

According to table 5, as far as transit crime was concerned in Osogbo, those who travelled in official vehicles were deemed the most secure. Next to this group were the occupiers of private vehicles. Okada passengers were seen as the group with the least level of transport security in the study area.

Temporal Dimensions to the Occurrence of Transit Crime in Osogbo

The temporal dimension to transit crime in Osogbo was examined.
The result is as shown in table 6.

Table 6. Temporal Dimensions to Transit Crime in Osogbo
(Data source: Author's Field Work, 2017)

SN	Type of Crime	Time Most Rampant			
		Morning	Afternoon	Evening	Night
1.	Pickpocketing	45.6%	42.3%	52.5%	2.1%
2.	Armed Robbery	13.2%	21.4%	2.4%	3.5%
3.	Assault and Battery	3.2%	5.3%	4.6%	11.3%
4.	Rape/Sexual Harassment	0.2%	0.7%	18.3%	9.5%
5.	Kidnapping/Abduction	2.4%	26.6%	45.5%	4.3%
6.	Carjacking/car theft	6.1%	14.7%	17.6%	13.1%

According to table 6, 52.5% of the respondents opined that pickpocketing was most rampant in the evening (52.5%), armed robbery was said to be the most rampant in the afternoon (21.4%), assault and battery was most rampant at night (11.3%), rape or sexual harassment was most rampant in the evening (18.3%), kidnapping or abduction was most rampant in the evening (45.5%), while carjacking or car theft was most rampant in the evening (17.6%). Further analysis reveals that pickpocketing was the most rampant transit crime in the morning (45.6%), afternoon (42.3%) and evening (52.5%), while carjacking or car theft was the most rampant transit crime at night.

TRAFFIC CONTROL AND MANAGEMENT IN OSOGBO

Policing is a very germane aspect of security. In the context of this study, policing goes beyond the security services provided by the conventional police force. Rather, it encompasses the security services provided by all the security agencies in Osogbo. The security agencies as conceived in this study are the Nigeria Police Force, the Nigeria Security and Civil Defence Corps, and the registered vigilante groups. An assessment was made of the efficiency of these security agencies in Osogbo. Respondents were asked to rate some indicators to measure the level of the efficiency of these bodies from 1 to 5. These indicators are made up of the six major manifest functions of the agencies. The indicators employed were: adequacy of transit security provision;

dignity, integrity, respectability, reliability and trustworthiness; transit crime prevention or proaction; responsiveness to reports of crime; law enforcement/making criminals face the full course of law; and the ability to instil confidence when present. The respondents' assessment of the efficiency of the security agencies is as summarised in table 7.

Table 7. Efficiency Rating of Security Agencies in Osogbo
(Data source: Author's Field Work, 2017)

Indicator	N	TWV	REII	Rank
Adequacy of transit security provision	432	968	2.24	2
Dignity, integrity, respectability, reliability and trustworthiness	431	901	2.09	3
Transit crime prevention or proaction	430	413	0.96	4
Responsiveness to reports of crime	432	276	0.64	6
Law enforcement/making criminals face the full course of law	431	388	0.90	5
Ability to instil confidence when present	432	1214	2.81	1

According to table 7, the respondents did not have a high opinion of the security agencies as far as transit security provision was concerned in the city. For instance, the indicator with the highest index, the ability to instil confidence when present, has a value of 2.81. Responsiveness to reports of crime has an index that is as low as 0.64. All these six indices say a lot about how the respondents viewed the transit service provision of the security agencies in Osogbo. In other words, the respondents rated security agencies in Osogbo low on their transit security provision.

CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

This study has explored several types or categories of transit crimes in Osogbo. The findings of the study, as discussed in the foregoing section, are to a reasonable extent in consonance with what have been established by several previous studies in the literature of urban transport security. In summary, the study found that several conventional transit crimes were perpetrated in the study area as earlier found by Odufuwa (2012a). However, the study provides no empirical evidence to support the prevalence of some transit crimes in Osogbo. Such transit crimes include fare evasion, murder, terrorism, and vandalism. The study also reveals that transit crimes in Osogbo have a relationship with some socioeconomic characteristics, and that there is time dimension to them. These corroborate the findings of Odufuwa (2012b), Ajayi and Ajayi (2014), and Uittenbogaard (2014). It was also found by this study that the perception of urban transport security varies by mode, as earlier established by Olojede, Daramola and Olufemi (2017).

Further, the study uncovered several causes of transit crime in Osogbo, determined the security indices of the intra-urban transport modes in the city, and assessed the efficiency of security agencies in the city. More importantly, this study has given us important insights into understanding the security issues in urban transportation in Osogbo. The implications of the findings of this study are many. They cut across physical planning, transport planning, and urban policing, among other institutional interests. Consequently, measures should be put in place by concerned stakeholders to engender a secure transport environment in Osogbo. To this end, the following policy recommendations are proffered.

First, a holistic and systemic overhaul of the transport system in Osogbo should be accorded topmost priority. Transport facilities in the city should be improved on with non-motorised transport and mass transit as integral parts. Hitherto these have been practically non-existent in Osogbo. Much of the security threats associated with okada could be prevented by mass transit, and captive riders would feel more secure. In addition, the proscription of okada operation in the city should be conscientiously contemplated. If the road infrastructure of the city is overhauled, the need for okada would be undercut despite its present seeming indispensability. Also, the provision of walkways, streetlights, and CCTV would go a long way in enhancing the security of vulnerable travellers in the city. Moreover, with a view to winning back the confidence of travellers in the city, security agencies in Osogbo should actually outdo themselves by

significantly improving on their services. As a way of achieving this is, they should consider the joint task security force option. This would go a long way in ensuring a secure urban transport milieu in Osogbo.

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URBAN AGROECOLOGY IN CAMPO GRANDE, BRAZIL

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Abstract: Sustainable agriculture has a different meaning from region to region, most of scientific literatures highlight a dichotomy between developed and developing countries approaches. In this general context agroecology in Brazil is linked to the family farming which produce more than half of food consumed domesticaly. Historicaly, a set of policies were implemented in order to address food security on federal, state and municipal levels, with large impact on family farming, like urban agroecology. This paper aims to develop a diagnosis on the urban agroecology in Campo Grande.

Key words: urban agroecology, organic farming, family farmers, Campo Grande, Brasil

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INTRODUCTION

The concept of sustainable agriculture has evolved since the early 1980s on the basis of ecological principles of agroecology, in order to host ecological and equity problems posed by the adoption of modern industrial agriculture. Sustainable agriculture is obviously a normative concept, leading to different definitions by various disciplines and affiliations (Altieri, 1998). Under the sustainable agriculture umbrella emerged many new concepts like organic farming, agroecology and urban agroecology. The most prominent example of urban agriculture is represented by the Cuban experience, where become a significant source of fresh produce for the urban and suburban populations. As a grassroots movement in response to the crisis brought about by the loss of trade, a large number of urban gardens emerged in Havana and other major cities (figure 1) (Altieri et al., 1999).

Cuban peasants where the main pawns who made possible the transition to more agroecologicaly integrated and diverse farming systems. They have been able to boost food production without scarce and expensive imported agricultural chemicals by using more ecological inputs (Duff and Padilla 2015). The new habits caused by the modern life shaped the relationship between urban inhabitants and food producers. In response to the lost link with the food production today, in large urban centers, it has increased the number of people who often - even in small spaces in their backyards and apartments - grow culinary herbs, medicinal, vegetable and even some fruit (Mougeot, 2000).

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Figure 1. Urban agroecological farm in Havana, Cuba
(Source: Photograph by author, 23 February 2017)

The expansion of the organic sector in Brazil is seen as a leverage for the social emancipation of the small family farmers. Large cities take advantage of the initiative of family farmers from the peri-urban districts (Altieri and Nicholls 2008).

In the paper it will be explored the urban agroecology in Campo Grande, the capital and also the largest city in Mato Grosso do Sul. Campo Grande occupies 8.096 km2 in the central part of the state, near the watershed divide of the Paraná and Paraguay basins (figure 2). Altitudes range from 500 to 675 m (Campo Grande, 2013). The city is one of the most dynamic in terms of demographic growth, increasing from 140,000 people in 1970 to 853.622 people in 2016 (IBGE, 2016). The climate is tropical humid with wet summers and dry winters. The precipitation is heaviest from October to March, which is the period when mean temperatures are approximately 24°C. June, July, and August are the driest months.

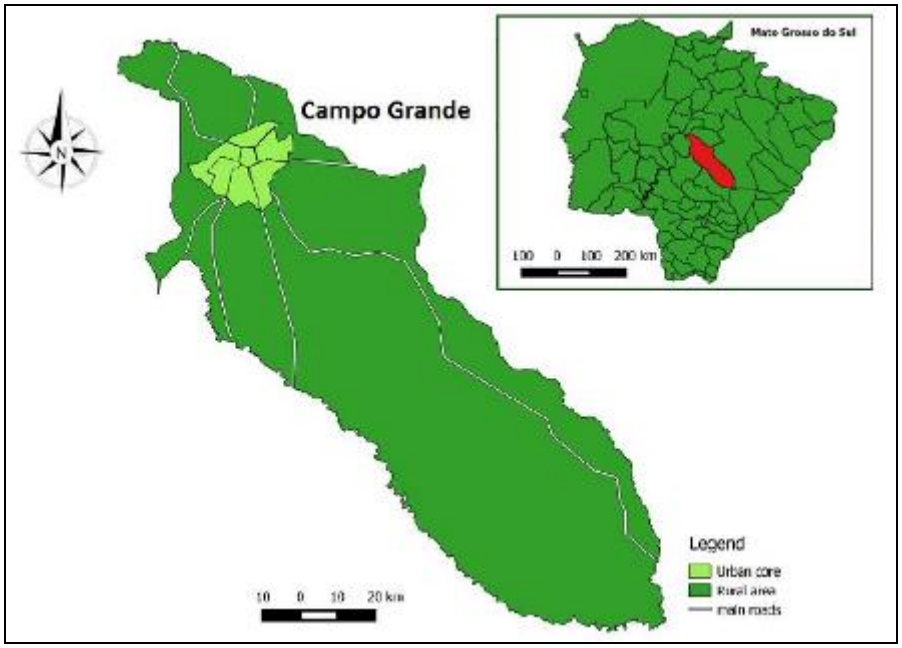

Figure 2. Location and structure of the administrative unit
(Source: own realization)

METHODS

This paper aims to develop a diagnosis on the urban agroecology in Campo Grande. A mixed method of questionnaires and interviews was conceived as a means of obtaining data to be used in support of research on agroecology in Campo Grande. While questionnaires can provide evidence of patterns amongst large populations, qualitative interview data often gather more in-depth insights on participant attitudes, thoughts, and actions (Kendall, 2008).

The questionnaire was applied in two different days in an organic market. The organic market is organized twice per week on Wednesdays and Saturday from 6 am to 9 am in the Radio Club Park (figure 3). The organic market group up to 10 farmers from the urban outskirts. The questionnaire was applied in Portuguese, therefore the help of a translator was considered. The language barrier was one of the main limitation in the research.

Figure 3. Organic market in Radio Club Park, Campo Grande – MS
(Source: photograph by author, 23 March 2016)

The survey was applied to all available farmers in the market, respectively 10 farmers. The questionnaire was designed to provide a profile of the family farmer that use agroecological practice from different perspectives. Those perspectives included, experiences, practices, motivations, personal preferences. The questions were refined a number of times and the questionnaire was reviewed by an expert that works with agroecological farmers for clarity of instructions, completeness of alternatives, and use of appropriate language and terms. The final version of the questionnaire contained 38 items that comprehensively investigates the transition from conventional farming to organic production. Other topics are the factors prompting conversion and the effects of output changes. Data were gathered on farm resources, sales possibilities and farmers‘future expectations. Data were evaluated using simple statistical methods, which were completed using Excel. The questionnaire was accompanied by an interview with some of the farmers, and also a farm visit in order to understand better the reality.

RESULTS AND DISCUSSIONS

The investigation of the organic farm location in Campo Grande shows that the producers are coming from the peri-urban side, within half hour drive (figure 4). Mainly, their farm is located very close to the main roads that cross the administrative unit. Four farmers need approximatively one hour to get to the market, from this it can be deducted they are leaving farther. Only one interviewed farmer needs almost 2 hours, being also the only one who comes from another municipality, respectively Rochedinho.

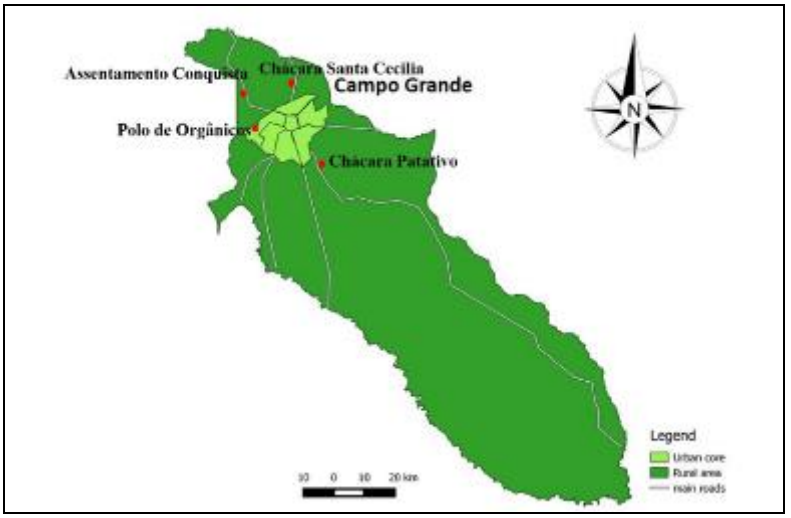

Figure 4. Localisation of the organic farms
(Source: own realization)

Most of the producers interviewed (4 out of 10) are having their farm situated in Polo do Orgânicos Polo Empresarial Oeste (exit Aquidauana) (figure 5). The settlement, regroup family farmers that decided to adopt agroecological practices becoming an important center for knowledge in the field. The sight uses various types of agroecological practice, from the PAIS[1] model supported by SEBRAE[2] till own models based on life experience.

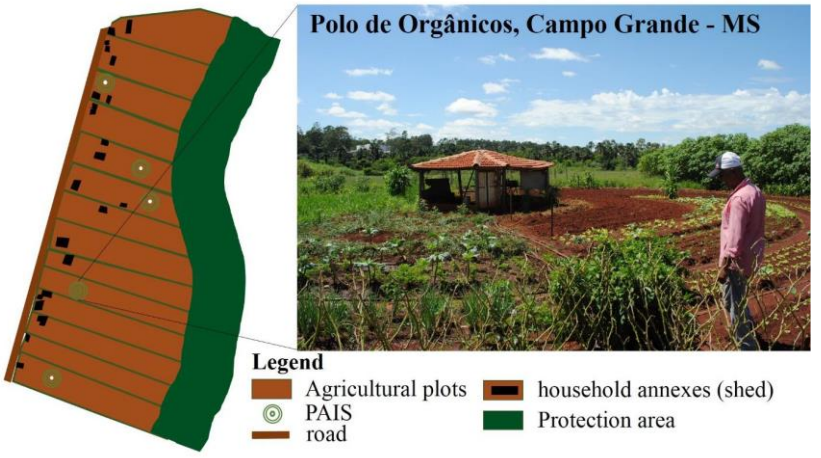

Figure 5. Polo do Organicos, Campo Grande – MS
(Source: own realization)

Other producers are from various Assentamentos from the periurban area, such as Conquista, Indu Brasil, Colônia Rezolândia Aguão, Nova Era, Só Alegria, and Três Barras. The Agrarian Reform in Brazil aims to promote better distribution of land by changing the ownership

[1] PAIS - Integrated and Sustainable Agroecological Production (Produção Agroecológica Integrada e Sustentável);
[2] SEBRAE - Brazilian Service of Support to Micro and Small Enterprises (Serviço Brasileiro De Apoio Às Micro E Pequenas Empresas);

and land use system in order to meet the principles of social justice, sustainable rural development and increased production. INCRA[3] is the institution charged with current land reform that promote the implementation of an assentamento rural model based on economic viability, environmental sustainability and territorial development. There are more than 9334 assentamentos across Brazil that impact the life of 977.491 families. In Mato Grosso do Sul there are 204 assentamentos with 27.841 families that benefit from this land reform (Komori, 2007).

Acoording to the datas published by INCRA, in Campo Grande there are 14 Assentamentos, from which 7 were attributed through the Agricultura Familial program, respectively more than 1000 families (table 1).

Table 1. Family farmers in Campo Grande
(Data source: INCRA, 2015)

Municipality	Community	Community type	No. of families
Campo Grande	Anhanduí	Agricultura Familiar	70
Campo Grande	Buriti	Remanescente de Quilombo	61
Campo Grande	Campo Grande	Outros	120
Campo Grande	Colônia Rezolândia Aguão	Agricultura Familiar	65
Campo Grande	Conquista	Agricultura Familiar	70
Campo Grande	EFA COAAMS	Escola Família Agrícola	129
Campo Grande	Indu Brasil	Agricultura Familiar	700
Campo Grande	Nova Era	Agricultura Familiar	30
Campo Grande	Pantanal Industrial	Agricultura Familiar	30
Campo Grande	Penitenciária Federal de Campo Grande	Outros	289
Campo Grande	Só Alegria	Projeto de Crédito Fundiário	16
Campo Grande	Terra Boa	Projeto de Assentamento INCRA	30
Campo Grande	Três Barras	Agricultura Familiar	60
Campo Grande	Três Corações	Projeto de Assentamento INCRA	160

Based on the given answers, it can be highlighted the type of production practiced on the farms. On the studied farms, mixt organic production and conventional production were practiced, revealing a transition from conventional to organic. Of the 10 farms, on 7 farms (70% of those studied) only crop production was practiced while 3 farms (30%) raised crops and kept animals. However, there is a desire of the farmers to create a more diverse exploitation. Some of the farmers mentioned, their intention to introduce fishery or bee keeping on their farm.

Research on organic farmers is popular but only in few situations is explored the motivations that contributed to the conversion to the organic practices. It can be distinguished to main reasons behind the conversion process respectively: personal factors and economic benefits. In the study Organic production in the context of family farming in Mato Grosso do Sul conducted by Padua (2014), in which 101 farmers were interviewed, 49% declare themselves as organic, and 8% this condition is mainly attributed to possess organic production certification. Others indicated this condition for not using chemical inputs in crops or respect all the practices recommended in organic production.

However, among the 51% of farmers who consider themselves in transition, 32% mentioned the great difficulty to fully use all the agroecological practices. At least 70% of the

[3] INCRA - National Institute of Colonization and Agrarian Reform (Instituto Nacional de Colonização e Reforma Agrária)

interviewed farmers have produced food using the conventional agricultural model. However, those are the ones attributed greater difficulties in agroecological transition, due to the need for changes in management. Studies reveals a complex environment who contributes to the decision making in the conversion toward organic farm. Fairweather (1999), identified two types of organic farmers, the - committed‖ and the - pragmatic‖ as well as three types of conventional farmers. More detailed Darnhofer et al., (2005), defines based on 15 criteria‘s five farmer types: committed conventional, pragmatic conventional, environment-conscious but not organic, pragmatic organic and committed organic.

Nevertheless, the applied surveys indicated that 70 % of converted farmers did so because of the financial perspective, a new market (figure 6). A major role in the conversion was played by the presence of a subsidized program (PAIS) most of the farmers adhering to this program. According to the datas collected the economic reasons were determinant for the conversion, followed by 20 % for ethical reasons (environmental concern, production of healthy food). Farmers were able to choose from a list of motivating factors, most of them marked all the categories and attributed a value from 1-5 according to the importance in their choice (figure 6).

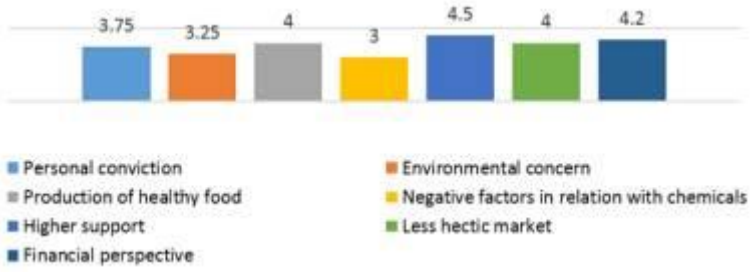

Figure 6. Reason for conversion from conventional agriculture to organic agriculture

Four out of ten of the interviewed farmers converted their farm in 2008, being the moment when PAIS project was launched, the others converted in the following years, respectively, two in 2009, one in 2010 and two in 2011. Only one farmer converted his farm more than 10 years ago, when organic farming was less known. Another farmer, inherited the farm from the parents who practiced conventional farming and he was the initiator of the conversion, mainly due to personal conviction. All the farmers kept the same production type after the adoption of the agroecological practices. In the depth interview carried with the owner of an organic restaurant (Márcia Chiad), who is one of the customers of the organic farmers emphasize the "*need of changing the production type of the organic farms in order to answers to some urban demands*".

The average size of the organic farm of those questioned was 10.9 hectare, but a deeper look offers a clear image. One of the interviewed farmers had in possession a 40 hectares farm, determining in consequence an average surface for the other farmers around 7 hectares. Even this average surface is in reality smaller, farmers declaring they use between 1 and 2 hectares for organic farming, respectively 30% of the whole surface.

The other two third has different functionality, respectively protected areas, pasture, forest or conventional production. However, those who are beneficiaries of PAIS project have 0,5 hectares of agroecological model and on the rest of the farm is used different type of organic production. The average surface of organic farmers is lower than the average surface of the family farms in MS (37 ha) or in the municipality of Campo Grande (12 ha) (IBGE, 2006).

The farmers were asked if since the adoption of organic farming changed the size of the farms. Six of them kept their original size and the other four increased slightly their surface. The questioned farmers revealed the type of properties of their farm, respectively half of the (five) were operating on their own private land and the other half (five) used a governmental land

(INCRA usufruct property systems). In one case the farm was leased from family member. Research on the land area locations aimed also to highlight the perceived quality of the land. In unanimity respondents were appreciated their land as good quality.

Concerning the labor force in all the cases the human resource was represented by family members. In all farms there were no employees, and when a need for labor occurred day-workers were hired (figure 7).

Despite of the large size of the farms, mechanization was partly used (figure 7). In seven farms they use farming machines mainly small tractor (Tobata) and the most present electric equipment was the irrigation system in some farms received as a kit through the PAIS project.

Figure 7. Crop protection and small mechanic tractor used
(Source: photograph by author, 8 March 2016)

The irrigation system is partly used. There is the climatic advantage given by the presence of the rainy season when the irrigation is used occasionally.

Concerning the plant protecting methods employed, the majority of farmers (eight) used a biological method learn in trainings delivered mainly by SEBRAE agronomists (figure 8). Sometimes mechanical or agrotechnical methods are employed.

Figure 8. Biological protective substances
(Source: photograph by author, 8 March 2016)

Benefiting from a good quality soil and favorable climate, farmers are not concerned about the need of nutrient supply. Nevertheless, farmers use organic manure, green manure, mulch and compost in order to increase production (Larsen, 2009).

As mentioned, the economic factors played a key role in the changeover the production system. Therefore, the respondents when questioned about the sales price of their organic product, appreciating with small variations similar with to the conventional products. The price of designated organic products is generally higher than the usual market price. The fluctuation of the production determined by the climate has an impact in establishing the price. When overproduction is occurred the price decrease. The higher price is decreasing from year to year and sales price trends differ for week to week.

In the exploration of the sales channels of the organic products, the vast majority sold their products in the organic market (the organic market is organized twice per week, respectively Wednesday and Saturday from 6 am to 9 am). The farmers interviewed were satisfied with the organic market, indicating that already at 7 o'clock almost all their products being sold. As other means of product distribution, the national program of school supply PNAE[4] or PAA[5] is facilitating their product selling to different public entities. Once per week SEBRAE is opening its door for an organic farmer to sell organic products to its employees, being highly appreciated by both producers and employees.

More limited is their access to specific shops. Several managed to sell organic products to organic restaurants. The owner of the Recanto das Ervas organic restaurant (Márcia Chiad) emphasized the importance of "*supporting organic farmers by buying their products*". Mentioning that other "*organic restaurants from Campo Grande prefer to buy organic products from Sao Paulo*". She considers that is "*not sustainable to neglect the local farmers and it's important to strengthen the relationship with them*" (figure 9).

Figure 9. Organic restaurant owner (Márcia Chiad) buying from local organic farmers
(Source: photograph by author, 23 March 2016)

Two farmers, managed to establish strong relations with their customers, therefore sometimes they sale directly from home. None of the farmers possessed sales contract. Selling directly from one's farm location is a typical practice offering the advantage of maintaining personal contacts, product identity and fewer logistic problems (Kis, 2007).

Farmers observed an increasing demand for organic products, therefore most of them intend to improve production. In order to improve production without using chemicals is hard task, therefore interviewed farmers are engaged in different activities in order to improve their knowledge. Some of the farmers inherited the agricultural practices from their ancestors, the other part discovered those practices through different courses/seminaries realized by technicians and combined with their own experience.

[4] PNAE- National School Feeding Program (Programa Nacional de Alimentação Escolar)
[5] PAA - Food Procurement Programme (Programa de Aquisição de Alimentos)

Most of the farmers (seven) admitted that one of the main sharing knowledge activity in the fiels is Dia di Campo. Dia di Campo is event organized yearly by Secretaria Municipal de Desenvolvimento Econômico, Ciência e Tecnologia, Turismo e do Agronegócio (SEDESC) with the main aim to create a sharing environment in the agroecological field. More than 250 small farmers participate at this event, together with technicians, experts and different decision making that all share knowledge and practice. Participants have the opportunity to learn organic production techniques directly from those have a high expertise and also is a place where useful information concerning organic farming are spread by local authorities.

When asked about the future, they were unanimously optimistic considering that organic market has a large potential and is and observable positive trend (figure 11). In which consist the market opportunities and consumers interests majority of farmers highlighted the huge potential and believes it will be better for them in the future.

When asked about local support, regulation and bureaucracy, they were concerned and aware that in the future, the organic environment will be more regularized and probably more regulations. They were concerned about the organic certifications (figure 10) that they need to produce. The farmers are certifying their products through different agents such as Ecocert Brasil Certificadora, IBD Certificações LTDA, Cooperativa ddos Produtores Orgânicos da Agricultura Familiar de Campo Grande.

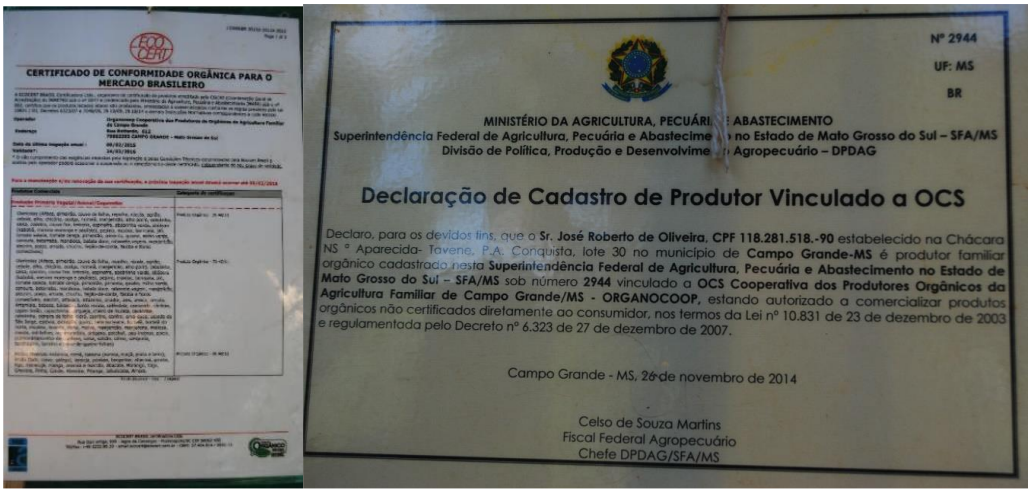

Figure 10. Organic certificates own by family farmers from Campo Grande
(Source: photograph by author, 23 March 2016)

When asked about climate change, opinion was different half of them considering climate change is contributing positively to their production due to the increased amount of precipitation. By other hand the others were aware about the implications of climate change and possible risks saying that they need to think about protection methods.

Finally, when asked what should be improved in the system or what recommendation they have, some of the farmers highlighting several needs. First of all, of them considered agroecology practice as being physically hard, more time being requested in the production. Therefore, only perseverance and long-term thinking can be successful. One of the farmers proposed for the hard labour to acquire equipment within the community, otherwise the investment is too high. Increased subsidies could contribute in improving the organic farming. Despite the fact that is an increased demand for organic products, several farmers mentioned the need to promote more efficiently their products.

Education for both producers and consumers are key vectors in the improvements of the system.

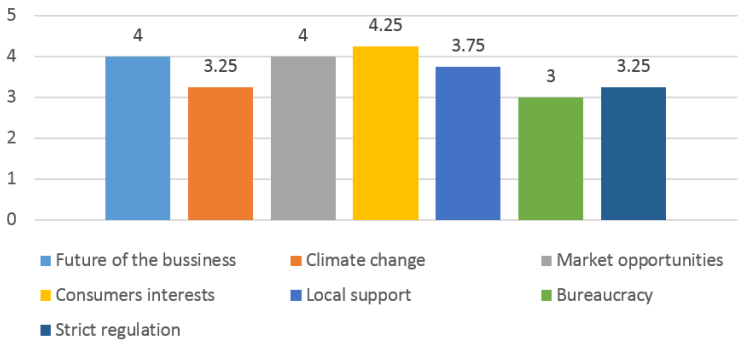

Figure 11. Future perspective of family farmers

One of the most mentioned complain was related to the seeds and high price. Farmers mainly by their seeds and only few of them are producing their own seeds and only for few products. Sometimes they exchange seeds or they buy from cooperatives. It is a common practice to use hybrid seeds, easily found on the market. Another important remark is that the concerns about seeds are not present in the peasant‘s mindset, probably because they do not have a strong tradition in family farming, whereas, in traditional communities (more experienced with this type of production) have developed an ancient knowledge about seeds restoration/conservation. It can be observed that those who inherited the farm from their parents were aware about the need to produce their own seeds (Padovan, 2005).

CONCLUSION

The present research aimed to portray the profile of the organic farmers from Campo Grande. The farmers questioned converted they farm less than 10 years ago mainly due to the economic opportunities accompanied by personal conviction. The main characteristic of the organic farms is that they have only family members that are supporting the farm without hiring employees. Also, the opportunity to be self-employed appeared to be a motivating factor behind conversion to organic farming as it also meant access to greater subsidies.

Beside the subsidies that are attributed to organic farmers other governmental facilities are supporting agroecological practices. Producers can have access to government markets (PAA and PNAE) with obvious advantages, such as guaranteed sale, fixed location, small delivery is accepted and one of the most appreciated is the wide diversity of products required (vegetables, fruits, herbs). Concerning agroecological practices used on the farm, farmers inherited knowledge and developed skills through own experience. A major role is played by several institutions engaged in transfer of knowledge through courses/seminaries or at *Dia di Campo*. Considered physically difficult, farmers are enthusiastic about the benefits and positive about the future.

Organic producers from Campo Grande benefits from governmental support, however there are still some difficulties. There is an incipient network created but not enough for the sustainability of the system. Therefore, it is desired the consolidation of the associations of the farmers that share the same goals and extremely important is to integrate consumers in the network. Farmers are anticipating the demand of the consumers, being affected by change of their behavior. If the relationship producer – consumers is enhanced than a more coherent market can be foreshadowed. There is an obvious competition with conventional products, which in many cases benefit from a better aesthetic and a better price attracting many consumers. Therefore, a better promotion of the organic products should be envisaged. Improvements in the flow of production and expansion of marketing channels could contribute to the stability of the farmers. Parallel with the projects that aim to support the farmers, educational activities should be addressed to consumers in order to understand the benefits of agroecological practice.

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INDUSTRIAL ACTIVITIES IN MUREŞ COUNTY (PART II)

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Abstract : In Mureș County, year 2015, the secondary sector comprised a total number of 42,427 workers, fifth place of the 10 Transylvanian counties (11.2% of the 377,517 employees). Thusly, the values of industrial production were structured as follows: *light industry* (18.3%, 7,763 employees), *wood processing industry* (17.7%, 7,513), *food industry* (16.8%, 7,129), *machine industry* (16.5%, 6,989), *chemical, cellulose and paper industry* (8.8%, 3,739), *construction material industry* (7%, 3,003), *extractive industry* (6.2%, 2,661), *other industrial branches* (4%, 1,662), *electricity industry* (3.3%, 1,398), and *metallurgical industry* (1.4%, 570).

Key words: methane gas, secondary sector, light industry

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INTRODUCTION

The current scientific endeavour is a continuation of the 2018 study regarding industrial activity in Mureș County, published in the Annals of the University of Oradea, Geography Series, 28(1): 36-53. Therefore, the aim is to emphasize several other aspects of industry in Mureș, with a new cartographic depiction of the transport network and the active population distribution, generally trying to avoid reshuffling previously researched issues. This paper intends to create an inventory of the industrial activities that take place in Mureș County and, following the analysis of their origin and evolution, to identify several development directions, taking into account the principles of industrial localisation. The study aims to be a useful instrument for the local government, which can then develop strategies to attract investments according to the industrial branches most suitable for the county. The basic unit for industry analysis is the factory, which manufactures a product with the help of technological machinery and employs a labour force characterised by number and education level.

The clustering of enterprises into industrial branches is essential, as each industrial branch has a different approach when it comes to the origin and acquisition of resources (raw materials), energy, work force and its training, and, last but not least, product distribution. These requirements influence

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the principles of industrial organisation, the enterprises being located based on the required resources, type and quantity of energy used, outlet market location and the location of the component and spare parts providers. Locations frequently do not meet the required standards and enterprises select them based on the most advantageous financial conditions or focusing on industrial park type agglomerations. The short period between 1945-1948 was one of great complexity in terms of social-economic and political conditions, being an ambiguous transition period as Romania was under foreign ocuppation and forced to yield to pro-Soviet interests and reforms. On 11th June 1948, the nationalisation of the main means of production began, mainly all industrial units with more than 50 employees, which became state property. The smaller units, with less than 50 employees, were transformed into local cooperative units, some eventually becoming middle or large state enterprises. Following said measures, the industry became a centralised and stepwise activity, whose evolution was to be directed and controlled by development plans (the first two years included annual plans, followed by five year plans, which also imposed development directions and clear objectives for their completion).

The old industrial plants were upgraded and expanded, alongside with the creation of new industries. Forced urbanisation therefore became the norm and a massive rural exodus took place, which led to the considerable depopulation of rural areas, with severe long term effects. This led to the establishment of the first chemical industry colossi of Mures County, *Târnăveni Chemical Plant* and *Târgu-Mureş Nitrogen Fertilizer Plant*, which required tremendous resources and energy to run. Two high capacity power plants were constructed for this very purpose, one in Fântânele and one in Iernut, which burned gas from the gas domes of the Transylvanian Plateau.

Other large enterprises emerged afterwards, in the siderurgical industry (*Nicovala Sighişoara*), construction materials (*Sighişoara Ceramic Products Enterprise; Târgu-Mureş Constructions-Assembly Plant; Sighişoara Glass and Tile Enterprise; Ardeleana* and *Hercules Târnăveni*), as well as in several industrial sectors located primarily in the county capital, such as: machinery (*Metalotehnica; Light Industry Machinery Enterprise; Electromureş; Auto Repair Works*), wood processing (*Wood Mill*), textiles (*Silk Weaving Mill, „Mureşul", Leather and Gloves Factory*) and food (*Sugar Factory, Mill, Bakery and Pasta Enterprise, Vegetables and Fruit Enterprise, Meat and Milk Enterprise, Vinalcool, Zahărul Luduş*, etc).

The industry was mostly extensive in nature and therefore required a large workforce. Thusly, Romania became a massive energy consumer, with an ever decreasing capacity to provide food for its population. This contributed to the food and energy shortages of the 1980s, which impacted the populace first and foremost. These massive industrial investments required external loans. After 1990, as the economy transitioned to a market phenomenon, all industries suferred massive restructurings, complex and difficult privatizations, creating social problems and massive layoffs. The noncompetitive sectors became even less competitive after 1990. The system of commercial and autonomous companies proved unresponsive to the principles of consumption economy. Moreover, with the extinction of the Council for Mutual Economic Assistance, which included the former socialist states, Romania lost an important outlet market, as well as its Third World partners (the Arab countries). The massive privatisations that occured after 1997 and 2000 diminished the economic importance of the state, phenomenon further exacerbated by the insidious effect of intermediaries, at production level, as well as at distribution level (the „leech" company system). The current situation proves that most enterprises have been illicitly privatised, while many investors proved to be disloyal partners. In the end, this fact contributed to the dissolution of a massive part of production and therefore to a stringent need for job reconversion, a problem which has not been settled to this very day.

METHODOLOGICAL ASPECTS

We must emphasize that this scientific endeavour implied considerable research, especially the activity profiles of all current and former firms that had emerged after 1990, thus employing

the historical method. Of great use were the documents provided by the *Mureș Commerce and Industry Chamber*, which devised „lists and rankings" based on the four economic sectors, a methodological aspect integrated in the synthesis and analysis methods.

Several other studies were consulted, which helped us broaden our understanding of some important issues (Claval, 1974; Pop, 1972, 1996, 2007, 2012; Bailly and Béguin, 1982, 2001; Bailly, 1991; Max, 1991; Șoneriu and Mac, 1973; Harries and Norris, 1986; Nimigeanu, 1996; Carles, 1998; Păcurar, 2006; Barnes, 2009; Pop and Mârza, 2012; Cocean et al., 2013; Tofan, 2014; Bailly et al., 2017; Tofan and Niță, 2018), taking into account three fundamental principles: spatiality-causality-integration. All of these were acked by the information from the general urban plans and development strategies of the 102 smaller administrative-territorial units, the most used method being that of comparison.

We also utilized the statistical data provided by the Mureș County Department of Statistics, as well as the National Institute of Statistics, through its TEMPO-Online data base, the Work Force section, Employees subsection, number of employees at the end of each year, divided by industrial activities. Processing said data in order to emphasize the quantitative aspects of the phenomena and processes under scrutiny was done using statistical-mathematic techniques. Above all, lies field research, which enabled us to fully grasp the entire analysed territory, with cartographic representations, addended by information from websites and local media (the direct and indirect observation methods). Starting from the fundamental principles, by employing the methods of observation, analysis and synthesis (Herman and Benchiș, 2017; Herman et al., 2017; Ilieș et al., 2017), we identified the phenomena that led to the current location of industrial activities, while the deductive method helped us identify possible locations for future industrial development. For the most reader friendly graphical representation of information, we used the cartographic method (Baias et al., 2010; Herman et al., 2016; Ilieș et al., 2016; Romocea et al., 2018), superimposing our findings and demarcating the spatial units by contextual differences. Despite the fact that the total number of current industrial activities across the county were mentioned, there is a possibility that some may disappear, due to bankruptcy (Nimigeanu, 1996, p. 7). Difficulties arose due to the lack of quantitative information regarding supply, production and market, deemed classified by companies, which would have allowed for a better analysis of the infrastructure needed for the interlinking of the three main types of activities in an enterprise.

THE EXTRACTIVE INDUSTRY

The extractive industry is characterised by source location; in turn, it conditions the nearby location of mineral resource processing units. The vast majority of processing activities involve ore cleaning and sorting, which is why the transport of raw materials, together with the unusable halvus, must be avoided, to decrease costs. The existence of extractive centers and transport mainlines enables the insertion of units that consume a tremendous amount of energy from natural gas, which is less polluting than coal, but less efficient, most being metallurgical or chemical plants. Nonmetal resources also comprise construction materials, such as andesites with pyroxenes from the Mureș Defile (Meștera-Ciobotani) and Sovata (Ilieși), used primarily for road and railway constructions. Until 1995, Meștera quarry was state-owned. It was later purchased by S. C. Hamerock S. A. from Miercurea-Ciuc, which then merged with Lafarge Agregate Betoane. In 2004, the andesite quarry was acquired by Hodaco Prodcompex LLC.

It lies on the right bank of the Mureș River, with a surface area of around 12,000 square meters. Between the 1970s and 1997, there was a 6 hectare quarry operational in the Mermezeu Valley. Hodaco Prodcomex LLC of Stânceni obtained a licence in 2004 to continue andesite exploitation for a period of 14 years, which is roughly the same period for which the reserves are certified. In 2013, the licence for Mermezeu Quarry was awarded to Andezitul Stânceni LLC, headquartered in Târgu-Mureș, its surface area reaching 20,000 square meters. One of the major problems plaguing the two quarries is related to their uncertain judicial situation, since

there has been no environmental permit issued. It is widely known that they are located in the Upper Mureș Defile Natural Park (natural protected area of national interest) and the exploitations require first and foremost an environmental impact study by the ministry. The rocks are used as they are, sorted solely as aggregates, and therefore special processing is not needed. However, the large reserves and the ever increasing demand for such materials nationwide requires the modernisation of the railway system, which is the main mode of land transport for heavy goods, by increasing speed on already electrified lines (main railway 4) and electrifying and overhauling the Deda-Războieni railway line.

INDUSTRY OF ELECTRICAL ENERGY

In 2013, Romgaz took control of the powerplant from Electrocentrale București, Electrocentrale Mureș Branch. The powerplant's output is limited to 39.5% due to the high costs of natural gas and the prominence of hydroelectrical power and coal based energy. In order to reduce fuel consumption as well as to quell air pollution (especially nitrogen monoxide emissions), in the summer of 2018, the management made several investments to the plant's output, changing the technology for producing electricity by using the combined gas-steam cycle (classical and gas turbines). This improvement will become operational in 2020, with a total power of 430 MW.

The high installed capacity of the county and the flexibility of the energy production enables the development of high energy consuming industrial sectors. The Iernut powerplant can therefore function as a base unit, while the hydroelectric unit of Răstolița and the solar parks can deal with the energy spikes. However, the two main energy producers, Romgaz and Hidroelectrica, alongside Transelectrica, the manager of the National Energy System (NES), must update and reconfigure the connection network between the production units. The manufacturing of aluminum is a frequently given as an example of a high energy consumption sector, the plants being located mostly in energy-intensive regions, as energy can rarely be transported without losses along the way. In most situations, bauxite (the required mineral for aluminum) is excavated across the globe, shipped in large quantities by transoceanic tankers to countries producing cheap energy, processed in ports in the form of alumina (such as Tulcea) and then transported by rail to aluminum plants. The fact that Mureș County is crossed by the main railways nr. 3 and 4 is therefore a considerable advantage.

METALLURGY INDUSTRY AND MACHINES ENGINEERING

The main phenomenon that caused the fall of the metallurgical and machinery industries was a lack of understanding of the mechanisms governing the market economy: most companies focused on production and distribution, without investing in scientific research, crucial in a competing market.

Before 1989, the state and society as whole managed scientific research, and the industrial units benefitted freely from it, while the county did not have a strong, traditional university and technological center, which could prepare future researchers. This phenomenon, under the new economic conditions, left most companies exposed. Lack of know-how regarding supply and outlet-markets exacerbated the problem, as it remained in the hands of the government, leading to uncertainty in terms of decision-making and loss mitigation. Contradictory information regarding development projects allowed neither the identification of sectors whose products could benefit from higher demand, nor the identification of development opportunities of new industrial branches. Beyond the necessity to invest in research and workforce training, the metallurgical and machinery industries are dependent on supply and sales. The faster and safer these processes are, the lower the product costs are; therefore, their vast majority will tend to concentrate in locations with easy access to fast transport and communications, such as highways, modernised railways, and airports. This clustering is further strengthened by the fact that machine building companies function better in industrial agglomerations, where they can easily trade with the elements required for complex product development and where they can put the already available infrastructure and services to good use.

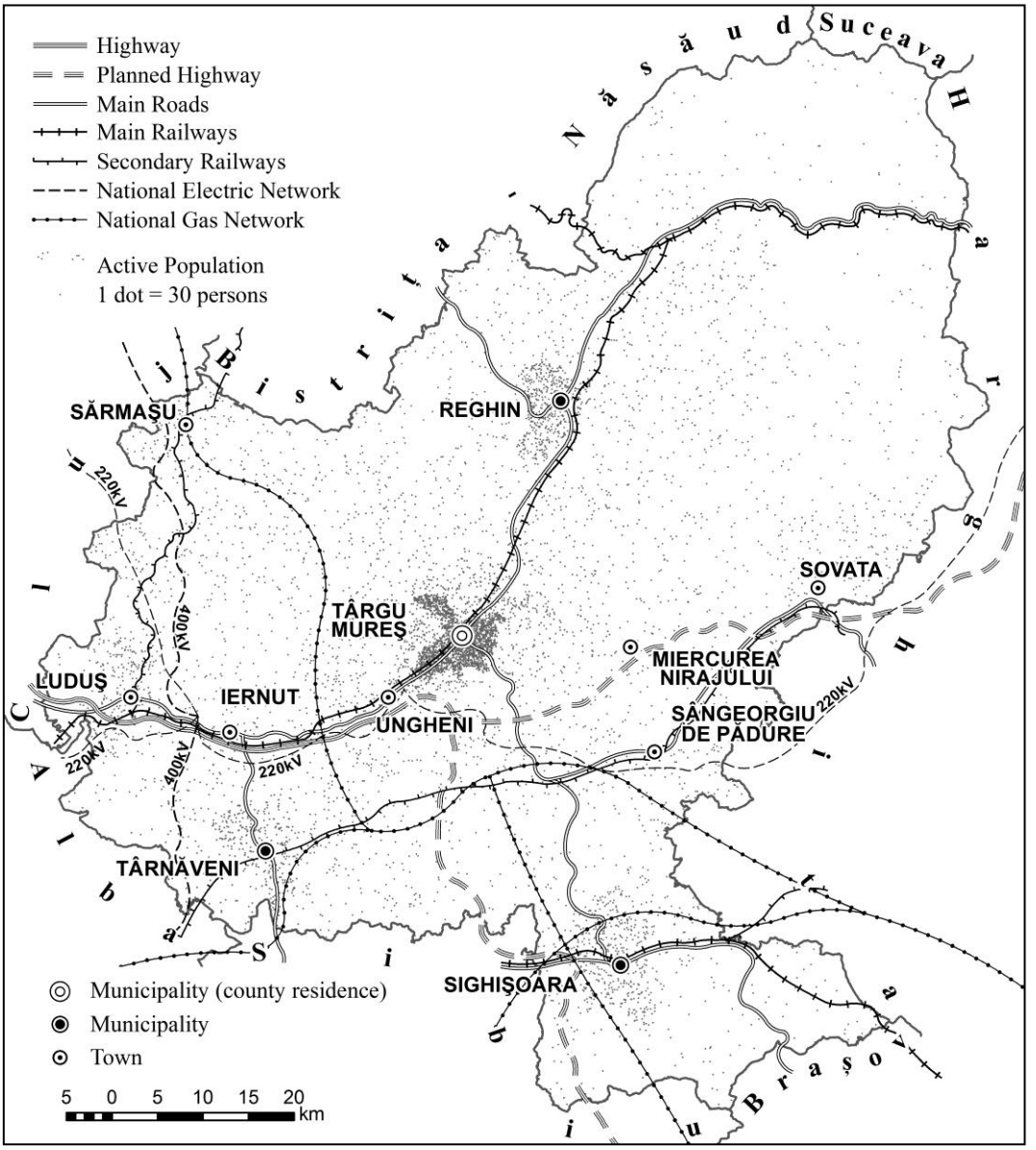

Figure 1. Main transport network and repartition of active population in Mureș County

CHEMICAL AND PAPER INDUSTRY

The largest chemical industrial plants are located in the vicinity of methane gas and salt deposits, on major circulation routes, mainly railways (the vast majority of products, bought in bulk and extremely heavy, are shipped by rail). Exports mainly pass through the distant Black Sea ports, which means that the lack of proper railway connections may critically hamper trading.

The medicine and cosmetics industries are the main engine and source of investments in research; therefore, drug and cosmetic companies will most likely locate near the educational, medical and pharmaceutical nexus of the county.

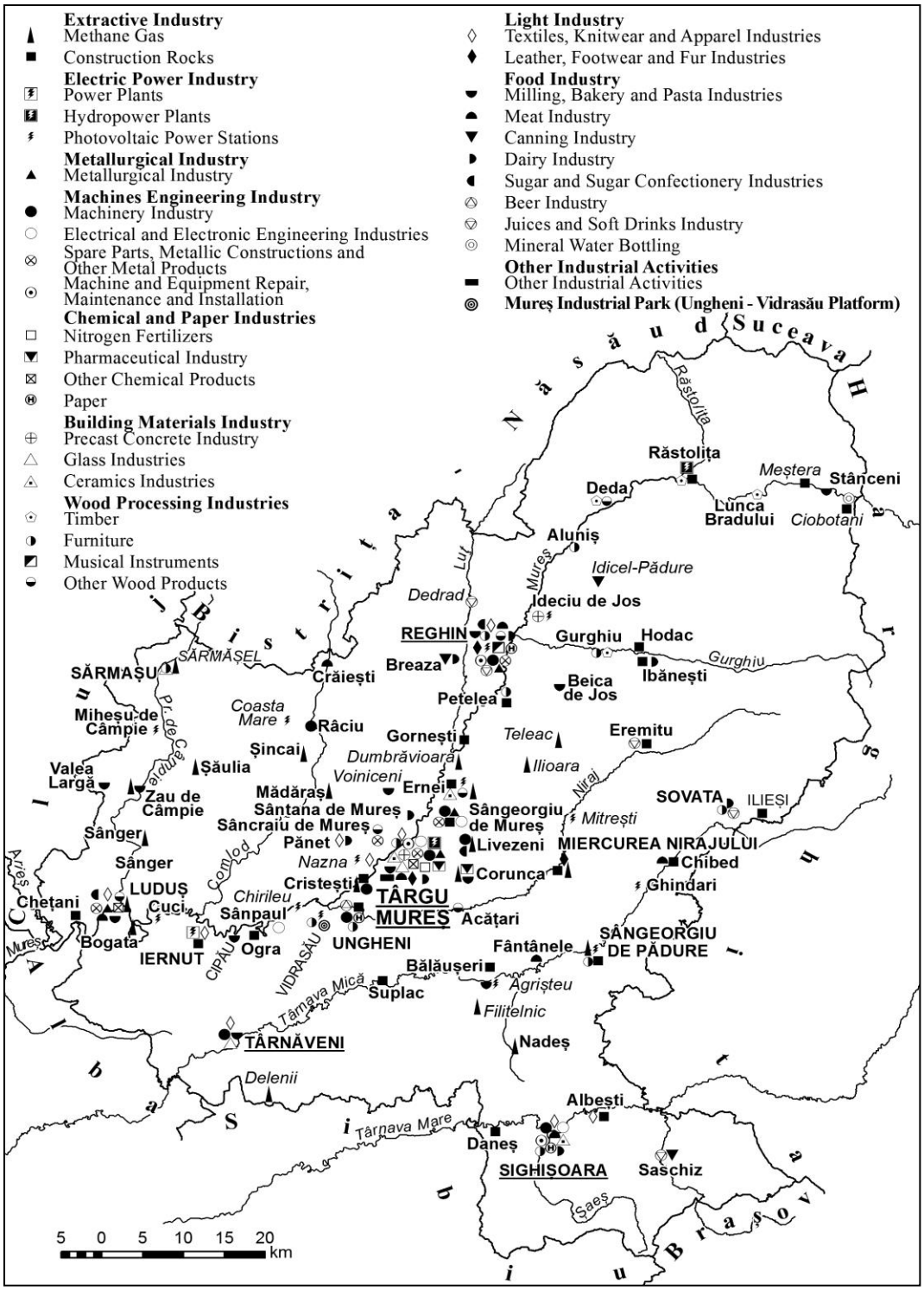

Figure 2. The industrial sectors and subsectors of Mureş County, 2017
(Source: G. B. Tofan & A. Niţă, 2018, p. 41)

CONSTRUCTION MATERIALS AND HANDICRAFT

Suppliers of construction materials are generally concentrated close to their necessary resources, their markets, as well as to the available workforce. Despite the fact that a fast connection between supply, production and sales is important, the units comprising this sector have the advantage of product imperishability and are thus able to create caches; therefore, the less expensive locations, situated far from industrial clusters and main transport routes, are extremely suitable for such units, especially if a source of raw material is nearby.

LIGHT INDUSTRY

Light industry companies utilize light equipment, fewer raw materials, while the resulting products are easily shipped. The main location criterium is the availability of cheap labour, especially when one takes into account the fact that workforce training is effortless. Raising land prices in large cities and close to transport routes will eventually force these companies to relocate to the adjacent rural areas, frequently containing a young labour force.

FOOD INDUSTRY

Resource and product perishability is the main element influencing the location of food industry. The existence of cheap labour is an additional criterium. Therefore, their location is either at the source, or in areas with easy access to transport infrastructure, for a fast connection with distributors and consumers. Frequent locations are smaller cities and towns, halfway between the source and the main transport routes. These are locations with an infrastructure superior to communes and a relatively well-educated labour force.

CONCLUSIONS

At the end of this scientific endeavour, we would like to draw some conclusions on the topic at hand:

- the activities of the secondary sector in Mureş are part of the Transylvanian industrial region, of great complexity, represented by almost all industries, from natural resource extraction all the way to industrial processing, with its subsectors;

- in terms of the industrial production value of the county, the light industry holds the number one spot with 18.3%, while metallurgy is last, with only 1.4%;

- Mureş County has two main industrial areas: *one on the middle section of Mureş*, with high industrial concentrations in Târgu-Mureş (metallurgy, machinery, chemical industry, wood processing, ligh and food industries), followed by other centres such as: Reghin (metallurgy, machinery, furniture and musical instruments, textiles, shoes, beverages etc); Ungheni (construction materials, machinery, furniture, beer etc), Iernut (construction materials, energy and textiles)and Luduş (sugar), while the second lies on *the Târnave* (Târnăveni, Sighişoara, Sângeorgiu de Pădure), with a concentration of industries producing machinery, electronics, glass and ceramics, furniture, textiles, dairy products etc;

- positioned in the metropolitan area of the county capital, the commune of Sângeorgiu de Mureş is the most industrialized rural area (metallurgy, machinery, other metal products etc), there are also a series of communes specialized in food industries: Agrişteu, Voiniceni, ValeaLargă (bakery and pastry), Crăieşti, Fântânele (meat), Breaza, Brâncoveneşti, Saschiz (cans), Ibăneşti, Pănet, Sântana de Mureş, Breaza (dairy), Batoş (beverages), Stânceni (mineral water bottling);

- the most important industrial units are the following: *Iernut Powerplant* (energy), *Plasmaterm* (metallurgy), *Maviprod & Irum* (machinery), *Electromureş*, *Hirschmann Automotive* (electrotechnics and electronics), *Azomureş* (chemical fertilizers), *Gedeon Richter*, *Bioeel, Sandoz* (medicine and pharmaceuticals), *Romchim* (other chemical products), *Gecsat* (glass), *Siceram* (ceramics), *Mobex, MobilaDalin, MobilăSovata*, *Artemob, Kastamonu* (furniture), *Hora, Gliga* (musical instruments), *Textor, Larom, Târnava* (textile industry),

Manpel, Alpina Shoe Production (shoe and leather), *Eldi, TimKo Brut* (bakery and pastry), *Primacom, OpreaAvicom, Egan Prod* (meat); *AgroSprint* (can industry), *Hocland, Mirdatod Prod, Therezia, Indlacto* (cheese), *Tereos* (sugar), *Neumarkt* (beer industry), *NaturAgrofar* (beverages), *Romaqua Stânce*ni (mineral water bottling) etc.

- the most significant changes took place in Târnăveni (Bicapa, Carbid Fox, and Cars), which led to depopulation and poverty;

- the existence of single industrial park, at Ungheni-Vidrasău, currently hosting with 18 firms and 1,700 employees (Tofan & Niţă, 2018, p. 52).

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IMPACT ASSESSMENT OF TILLAGE ON CROP YIELD IN THE GUINEA SAVANNAH PART OF KWARA STATE, NIGERIA

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Abstract: Land and water resources are central focus to agriculture and are linked to environmental challenges like erosion, soil degradation, water pollution, climate change adaptation, destruction of ecosystems and habitat destruction among others. The major driver of these challenges is the use of inappropriate tillage pratices. This study investigated the environmental impact of tillage methods on crop yield and also model the impact associated with tillage methods on crop yield in the guinea savanna ecological zone, Kwara State, Nigeria. Traditional heap (T), Plough/Harrow (PH), Plough/Harrow/Ridge (PHR) and No-till tillage (NT) methods commonly used in the study area were applied to experimental plots at Unilorin Teaching and Research Farm (UTRF) and National Center for Agricultural Mechanization (NCAM), Idofian. Using Randomized Complete Block Design (RCBD), each treatment had three replicates making 12 experimental plots at each location for 2015 and 2016 planting season. Soil Water Assessment Tool (SWAT) was used to simulate the impact of the tillage methods on crop yield in watersheds over two planting seasons. The result findings reveal that crop yield (kg/ha) parameters had PH yield > NT yield (P (0.015) < 0.05) > T yield (P (0.04) < 0.05) and > PHR yield (P (0.046) < 0.05) for UTRF and NCAM sites in 2015 while in 2016, PH yield > T yield (P (0.026) < 0.05) > PHR yield (P (0.046) < 0.05) and no statistical difference between PH and NT at both locations. Also, in the UTRF site, plant height, number of leaves, leave length and leave width explained 59.3% and 43.3% in 2015 and 2016 of the variance in the yield of maize respectively, while in NCAM site, these variables explained 54.7% and 1.1% in 2015 and 2016 respectively. The study concludes that the different tillage methods impact on the crop yield, however, Plough/Harrow had comparatively favorable effect on the soil environment, contribution to surface runoff and crop yield. It is therefore recommended that PH should be adopted for a sustainable environment.

Key words: tillage, environmental impact, crop yield, agriculture

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INTRODUCTION

Many studies have investigated the effect of soil tillage on crop yields, however the results are often contradictory owing to different soils and crops and using different tillage intensities.

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Some authors reported sustained or increased crop productivity in conservation tillage, but usually a negative yield impact was observed depending on the duration and extent to which the conservation tillage is enacted, crop type, as well as on the climate region. The effect of tillage systems on crop yield is not uniform with all crop species, in the same manner as various soils may react differently to the same tillage practice.

According to Cook and Trlica (2016), Corn-yield reductions during the first several years after conversion to Notill from conventional tillage have been noted particularly on poorly drained soils, in Continuous Corn rotations, on certain soil types (e.g., high Organic Matter, fine texture), and in colder, wetter, and more northernly climates. However, other Notill studies have shown no distinct effect of tillage on yield and even a yield advantage in certain years indicating that relative crop performance under Notill may depend on environmental and management interactions.

Agbede et al., (2008) reported that compared with zero tillage methods, mechanized tillage methods caused reduction in plant height, leaf area, stalk girth, dry matter and grain yield and also gave lower N, P, k, Ca and Mg content of the plant. Growth and yield parameters reduced with increased implement pass. Hence, Grain yield was reduced by 11 to 25% as a result of mechanized tillage which was not favourable to performance of sorghum.

Senjobi et al., (2013) concluded that the traditional tillage system resulted in the most favorable soil environment, for crop growth and best performance of crop followed by conventional and no-tillage system in the area studied respectively. The significant difference in yields adduced to lower bulk density, higher water holding capacity and porosity which increased plant root proliferation and optimal utilization of soil nutrients under tilled methods. Hence tillage methods have the capability to increase production while no-tillage is better under long term production for sustainable land use.

Policymakers and environmentalists believe that there is an urgent need for a change in the agricultural land management practices towards the adoption of "best management practices" (Amir and Theodor, 2012; Derpsch and Friedrich, 2010; Herman, 2010; IAASTD, 2009; FAO, 2008; IPCC, 2007). Some of such agricultural land management practices include crop rotation, alternate management practices on cultivated land, and conservation tillage practices. Besides, numerous Federal and State incentive-based programmes have been introduced in order to improve several environmental amenities. Some of the programmes are the Conservation Reserve Program (CRP), the Environmental Quality Incentive Program (EQIP), the Wetland Reserve Programs, Agricultural Development Programme (ADP) among others. The information from the literature point to the fact that tillage practices have great impact on the soil physical, chemical and biological properties, runoff amount, sediment loss, nutrient cycling (input and output), velocity, water quality and crop yield (Aina, 2011; Ohu, 2011; IAASTD, 2009; Giller et al., 2009; Mostaghimi et al., 1988; Lal, 1989). However, the type of soil, slope, precipitation amount, climatic condition, and the type of crop planted vary from place to place consequently influencing the level of impact of tillage on crop yield. This study investigated the environmental impact of tillage methods on crop yield and also modeled the impact associated with tillage methods on crop yield.

The Study Area

The study was carried out at the University of Ilorin Teaching and Research Farm, Ilorin (UTRF) and National Centre for Agricultural Mechanization (NCAM), Idofian which are located in Ilorin South Local Government Area and Ifelodun Local Government Area, Kwara State respectively. UTRF is located between latitudes 8º28′N and 8º29′30″N, and between longitudes 4º 38′30″E and 4º40′30″E NCAM is located between latitudes 8º22″N and 8º23″N, and between longitudes 4º40″E and 4º41″E (figures 1). The Ilorin-Lokoja trunk A road marks the northern limit from the Oyun river bridge (Ahaneku, 1990). The climate of the study area falls within the tropical hinterland climatic zone. It is tropical and seasonal having dry season occurring between November to April, and rainy season between May and October (Mustapha, 2008). The temperature ranges from 20ºC-30ºC. The vegetation is Guinea savannah grassland which is

characterized by the presence of fire tolerant woody shrubs and trees which are biologically suited to withstand dry conditions such as locust bean trees, shear butter trees etc. The soil is ferruginous tropical soil and classified as Topic Haplustalf of Eruwa, and Odo-owa series. The parent material consists of Micaceousschists and genesis of basement complex origin which are rich in ferro-magnesian minerals. Majority of the people in the study area practice subsistence farming, petty trading and are small holder farmers comprising of Yoruba, Fulani and Nupe and practice a combination of land tenure systems such as individual, rent, communal, lease hold among others. According to Ahmed (2009), food crops such as Yam, Cassava, Maize, Rice, Soya beans, Locust-beans and Groundnut are produced. Some local industries include: Garri processing, minning, Shea butter processing, trading, commerce, administration, etc.

Materials and Methods

Four treatments with three replicates were carried out using Randomized Complete Block Design (RCBD). They were treatment A (zero or no-tillage- NT), treatment B (plough and harrow-PH), treatment C (plough, harrow and ridge-PHR), and treatment D (heap traditional farming-T). These are conservative and conventional tillage types used in the study area. Simulation was made from the experimental plot for the entire Oyun drainage basin. Maize (Zea Mays. L. SWAM 1 variety) was planted for two farming seasons (i.e 2015 and 2016 farming year) on plot size of 5m x 5m at spacing of 75 cm between rows and 50 cm within row. NPK (15:15:15) fertilizer was applied at 4 weeks and 8 weeks of planting, pre-emergence and post emergence herbicide for weed control were administered on the sets of the experimental plot as a normal agronomic practice.

These covered for both conventional and conservative tillage methods used in the study area. Soil Water Assessment Tool (SWAT) was also used to model the impact of tillage on crop yield through a ARCSWAT 2012.10.19 for ARCGIS software 10.2, 10.3 and 10.4. The Hydrologic Response Unit (HRU) was generated in the SWAT environment. Maps and satellite images showing the landuse types, soil, climate, relief and drainage were sourced from National Space Research and Development Agency, Nigerian Geological Agency, Kaduna State and Kwara State Bureau of Lands and Survey. Data were complemented with information from relevant books, journals, internet sources and literature.

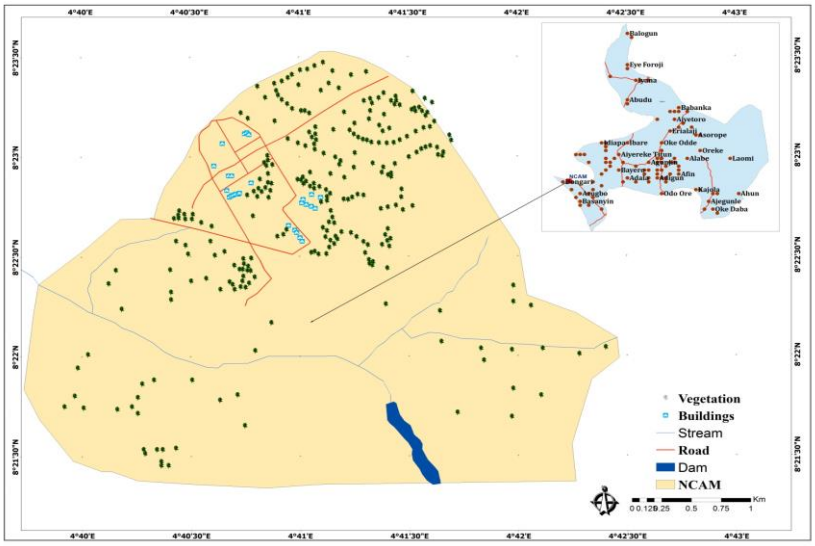

Figure 1. Map of National Center for Agricultural Mechanization (NCAM) with inset of Ifelodun Local Government Area, Kwara State, Nigeria
Source: National Space Research and Development Agency (2014)

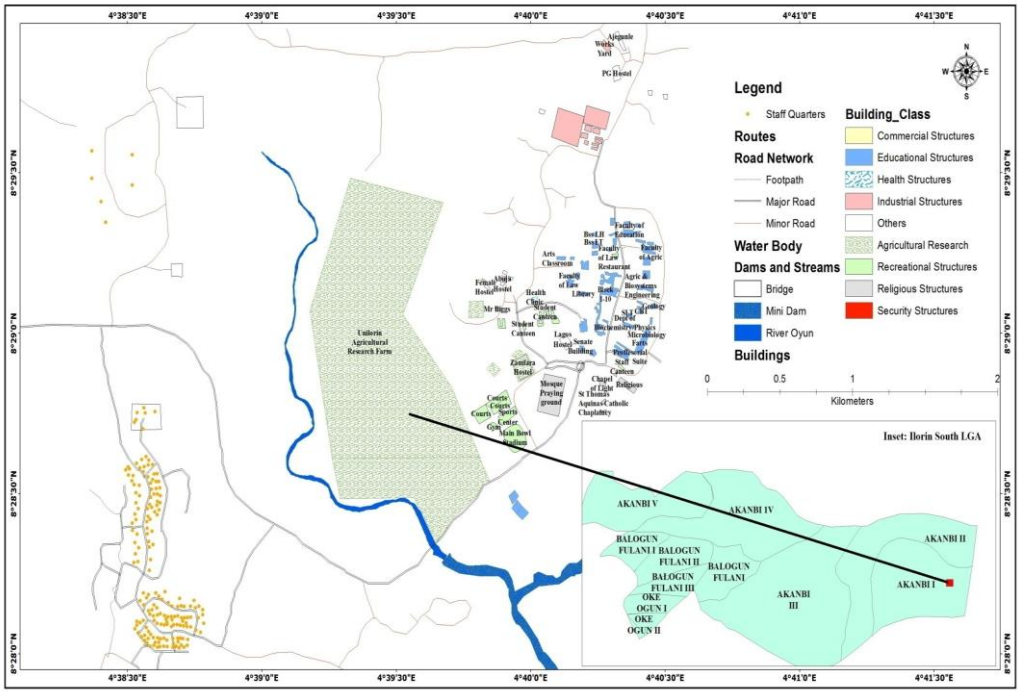

Figure 2. Map of University of Ilorin showing the Teaching Research Farm with inset map of Ilorin South Local Government Area
Source: GISCleric International (2014)

RESULTS AND DISCUSSION

Agronomic Variables and Crop Yield in the University Teaching Research Farm (UTRF) and National Center for Agricultural Mechanization (NCAM) Experimental sites.

Most of the yield parameters measured was recorded highest on the Plough/Harrow and Plough/Harrow/Ridge tillage method except for the leaf area index which was recorded highest on Traditional heap and Notill tillage methods (see table 1 and 2). For instance, at highest mean value of leave width, leave length and maize height, an improved maize yield was recorded on PHR plot at the NCAM experimental site in both years while only 2015 recorded high yield on PH plot. The reverse is the case for UTRF experimental site where majority of the yield parameters were recorded highest on the Traditional heap and Notill methods. Also, leave length, number of leave area and plant height recorded an improved maize yield on Traditional heap plots in 2016 but 2015 was recorded high yield on Plough/Harrow plot. In addition, Plough/Harrow plot recorded the highest yield value for both site in 2015 although this was not the case in 2016. This implies that there is an improved maize yield in the application of PH compared with the other tillage types (see figure 3-8).

Table 1. Summaries of Yield Parameters for 2015 and 2016 planting season (UTRF)
(Data sources: Author's fieldwork, 2016)

SN	Agronomy Parameters	Tillage Type	Minimum		Maximum		Mean		Std. Dev.		CV	
			2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
1.	Maize Height	Traditional heap	1.65	1.98	1.95	2.93	1.81	2.32	0.15	0.52	8.29	22.41
		Plough/Harrow	1.72	1.56	1.86	2.46	1.78	1.89	0.07	0.49	3.93	25.93
		Plough/Harrow/Ridging	1.33	1.89	2.11	2.2	1.60	2.02	0.44	0.15	27.5	7.43
		No-Till	1.42	2.09	1.78	2.35	1.65	2.18	0.19	0.14	11.52	6.42
2.	No of Leaves	Traditional heap	12	10	13	13	12.33	11.33	0.58	1.52	4.7	13.42
		Plough/Harrow	12	11	13	13	12.33	11.66	0.58	1.15	4.7	9.86

		Plough/Harrow/Ridging	12	11	12	12	12.00	11.66	0.00	0.57	0	4.89
		No-Till	10	12	12	15	11.00	13.66	1.00	1.52	9.09	11.13
3.	Leave Length	Traditional heap	0.76	0.97	0.9	1.1	0.85	1.02	0.08	0.06	9.41	5.88
		Plough/Harrow	0.71	0.75	0.81	1.05	0.78	0.93	0.05	0.16	6.41	17.2
		Plough/Harrow/Ridging	0.76	0.9	0.87	0.94	0.83	0.91	0.06	0.02	7.23	2.2
		No-Till	0.62	0.86	0.83	1	0.75	0.95	0.11	0.07	14.67	7.37
4.	Leaf width	Traditional heap	4.13	4	4.88	5	4.38	4.33	0.43	0.57	9.82	13.16
		Plough/Harrow	4.05	3.5	4.41	4.3	4.21	3.93	0.18	0.40	4.28	10.18
		Plough/Harrow/Ridging	4.23	4	4.59	5	4.37	4.66	0.19	0.57	4.35	12.23
		No-Till	4.13	3.3	4.75	4	4.42	3.6	0.31	0.36	7.01	10.00
5.	Crop Yield (tones/ha)	Traditional heap	1000	1040	1800	1600	1400	1253.33	400	302.87	28.57	24.17
		Plough/Harrow	2000	640	2600	1280	2333.33	880	305.51	348.71	13.09	39.63
		Plough/Harrow/Ridging	1200	760	2000	920	1533.33	826.66	416.33	83.26	27.15	10.07
		No-Till	1000	440	1400	720	1200	586.66	200	140.47	16.67	23.94
6.	Leave Area Index	Traditional heap	1.91	2.52	2.21	2.85	2.01	2.67	.169	.166	8.40	6.21
		Plough/Harrow	1.80	1.81	2.46	2.52	2.19	2.19	.348	.358	15.89	16.34
		Plough/Harrow/Ridging	1.72	1.11	2.12	1.85	1.92	1.35	.201	.422	10.46	31.25
		No-Till	2.11	2.46	2.69	3.10	2.48	2.84	.327	.336	13.18	11.83

KEY- T-traditional heap, PH-plough/harrow, NT-No-till, PHR-Plough/harrow/ridge, CV- coefficient of variation, UTRF –Unilorin Teaching and Research Farm plots.

Table 2. Summaries of Yield Parameters on NCAM site for 2015 and 2016 planting season
(Data sources: Author's fieldwork, 2016)

SN	Agronomy Parameters	Tillage Type	Minimum		Maximum		Mean		Std. Dev.		CV	
			2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
1	Maize Height	Traditional heap	1.59	2.04	1.76	2.2	1.69	2.10	0.09	0.08	5.33	3.81
		Plough/Harrow	1.6	1.98	2.01	2.41	1.82	2.19	0.21	0.21	11.54	9.59
		Plough/Harrow/Ridging	1.57	1.9	1.85	2.28	1.67	2.11	0.16	0.19	9.58	9
		No-Till	1.53	1.06	1.68	1.29	1.58	1.15	0.08	0.11	5.06	9.57
2	No of Leaves	Traditional heap	10	12	12	13	11.33	12.33	1.15	0.57	10.15	4.62
		Plough/Harrow	11	11	12	13	11.33	12	0.58	1	5.12	8.33
		Plough/Harrow/Ridging	12	12	12	13	12	12.33	0.05	0.57	0.42	4.62
		No-Till	10	8	11	9	10.33	8.33	0.05	0.57	0.48	6.84
3	Leave Length	Traditional heap	0.72	0.8	0.81	0.95	0.75	0.86	0.13	0.07	17.33	8.14
		Plough/Harrow	0.75	0.69	0.84	0.82	0.81	0.77	0.04	0.07	4.94	9.09
		Plough/Harrow/Ridging	0.79	0.82	1.03	0.96	0.89	0.89	0.13	0.07	14.61	7.87
		No-Till	0.71	0.59	0.78	0.82	0.75	0.68	0.04	0.11	5.33	16.18
4	Leaf width	Traditional heap	3.48	4	3.63	4.2	3.55	4.13	0.08	0.11	2.25	2.66
		Plough/Harrow	3.2	3.5	3.9	4.1	3.60	3.76	0.36	0.30	10	7.98
		Plough/Harrow/Ridging	3.48	4	4.23	4.4	3.76	4.23	0.41	0.20	10.9	4.73
		No-Till	3.23	2.3	3.63	3	3.40	2.6	0.21	0.36	6.18	13.85
5	Crop Yield (tones/ha)	Traditional heap	400	440	600	800	466.67	586.66	115.47	189.03	24.74	32.22
		Plough/Harrow	1200	600	1800	640	1400	613.33	346.41	23.09	24.74	3.76
		Plough/Harrow/Ridging	400	680	800	800	566.67	733.33	208.17	61.10	36.74	8.33
		No-Till	200	360	1000	800	733.33	520	461.88	243.31	62.98	46.79
6	Leave Area Index	Traditional heap	2.35	2.91	3.29	4.13	2.80	3.34	.471	.677	16.82	20.26
		Plough/Harrow	2.16	1.97	2.68	3.39	2.45	2.78	.270	.732	11.02	26.33
		Plough/Harrow/Ridging	1.92	2.13	2.81	2.97	2.48	2.57	.492	.423	19.83	16.45
		No-Till	2.41	2.70	2.96	3.53	2.72	3.200	.283	.439	10.40	13.71

KEY- T-traditional heap, PH-plough/harrow, NT-No-till, PHR-Plough/harrow/ridge, CV- coefficient of variation, NCAM- National Centre for Agricultural Mechanization experimental plot

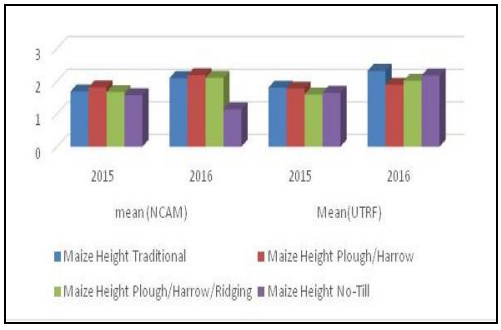

Figure 3. Mean Maize Height on Different Tillage Type in UTRF and NCAM Experimental Plot for 2015 and 2016 planting
Source: Author's fieldwork (2016)

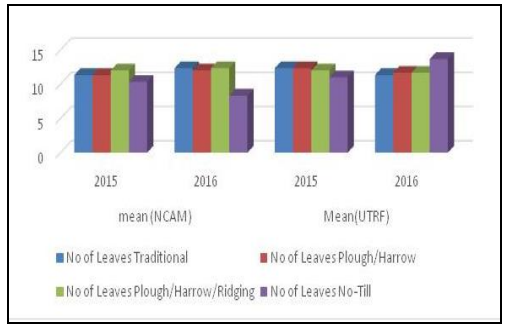

Figure 4. Mean Leave Number on Different Tillage Type in UTRF and NCAM Experimental Plot for 2015 and 2016 planting season
Source: Author's fieldwork (2016)

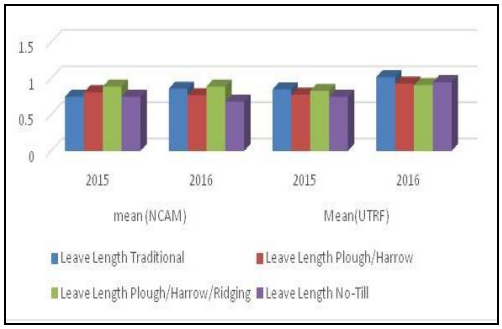

Figure 5. Mean Leave Length on Different Tillage Type in UTRF and NCAM Experimental Site for 2015 and 2016 planting season
Source: Author's fieldwork (2016)

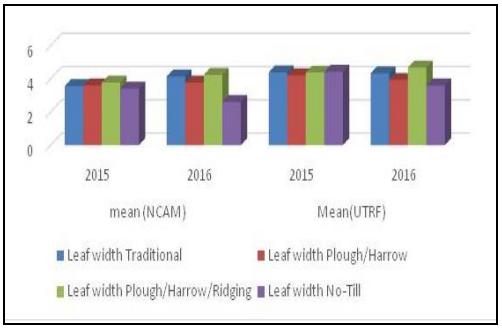

Figure 6. Mean Leave Width on Different Tillage Type in UTRF and NCAM Experimental Site for 2015 and 2016 planting season
Source: Author's fieldwork (2016)

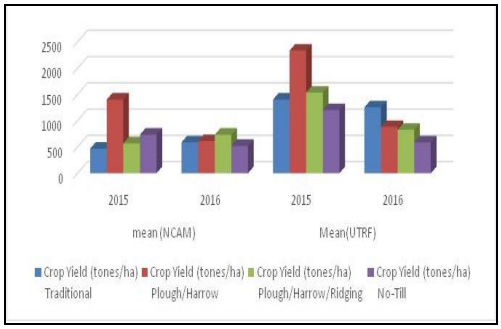

Figure 7. Mean Crop Yield on Different Tillage Type in UTRF and NCAM Experimental Site for 2015 and 2016 planting season
Source: Author's fieldwork (2016)

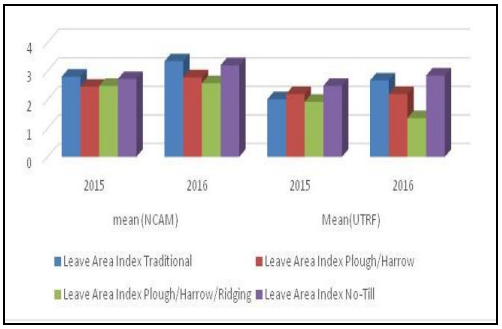

Figure 8. Mean Leave Area Index on Different Tillage Type in UTRF and NCAM Experimental Site
Source: Author's fieldwork (2016)

Impact of Tillage Methods on Maize Yield Parameters

Table 3 shows that there was no significant impact of the tillage methods on maize height on the UTRF experimental site in 2015 and 2016 (p value (0.705) > 0.05 and p value (0.562) > 0.05 respectively). For the NCAM site, there was no significant impact of the tillage methods on maize height in 2015 (p value (0.317) < 0.05) but there is a significant impact of the tillage methods on maize height in 2016 (p value (0.01) < 0.05). Hence, tillage methods do affect the maize height although a remarkable effect was not marked between 2015 and 2016.

Table 3. Tillage Impact on Maize Height
(Data sources: Author's fieldwork, 2016)

SN	Sites	Sum of Squares		Df		Mean Square		F		Sig.	
		2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
1	UTRF	.094	.310	3	3	.031	.103	.481	.731	.705	.562
2	NCAM	.087	2.186	3	3	.029	.729	1.381	27.721	.317	.001

For the number of leaves, there was no significant impact of the tillage methods on the number of maize leaves on UTRF experimental plot in 2015 and 2016 with p value (0.104) > 0.05 and p value (0.171) > 0.05 respectively as shown in table 4. On NCAM experimental site, there was no significant impact of the tillage methods on the number of maize leaves in 2015 (p value

(0.106) > 0.05) but there is a significant impact in 2016 (p value (0.001) < 0.05). This implies that the tillage methods do affect the number of leaves although a remarkable effect was not marked between 2015 and 2016.

Table 4. Tillage Impact on Number of Maize Leaves
(Data sources: Author's fieldwork, 2016)

SN	Sites	Sum of Squares		Df		Mean Square		F		Sig.	
		2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
1	UTRF	3.583	10.25	3	3	1.194	3.417	2.867	2.158	.104	.171
2	NCAM	4.250	34.25	3	3	1.417	11.417	2.833	22.83	.106	.001

Furthermore, table 5 shows that there was no significant impact of the tillage methods on the maize leaf length at the UTRF experimental site in 2015 and 2016 (p values (0.418) > 0.05 and p value (0.555) < 0.05 respectively). On NCAM experimental site, there was no significant impact of the tillage methods on the maize leaf length in 2015 and 2016 (p value (0.176) > 0.05 and p value (0.072) < 0.05). Hence, tillage methods do not affect the maize leaf length between 2015 and 2016 and at both locations.

Table 5. Tillage Impact on Maize Leave Length
(Data sources: Author's fieldwork, 2016)

SN	Sites	Sum of Squares		Df		Mean Square		F		Sig.	
		2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
1.	UTRF	.020	.021	3	3	.007	.007	1.602	.744	.418	.555
2.	NCAM	.036	.079	3	3	.012	.026	2.118	.3445	.176	.072

Table 6 reveals that there was no significant impact of the tillage methods on the maize leave width on the UTRF experimental site in 2015 and 2016 (p values (0.837) > 0.05 and p value (0.116) > 0.05). On NCAM experimental site, there was no significant impact of the tillage methods on maize leaf width in 2015 (p value (0.562) > 0.05) while in 2016, there was significant impact of the tillage methods on Maize leaf width (p value (0.001) < 0.05). The implication of this result is that tillage methods do affect the maize leave width although a remarkable effect was not marked between 2015 and 2016.

Table 6. Tillage Impact on Maize Leave Width
(Data sources: Author's fieldwork, 2016)

SN	Sites	Sum of Squares		Df		Mean Square		F		Sig.	
		2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
1.	UTRF	.075	1.947	3	3	.025	.649	.282	2.704	.837	.116
2.	NCAM	.191	5.057	3	3	.064	1.686	.731	24.079	.562	.001

In addition, table 7 reveals that leave area index across the four-tillage type (T, PH, PHR and NT) are not significantly different in 2015, but they are significantly different in 2016 with p value (0.134) > 0.05 and (0.003) < 0.05 respectively. The result indicated that leave area index were independent of tillage types at UTRF experimental site in 2015, but are influenced by tillage type in 2016. Also, the leave area index across the four tillage types (T, PH, PHR and NT) were not significantly different at NCAM experimental site in both 2015 and 2016 with p value (0.651 and 0.396) > 0.05. It implies that tillage type has no significant impact on leave area index in 2015 and 2016 at NCAM experimental site. Maize leaf area is of importance to photosynthesis and yield. The photosynthetic capacity of crops is a function of leaf area. Leaf area is important for crop light interception and therefore has a large influence on crop yield. The findings in 2016 is in agreement with Sullivan (2003) as cited in Karuma et al., (2016) who reported higher LAI values in maize cultivated under conventional tillage and attributed this to improved access to soil moisture as compared to no-till. Thus, higher LAI results in better ground cover for lesser soil

water evaporation and increased weed suppression. Therefore, the differences in maize LAI under the different tillage practices can also be attributed to the differences in exploration of the maize roots for soil moisture in the soil profile.

Table 7. Tillage Impact on Leave Area Index

SN	Sites	Sum of Squares		Df		Mean Square		F		Sig.	
		2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
1	UTRF	.558	3.982	3	3	.186	1.327	2.490	11.857	.134	.003*
2	NCAM	.264	1.152	3	3	.088	.384	.569	1.123	.651	.396

For crop yield, table 8 shows that the regression model for the tillage methods significantly impacted on crop yield in 2015 but not in 2016 on the UTRF experimental site with a coefficient of determination of 59.3% for 2015 which is relatively high and 43.3% for 2016 respectively. This further shows that there is a strong relationship and it is statistically positive with $r^2 = 0.593$. This implies that an improvement on the tillage methods will bring about increase to the maize yield in 2015 on UTRF site only. There is a relatively weak relationship and statistically positive with $r^2 = 0.433$ between maize yield and tillage methods. This also implies that the tillage methods improves maize yield in 2016 as shown by the research findings in the experimental farm. The Turkey test for 2015 further shows that on UTRF experimental plots, PH yield > NT yield (p value (0.015) < 0.05), PH yield > T yield (p value (0.04) < 0.05) while PH and PHR are not statistically different in crop yield. The Turkey test for 2016 shows that on UTRF experimental plot, T yield > NT yield (p value (0.042) < 0.05) while there is no significant difference between the other treatment plots.

Table 8. Impact of Tillage Methods on Crop Yield in UTRF Experimental Plot
(Data sources: Author's fieldwork, 2016)

Source	Type III Sum of Squares		Df		Mean Square		F		Sig.	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Corrected Model	2223333.333a	684266.667b	3	3	741111.111	228088.889	6.352	3.801	.016	.058
Intercept	31363333.333	9434133.333	1	1	31363333.333	9434133.333	268.829	157.236	.000	.001
Tillage Type	2223333.333	684266.667	3	3	741111.111	228088.889	6.352	3.801	.016	.058
Error	933333.333	480000.000	8	8	116666.667	60000.000				
Total	34520000.000	10598400.000	12	12						
Corrected Total	3156666.667	1164266.667	11	11						

a. Dependent Variable: Crop Yield, R Squared = .704 (Adjusted R Squared = .593)
b. R Squared = .588 (Adjusted R Squared = .433)

On NCAM experimental plot, the tillage methods significantly impact on crop yield in 2015 but not in 2016 with a coefficient of determination of 54.7% which is relatively high and 1.1% respectively as shown in table 6-9. This shows that there is a strong relationship and direct that is statistically positive with $r^2 = 0.547$ between tillage methods and maize yield at NCAM Plot. This implies that the tillage methods improve maize yield only in 2015 on NCAM site. There is a very weak direct relationship and but statistically positive with $r^2 = 0.011$ between the tillage methods and maize yield because there are other environmental factors which contributed largely to the maize yield at the expense of the tillage methods in the area. This also implies that the tillage methods improves maize yield in 2016 as shown by the research findings in the experimental farm. The Turkey test for 2015 on NCAM shows that PH yield > T yield (p value (0.026) < 0.05). Also, PH yield > PHR yield (p value (0.046) < 0.05) which is statistically significant. There is no statistical difference in maize yield between PH and NT. The Turkey test for 2016 experimental treatment revealed that there is no significant difference between all the treatment plots.

The SWAT analysis generated three (3) hydrological response units (HRU) each for the two study areas. The HRU is the smallest spatial unit of the model because it lumps all similar land use, soil, elevation profile, and slope within a sub basin based on user defined threshold. Shown in

tables 2 is the distribution of the HRU in UTRF and NCAM sub catchments. Figure 2 shows a schematic representation of the hydrologic cycle modeled in SWAT for the study areas.

Table 9. Impact of Tillage Methods on Crop Yield in NCAM Experimental Plot
(Data sources: Author's fieldwork, 2016)

Source	Type III Sum of Squares		Df		Mean Square		F		Sig.	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Corrected Model	1589166.667a	71466.667b	3	3	529722.222	23822.222	5.433	.961	.025	.457
Intercept	7520833.333	4514133.333	1	1	7520833.333	4514133.333	77.137	182.02	.000	.000
Tillage Type	1589166.667	71466.667	3	3	529722.222	23822.222	5.433	.961	.025	.457
Error	780000.000	198400.000	8	8	97500.000	24800.000				
Total	9890000.000	4784000.000	12	12						
Corrected Total	2369166.667	269866.667	11	11						

a. Dependent Variable: Crop Yield, R Squared = .671 (Adjusted R Squared = .547)
b. R Squared = .265 (Adjusted R Squared = .011)

Table 10. Distribution of the HRU in UTRF and NCAM sub catchments

Name	Sub basin	Hydrologic Response Unit	Land Area Covered (m2)	Tillage method
UTRF	18	44	0.463	PH
UTRF	18	45	0.201	NT, T
UTRF	18	46	0.209	PHR
NCAM	42	103	0.872	NT ,T
NCAM	42	104	2.19	PH
NCAM	42	105	2.56	PHR

*NOTE: T-Traditional heap, PH-Plough/Harrow, PHR-Plough/Harrow/Ridge, NT-No Till

In simulating the impact of the different tillage methods, Soil Water Assessment T model for both UTRF and NCAM experimental plots are 17.27 and 16.09 metric tons/ha. On UTRF site, NT, T and PHR treatment plots had the same value of 4.32 metric tons/ha while PH plot had 4.31 metric tons/ha. On NCAM experimental plot, all the tillage types had the same value of 4.03 metric tons/ha as shown in table 11. The modeled summary for crop yield is shown in figure 5. According to Aina (2011), No-tillage has proven to be an attractive alternative for maize (Zea mays L.) and other row crops on coarse-textured soils in the humid' and subhumid tropics while in the semi-arid region with fine textured soils, some type of conventional tillage system of mechanical seedbed preparation (plowing and harrowing) is necessary. The frequency and type of mechanical operation desired depends on soil characteristics and the crops to be grown.

The observations reveal that Plough/Harrow tillage method is the most suitable for optimum crop yield in maize production in this ecological zone. Therefore, the application of this tillage type by farmers in the study area is expected to give increased maize yield as well as conserve water and soil quality. Furthermore, the variations experienced between the two planting seasons in the crop yield on UTRF and NCAM experimental sites are probably due to innate soil properties, texture, structure, type of soil, weather variability among others. Lal (1986) observed increased maize grain yields on plots with no-till treatment (2.5 t ha-1) compared with the plow-till treatment (2.0 t ha-1) in southwest Nigeria. Also, Agbede et al., (2008), Obalum et al., (2011), and Senjobi et al., (2013) had different conclusion in their studies that traditional tillage system resulted in the most favorable soil environment, for crop growth and best performance of crop followed by conventional and no-tillage system and concluded that tillage methods have the capability to increase production while no-tillage is better under long term production for sustainable land use.

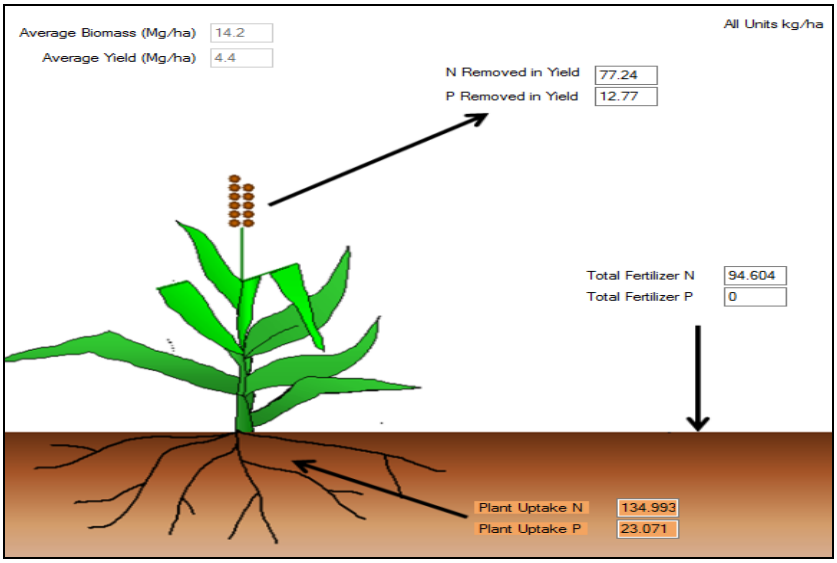

Figure 5. SWAT modeled summary for crop yield in the study area
Source: Author's fieldwork (2017)

Table 11. Crop/harvest yield in the study area
Source: Author's fieldwork (2016)

Tillage types	UTRF	NCAM
PH	4.31	4.03
NT	4.32	4.03
T	4.32	4.03
PHR	4.32	4.03
Grand total (metric tons/ha)	17.27	16.09

CONCLUSION AND RECOMMENDATION

The study concludes that the different tillage methods impact on the crop yield, however, Plough/Harrow had comparatively favorable effect on the soil environment, contribution to surface runoff and crop yield. It is therefore recommended Plough/Harrow should be adopted for a sustainable environment due to its comparatively favorable effect on the soil environment, contribution to surface runoff and crop yield in this ecological zone.

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A COMPARATIVE ANALYSIS OF CARBON EMISSIONS IN THE ECOLOGICAL ZONES OF NIGERIA

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Abstract: Carbon dioxide concentrations have risen in recent years. The increase in atmospheric carbon dioxide which has been linked to the onset of the industrial revolution has been largely responsible for the observed changes in the climate worldwide. This study examined the spatial emission of carbon from the different ecological zones in Nigeria and the relationship with vegetation health. Monthly data (January-December) of Moderate Imaging Spectroradiometer (MODIS) of Normalized Difference Vegetation Index (NDVI) and carbon data set of 500 m spatial resolution between year 2000 and 2012 for Nigeria were utilized for the study. The images were extracted from the archives of the National Earth Observatory. Zonal statistics of ArcGIS 10.1 software was employed to extract data of carbon emission and NDVI. Spearman's correlation analysis was used to determine the relationship between carbon emission and NDVI. The results showed that carbon emission ranged between 13.87 ppm and 256.89 ppm with the highest found in the fresh water swamp (142.15±60.00 ppm) and the least in sudan savanna (108.07±29.7 ppm). The forest zones had NDVI ranging between 0.35-0.80 while savanna zone recorded between 0.16 and 0.59. Results further showed that carbon emission contributes to NDVI depletion. ($r=-0.48$, $p<0.05$). Overall, there appear to be decline in vegetation health in Nigeria while the emission of carbon gradually increased during the study period. This study provides an opportunity to identify carbon sources so that adequate provision can be made for effective mitigation strategies to forestall the adverse impacts of climate change in a developing country.

Key words: Carbon emission, Vegetation, ecological zone, Nigeria, Normalized Difference Vegetation Index

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INTRODUCTION

Human presence on earth is made possible by carbon dioxide (CO_2) and other greenhouse gases which play an important role in earth's climate. CO_2 helps to stabilize the earth's temperatures to levels suitable for organic life through the greenhouse effect. Though, the increase in the concentration of greenhouse gases has been attributed as the major cause of global climate

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change which is the greatest challenge to humankind in the 21st century,carbon dioxide is the most prevalent GHG produced by human activities (Dilmore and Zhang, 2018; Harris et al., 2017). Its concentration in the atmosphere has however been on the increase since pre-industrial times (Olivier et al., 2017; Dilmore and Zhang, 2018) with an average concentration of 403.3 ppm in 2016 (Olivier et al., 2017). This rate of increase has also been well documented by the intergovernmental Panel on Climate Change (IPCC, 2014). Although, it has been reported that the African continent has the lowest rate of CO_2 emissions (Canadell et al., 2009; Salam and Noguchi, 2005; Collier et al., 2008) but the rate of increase is above the world average and it is likely to increase in the coming years (Canadell et al., 2009; Collier et al., 2008). The major sources of carbon emission in the tropics are timber harvest, woodfuel use, tropical deforestation, forest degradation, biomass burning and wildfires (Pearson et al., 2017; Herman, 2009; Houghton, 2012; Van der Werf et al., 2003; Fearnside and Laurance, 2004; Mouillot et al., 2006; Williams et al., 2007). Nigeria is Africa's most populous country and CO_2 emissions are on the increase majorly from Land use change and fossil fuels due to the rapid population growth and rapid growth in per capita GDP (Canadell et al., 2009; Momodu et al., 2011). Though, increased CO_2 emissions have been reported to have positive impacts on plant productivity (Prior et al., 2011), the negative consequences are too numerous. The African continent is one of the most vulnerable regions to climate change due to the fact that her economy is exposed to the vagaries of climate (Collier et al., 2008). Climate change is already a reality in Africa and is having serious impacts on biodiversity, food security,the spread of infectious diseases and conflict in many areas (Collier et al., 2008; Willms and Werner, 2009; Sewakanmbo, 2009). There are few measurements on the carbon emission rate in Africa (Mulatu et al., 2016; MacCarthy et al., 2018). Nigeria emits CO_2 and other greenhouse gases as a result of gas flaring during oil exploration. Although, there have been some studies on CO_2 emissions from urban transportation, the construction industry and energy consumption due to increase in population in the country (Okelola and Okhimamhe, 2013; Edeoja and Edeoja, 2015; Adusah-Poku, 2016; Usman et al., 2017), there are very few studies on the carbon emission rate from the vegetation on which the teeming population depends on for livelihood. This study therefore attempts to investigate the carbon emission rate in the different ecological zones in the country in other to suggest effective mitigation strategies to ameliorate the adverse impacts of climate change.

STUDY AREA

Nigeria is located in the western part of Africa and is one of the largest states in the west African sub region. It is bounded by the Gulf of Guinea in the South, Cameroon and Chad in the east, Niger in the North and Benin in the west and covers an area of 923,769 km^2. The country is located between latitude 4^0 and 14^0 N and longitude 3^0 and 15^0 E. The country has a varied topography with lowlands in the south, hills and plateau in the central part of the country, mountains in the south east and plains in the north. The climate also varies. The south and centre are tropical due to the location near the equator while the north is arid. The vegetation varies from tropical forest in the south to dry savanna in the north. The climate of the country is influenced by the Tropical Maritime (mT) air mass and the Tropical Continental (cT) air mass. The mT is moisture laden while the cT is dry (Iloeje, 1981). Temperature over the country varies from one place to the other.

Annual temperature of over 27° C is experienced in the interior while they are lower near the coast (Odekunle, 2004). Adelekan (2000) reported that the average annual temperature over the country has been increasing at a rate of 0.01°C annually Two main seasons are experienced in the country. These are the wet season which lasts from April to October and the dry season from November to March. Rainfall distribution is uneven and reduces as one moves towards the interior. For example, about 500 mm are recorded in areas in the northern fringes of the country while over 3000 mm are recorded for areas near the coast (Adejuwon, 1981). The climate becomes drier as one moves towards the North. The variations in the global climate are also experienced in the country's climate.

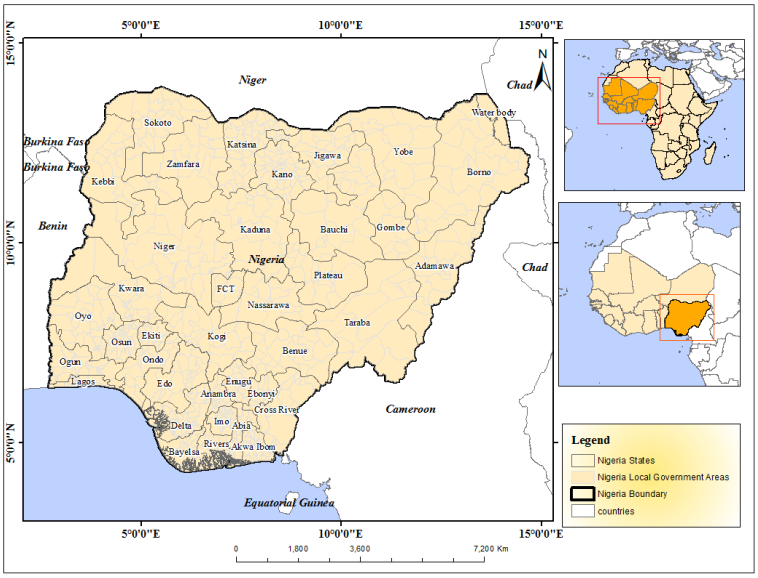

Figure 1. Study Area

METHODOLOGY

This study utilized the monthly data of MODIS (Moderate Imaging Spectroradiometer) Normalised Difference Vegetation Index (NDVI) and Carbon Data set with spatial resolution of 500 m by 500 m. The MODIS carried on board Terra-Aqua and NOAA-series satellites, respectively, are cost-effective sensors, which cover the globe at least once a day. The MODIS sensor acquires data in 36 spectral bands, with variable spatial resolution of 250–1,000 meters (depending on band), in narrow bandwidths and are recorded in 12-bit format. The 36 MODIS bands which are a compromise for atmospheric, land and ocean studies, and seven bands are considered optimal for land applications (Justice et al., 2002). Composite MODIS data have a temporal resolution of 8 days and are available from 2000 onwards.

PRE PROCESSING

Preprocessing includes the derivation of maximum value composite (MVC) monthly images from original daily radiance data. The procedure of deriving monthly MVCs included the examination of daily radiance values for each wave band, together with NDVI values, for each month for each pixel. The highest daily radiance/NDVI value in a month is identified and retained. This minimizes problems of cloud impacts typical of single-date remote-sensing studies (Goward et al., 1994; Eidenshink and Faundeen, 1994). Data were further corrected for atmospheric attenuation (e.g., dust or haze, Cihlar et al., 1994), and distortions due to sun angle and satellite sensor-view angle (Kogan and Zhu, 2001; Flieig et al., 1983; Cracknell, 1997; NGDC, 1993). These satellite images were radiometrically corrected however, geometric corrections had to be done. Since the satellite imagery data set is of global coverage, Nigeria was extracted from it using the Nigeria boundary shapefile. The images were then resampled in order to ensure the resize pixel of the two dataset. Monthly images (January-December) from 2000-2012 were rescaled to get the NDVI values ranging from +1 to -1 by using the following expression:

(NDVIi-128)*0.008

Where, NDVIi is NDVI for the month; the entire processing of the NOAA data has been done using Idrisi Taiga

POST PROCESSING OF SATELLITE IMAGERY

For NOAA-AVHRR, NDVI is universally defined as:

$$NDVI = \frac{NIR-Red}{NIR+RED}$$

Where NIR is the Near Infra red band and Red is the red band in the electromagnetic spectrum (Lillesand and Kiefer, 1994).

To derive the seasonal pattern of NDVI for 2000-2012, firstly, average NDVI for each year was computed by using the following expression:

$$\text{Average NDVIx} = \frac{JAN\_NDVI + FEB\_NDVI + \cdots\cdots\cdots\cdots DEC\_NDVI}{12}$$

Where, NDVIx is NDVI for y year and JAN_NDVI, FEB_NDVI…….DEC_NDVI stands for NDVI of particular months in that year.

Mean NDVI for 20 years was then computed by using the following expression:

$$\text{Mean NDVI} = \frac{Avg\ NDVI2000 + AvgNDVI2001 + \ldots AvgNDVI2012}{14}$$

To derive the seasonal pattern of Carbon for 2000-2012, firstly, average NDVI for each year was computed by using the following expression:

$$\text{Average NDVIx} = \frac{JAN\_CAR + FEB\_CAR + \cdots\cdots\cdots\cdots DEC\_CAR}{12}$$

Where, CARx is Carbon for y year and JAN_CAR, FEB_CAR…….DEC_CAR stands for Carbon of particular months in that year.

Mean carbon for 12 years was then computed by using the following expression:

$$\text{Mean NDVI} = \frac{Avg\ NDVI2000 + AvgNDVI2001 + \ldots AvgNDVI2012}{12}$$

Where, Average NDVI81…….. Average NDVI2000 stands for the yearly average NDVI value for 12 years.

ANALYSES

Zonal statistics methods of ArcGIS 10.1 software was used to extract the NDVI values and carbon emission values in different ecological zones of Nigeria. A correlation and regression analysis was further carried out to observe the strength of the relationship between carbon emission and NDVI. Data were presented in tables and maps.

RESULTS AND DISCUSSION

Table 1 presents the carbon emissions and NDVI values from the different ecological zones. The result shows that carbon emission from the different ecological zones ranged between 13.87 ppm and 256.89 ppm during the study period. The minimum emission rate was observed in the lowland rainforest with a mean value of 114.81±42.1 ppm while the maximum was from the freshwater swamp forest with a mean value of 142.15±60.00 ppm. The high rate of carbon emission in the freshwater swamp forest may be as a result of warm temperatures. Sjogersten *et al*., (2014) reported increased carbon dioxide emissions from tropical wetlands. Hu *et al*., (2016)

also noted that hydrological factors could be important in the emission of CO_2. Futhermore, the mineralization of organic carbon occurs as a result of the ability of microbes to survive in flooded areas which in turn distrupts soil microbial respiration. The low emission rate from the lowland forest may be attributed to the fact that the area is composed of diverse trees because Montagnin and Nair (2004), reported that trees are known to have a great potential of storing carbon in their biomass. Previous studies have revealed that the tropical forests are an important carbon sink (Pan *et al*., 2011) and that forests can play a major role in climate change through carbon sequestration or emission (Sedjo and Sohngen, 2012). Thus, the role of tropical forests is critical in the global carbon cycle. Reduction in emissions is a way of combating climate change. The result also shows that the NDVI value for the ecological zones range between 0.16 and 0.80. The highest NDVI value was recorded in the Lowland rainforest with a mean value of 0.56±0.14 while the lowest value was recorded in the Sahel savanna with a mean of 0.26±0.1. The high NDVI value recorded in the Lowland rainforest indicates very healthy vegetation and a high density of green vegetation. This may be attributed to the receipt of high precipitation. This indicates that green vegetation signifies a higher photosynthetic activity and vigour (Banan *et al*., 1995). The low NDVI value recorded in the Sahel savanna, Sudan savanna and Guinea savanna can be attributed to the low amount of rainfall received in this area which is in line with the findings of Meneses-Tovar (2011). Studies in other parts of the savanna in Africa also noted the relationship between precipitation and NDVI (Chamaille-James and Fritz, 2009). Vegetation blossoms where environmental conditions are favourable.The freshwater swamp forest was also observed to have average NDVI values probably due to the waterlogged nature of the area.

Table 1. Minimum, Maximum and Mean Carbon Emissions and NDVI in Different Ecological Zones in Nigeria

Carbon Emissions (ppm)		
Ecological Zones	Minimum-Maximum	Mean ±SD
Lowland Rainforest	13.87-199.61	114.81±42.1
Sahel savanna	99.87-120.95	109.71±5.9
Guinea savanna	101.19-121.94	112.37±6.4
Freshwater swamp	89.76-256.89	142.15±60.0
Derived savanna	75.59-241.83	129.36±53.1
Sudan savanna	73.82-156.46	108.07±29.7
NDVI		
Ecological zones	Minimum-Maximum	Mean±SD
Lowland Rainforest	0.35-0.80	0.56±0.14
Sahel savanna	0.16-0.40	0.26±0.1
Guinea savanna	0.18-0.55	0.33±0.1
Freshwater swamp	0.41-0.65	0.52±0.1
Derived savanna	0.23-0.59	0.43±0.1
Sudan savanna	0.19-0.51	0.32±0.1

Table 2 presents the monthly carbon emission rate and NDVI values during the study period. The emission rate ranged between 73.82 ppm and 256.89 ppm. The lowest emission rate was observed in the month of August with a mean value of 111.13±20.41 ppm while the maximum rate was recorded in January with a mean value of 165.91±66.97 ppm. The high rate of carbon emission observed in the month of January may be due to bush burning and other land cover changes which are prevalent during the dry season in many parts of the country as farmers clear and prepare their farmlands in anticipation of the rains which signifies the beginning of the planting season. Thus, the human activities during this period always make a substantial amount of carbon to be released into the atmosphere. Appiah et al., (2018) noted that bush burning constitutes a challenge to farming and thus a cause of climate variability and climate change. As

the CO_2 concentration grows, it increases the radiative forcing of the atmosphere, warming the planet. The low amount of carbon emitted in the month of August may be related to the growing season when plants absorb CO_2 from the atmosphere. This may also be due to a low ratio of photosynthesis to respiration which can be attributed to the fact that higher CO_2 enables plants to grow faster. The monthly NDVI value during the study period ranged between 0.16 and 0.80. The lowest value was observed in the month of April with a mean value of 0.42±0.28 while the highest value was also recorded in the month of April with a mean value of 0.42±0.28. The low and high NDVI observed in the month of April is an indication that there is a large range in vegetation health. This may also be attributed to the fact that the plants respond differently to weather change. This means that there are very healthy and very poor plants.

Table 2. Minimum, Maximum and Mean Monthly carbon emissions and NDVI in Nigeria

Carbon emissions(ppm)		
Month	Minimum-Maximum	Mean±SD
January	110.55-256.89	165.91±66.97
February	101.19-242.72	152.49±58.76
March	105.81-162.99	129.49±21.40
April	90.94 -132.87	114.13±15.24
May	92.13-132.58	108.05±14.52
June	82.11-116.93	100.79±14.79
July	78.99-118.70	104.99±15.79
August	73.82-127.56	111.13±20.41
September	74.30-121.95	97.16±17.82
October	75.59-115.10	93.06±14.16
November	110.09-139.25	121.99±9.94
December	99.87-199.61	152.82±45.23
NDVI		
Month	Minimum-Maximum	Mean±SD
January	0.20-0.60	0.35±0.16
February	0.19-0.52	0.32±0.15
March	0.17-0.51	0.31±0.14
April	0.16-0.80	0.42±0.28
May	0.18-0.67	0.41±0.23
June	0.27-0.58	0.41±0.13
July	0.30-0.59	0.40±0.09
August	0.23-0.54	0.41±0.11
September	0.35-0.55	0.45±0.07
October	0.34-0.73	0.51±0.13
November	0.27-0.64	0.45±0.14
December	0.24-0.62	0.39±0.15

Table 3 presents the annual rate of carbon emission and NDVI during the study period. The emission rate ranged between 99.20 ppm and 120.03 ppm. It was observed that year 2001 had the least rate of emission of CO_2 with a mean value of 100.68±1.71 ppm while the highest rate of emission was recorded in year 2007 with a mean value of 118.28±1.22 ppm. This shows that the rate of emission increased steadily from the beginning of the study period until it reached a peak in year 2007. This also corroborates the report of authors that the rate of carbon emission is reported to be on the increase globally (Friedlingstein *et al*., 2014; Raupach *et al*., 2007; Olivier *et al.*, 2017). The emission rate reduced slightly after year 2007. This may be attributed to the awareness being created on the impact of increased CO_2 in the atmosphere. The table also shows the NDVI values during the study period which range between 0.37 and 0.40. The minimum values were observed in year 2001, 2011 and 2012 with a mean value of 0.37±0.00 while the highest values

were recorded in year 2003 and 2007 with a mean value of 0.39±0.00. The result shows that the vegetation health is poor during the study period as the values are below 0.5. This may be attributed to changing precipitation pattern in the country and land use/land cover changes as a result of increase in population. Fashae et al., (2017) noted the relationship between precipitation and NDVI in the country.

Table 3. Minimum, Maximum and Mean Annual carbon emissions and NDVI in Nigeria

Carbon emissions (ppm)		
Year	Minimum-Maximum	Mean±SD
2000	108.78-110.06	109.73±0.63
2001	99.20-102.38	100.68±1.71
2002	113.48-116.82	114.46±1.58
2003	115.29-118.64	116.55±1.61
2004	106.49-109.98	107.57±1.65
2005	106.37-108.18	107.11±0.89
2006	107.89-108.87	108.18±0.47
2007	117.43-120.03	118.29±1.23
2008	113.52-116.06	114.53±1.24
2009	106.73-108.85	107.56±1.03
2010	104.88-112.56	107.69±3.49
2011	100.77-110.94	104.59±4.49
2012	100.42-110.08	104.36±4.69
NDVI		
Year	Minimum-Maximum	Mean±SD
2000	0.38-0.38	0.38±0.00
2001	0.37-0.37	0.37±0.00
2002	0.39-0.39	0.39±0.00
2003	0.39-0.40	0.39±0.00
2004	0.38-0.38	0.38±0.00
2005	0.38-0.38	0.37±0.00
2006	0.38-0.38	0.38±0.00
2007	0.40-0.40	0.39±0.00
2008	0.39-0.39	0.39±0.00
2009	0.38-0.38	0.38±0.00
2010	0.38-0.39	0.38±0.01
2011	0.37-0.38	0.37±0.01
2012	0.37-0.38	0.37±0.01

Figure 2 presents the correlation between carbon and NDVI. The line equation is given as $y = -301.9x + 242.85$. The R^2 value is given as 0.4886. This indicates that carbon emission contributes about 48% to NDVI depletion in the study area, provided all other factors remain constant as noted by Krakauer *et al.,* 2017. The rate of depletion of NDVI is given as 301.9 and at 242.85 ppm, NDVI would totally collapse which means it will become zero (0).

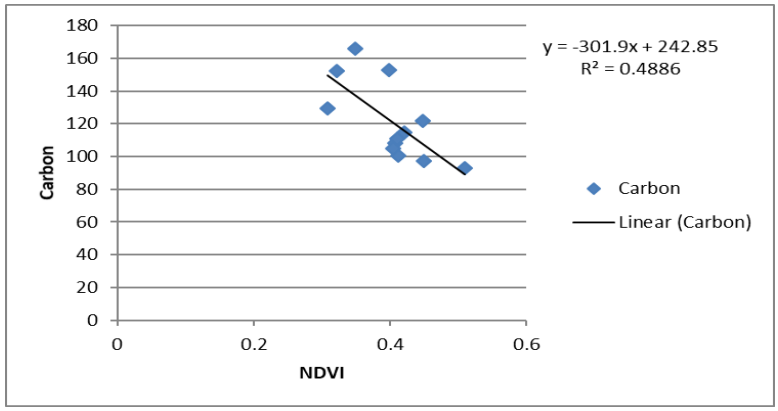

Figure 2. Correlation between NDVI and Carbon emission

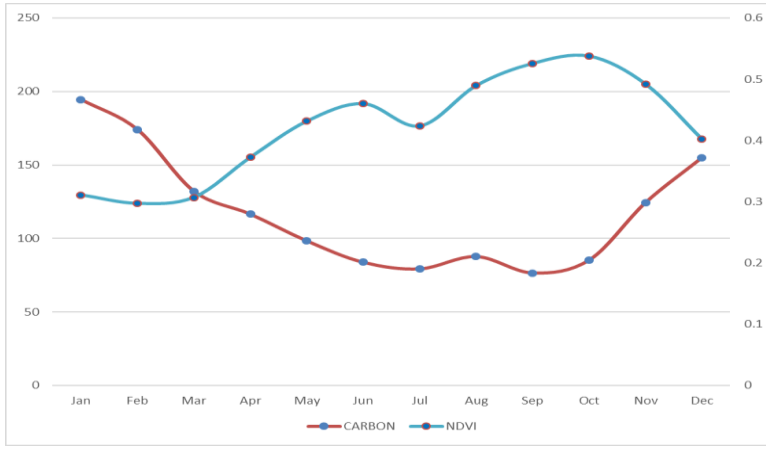

Figure 3. Monthly relationship between carbon emissions and NDVI

Figure 3 presents the monthly relationship between carbon emission and NDVI during the study period. An inverse relationship was observed from the figure. The highest carbon emission was experienced in January which coincides with the period of the lowest NDVI value. The lowest carbon emission was observed in the month of September which is also the month when NDVI was the highest. This relationship could be as a result of the fact that vegetation serves as a major sink of atmospheric carbon (Gibbs et al., 2007; Sedjo and Sohngen, 2012).

CONCLUSION

The study has shown that carbon emission rate is related to the vegetation type and the activities being carried out in each ecological zone. The emissions were also observed to be higher in the months of January, February and March and lower in the other months of the year. Vegetation health was also observed to be related with the climate and a general decline was observed during the study period. Carbon emission and NDVI were found to be inversely related while carbon emission was also observed to be a major contributor to the decline of the NDVI. The need to identify the various sources of carbon dioxide to the atmosphere in different ecosystems is necessary due to the increase in the rate of its emission. This will enable concerted efforts to be focused towards its reduction by adopting effective strategies that would forestall the adverse impacts especially in developing countries where the consequences are severe and the adaptive capacities are lacking.

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GROUNDWATER QUALITY IN RURAL VILLAGES CLOSE TO IRRIGATION FARM IN MOKWA LGA OF NIGER STATE, NIGERIA

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Abstract: This study investigated ground water quality in five rural villages that solely depends or hand-dug wells for both domestic and commercial activities. The five villages are located in the vicinity of an irrigation farm. Water samples collected from all accessible wells in the villages using standard procedures were analyzed for a total of eleven physical, chemical and biologic parameters at University of Ilorin laboratory. These parameters are pH, Temperature, Turbidity, Nitrate, Sulphate, Phosphate, Chloride, Electrical Conductivity, Total Dissolved Solids, Bio-chemical, Oxygen Demand and Dissolved Oxygen. Laboratory results obtained were compared with both Nigerian Standard on Drinking Water Quality (2015) and World Health Organization (2014) Standard on drinking water. Finding from the research revealed that only turbidity do not fall within the acceptable standard. Although the results obtained for Temperature and Dissolved Oxygen are within the acceptable limits as recommended by NSDWQ (2015) and WHO (2014), the values of these two parameters are considered not ideal enough in some of the settlements while the high temperature in some of the settlements can easily trigger chemical reaction, the values of Dissolved Oxygen recorded in some of the settlements indicates conducive conditions for active micro organism activities. The result of comparative quality rating of all the study parameter in each of the five study settlements revealed that groundwater quality generally increase with increasing distance from the irrigation scheme.

Key words: Irrigation, Agriculture, Environment, Degradation, Concentration, Groundwater

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INTRODUCTION

Irrigation is the artificial application of water to soil for the purpose of supplementing the natural available moisture for plant growth. It is one of the methods, man has discovered to fight nature (Iroye, 2018). The practice remains a vital aspect of agricultural production and socio-economic growth of any nation. Irrigation activity is as old as man; apart from the practice being

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developed since ancient time, important civilization of the world have developed on the basis of irrigation management (Gurjar and Jat, 2012). According to Shirsath (2009), many civilizations have risen and fallen with the growth and decline of their irrigation systems.

The four basic requirements in arable agriculture are seed/seedling, soil, solar radiation and water. Of all these four requirements however, water remains the most important. Plants depend on it for growth and photosynthesis. Not only that, nutrients in the soil can only be absorbed when dissolved by water. Asawa (2005) observed that, the application of water to soil is highly essential for plant growth as it creates favourable environment for growth through:

(I) cooling of soil and its surrounding;
(II) washing out and dilution of salts in the soil;
(III) aiding of tillage operation through the softening of clods; and
(IV) reduction in adverse effects of frost on crops.

Irrigation practice is especially germane for sustainable agricultural production considering the global changes in climate which is altering hydrological processes in different parts of the world. Although the frequency, duration and amount of rainfall has increased in some parts of the globe due incident of climate change, pattern of potential evapotranspiration which indicates the water needs of crops have also changed in other regions of the world, especially in Sub-Sahara Africa. Turral et al., (2011) estimated the incremental water requirements to meet the future demand for food due to changing climate to between 40 and 100 percent of the additional water needed without climate change; hence Ayoade (1998) opined that one effective way of combating drought problem is to harness the available water resources for irrigation.

The need for irrigation can however not be justified solely based on water need of crops; the United Nations (2015) projected, the world population to grow by 34 percent from the current 7.3 billion to 9.7 billion in 2050. Much of this increase which is strongly believe will occur in developing countries will require increase in food production by between 40 and 45 percent. Irrigation agriculture which currently uses 20 percent of all agricultural land to produce 40 percent of the world's food production no doubt remains an essential component of any strategy to achieve this (Kadiresan and Khanal 2018). Irrigation accounts for as much as 80 percent food production in Pakistan, 70 percent in China and over 50 percent in India and Indonesia. Not only that, irrigation activity help in creating job, empowerment of people and poverty reduction. Without irrigation, economic development, especially in developing countries will be difficult to achieve. According to Kadiresan and Khanal (2018) irrigation remains fundamental to productive agriculture and the foundation of rural livelihoods in major parts of Asia and Africa. Two-thirds of future grains in crop production are expected to come from irrigated land. Yahaya (2000) observed that it is only by promoting agricultural development through irrigation that widespread increase in economic well-being and effective demand essential for the removal of food problem will achieve industrial development in developing countries.

As important as irrigation is to mankind, the practice is fraught with a number of undesirable environmental impacts. Such impacts which can either be direct or indirect relates to changes in quantity and quality of soil and water and its effects on natural and social conditions in both the river basin where it is practiced and its downstream area (Herman 2009, 2010). The direct effects of irrigation are basically hydrological in nature (Tuinenburg et al., 2012). It includes reduction in downstream river flow, increased evaporation and ground water level in the irrigated area, atmospheric instabilities and diversions (Lo and Famiglietti, 2013; Tuinenburg et al., 2012; Keys et al., 2012). The indirect effect includes water logging, degradation of water quality, soil salinization, ecological damage and socio-economic impacts. Such effects take longer period to develop and may also be more far-reaching.

Water degradation resulting from irrigation activities is a serious issue (Postigo et al., 2018). It affects not only the people consuming the water, but also, the sustainability of such irrigation project. Latey et al. (1986) observed that "It is of relatively recent recognition that salinization of water resources is a major and widespread phenomenon of possibly even greater

concern to the sustainability of irrigation than is that of the salinization of soils, per Se. indeed, only in the past few years has it become apparent that trace toxic constituents, such as Se, Mo and As in agricultural drainage waters may cause pollution problems that threaten the continuation of irrigation in some projects".

It is the water degradation issue resulting from irrigation practice that is the crux of this research. This is germane going by the fact that extremely large quantities of agro-chemicals are being used to boost agricultural production on a global scale. The toxicity of these chemicals is often high, and can interact with groundwater through irrigation, thereby contaminating the underground aquifer (Romocea et al., 2018). Effort such as this geared to monitor groundwater quality is quite desirable. It will help in devising the means of protect it.

THE STUDY AREA

Mokwa Local Government Area of Niger State Nigeria is the study area in this investigation (figure 1). It is located between longitudes 5°3' and 5°4' East and between latitudes 9°16' and 9°18' North.

Data used in this study were collected from five rural villages of Batagi, Sabontuga, Kusogi, Lwa'afu and Kusokpan; all located at varying distance not too far from an irrigation farm (figure 2). Residences of these settlements solely depend on groundwater for both their domestic and economic activities. The area which has humid tropical climate experience wet season between April and October when Tropical Maritime Airmass is prevalent in the area. Dry season in this area begins with the onset of Tropical Continental Airmass which is predominant in the region between the months of November and March.

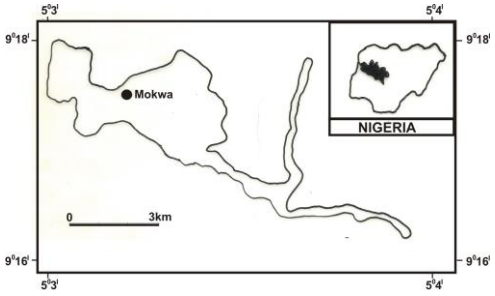

Figure 1. map of Mokwa LGA with Nigeria Showing Niger State as Inset
Source: Niger State Town Planning Authority, 2016

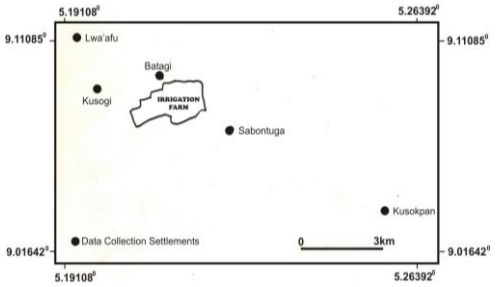

Figure 2. Irrigation Farm and Data Coleection points

Source: Dept of rural Dev. Mokwa LGA (2011)

The mean annual rainfall for the region is 1400 mm and this exhibits double maxima pattern with peak periods in June and September. Temperature in the area is uniformly high with a mean of 31°C while evaporation ranges between 4.2 and 8.1 mm. Relative humidity in the area is usually high and fluctuates between 70 to 80% in the rainy season but could fall below 40% in the dry season. The town is covered by ferruginous tropical soil, hydromorphic soil and alluvial soil which can be found along the floodplain of River Niger which is the main river that drains the region. The hydromorphic soil being waterlogged and poorly drained with high silt content is used for agricultural production, most especially rice cultivation.

MATERIAL AND METHODS

The research is based on data collected directly from the field. Water samples were collected using 75cl capacity plastic bottles from all the 21 accessible wells in the 5 rural villages. Five wells each were accessible in Sabotunga, Kusogi and Kusokpan; four wells in Batagi while two were accessible in Lwa'afu. Groundwater samples collected from each of the study settlement were subsequently mixed together to form a composite sample for each village. It is the five

composite samples that were analyzed in this study. The coordinates of the settlements, the number of wells sampled in each settlement, the distance of the settlements from the irrigation farm and elevation of the settlement are presented on table 1.

Table 1. Well Water Sampling Locations
Source: Author's Fieldwork, 2018

Settlements	Coordinates		Number of Wells	Distance from Irrigation Farm (Km)	Elevation (Meters)
	N (Degree)	E (Degree)			
Batagi	09.110850	005.227270	4	0.250	77.5
Sabotunga	09.076420	005.237270	5	0.800	74.7
Kusogi	09.081060	005.208640	5	1.200	75.6
Lwa'afu	09.123680	005.191080	2	2.400	72.8
Kusokpan	09.0116420	005.263920	5	6.200	73.8

Prior to sample collection, the bottles were sterilized and at the point of collection, the bottles were rinsed twice with the same water to be collected. The collected samples were thereafter transported to Chemistry Laboratory of University of Ilorin for analysis under preserved storage in dark insulated cooler containing ice packs to ensure brisk cooling. This is to prevent changes in chemical and biological content during transit. The analysis was carried out based on standard methods of water examination taking into consideration, the World Health Organization (2017) guidelines for drinking water and the Nigeria Standard for Drinking Water Quality (NSDWQ, 2015). However, data on water temperature and pH were taken at the sampling sites using thermometer graduated in Celsius and pH indicator respectively. Table 2 shows the analytical methods used in carry out this test.

Table 2. Analytical Methods used in Testing the Parameters
Source: Author's Fieldwork, 2018

S/N	Parameters	Analytical Methods Used
I	Turbidity	Nephelometry
II	Nitrate	Spectrophotometry
III	Sulphate	Gravimetric
IV	Phosphate	Spectrophotometry
V	Chloride	Mohr
VI	Electrical Conductivity	Gravimetric
VII	Total Dissolved Solids	Evaporation
VIII	Bio-chemical Oxygen Demand	Dilution
IX	Dissolved Oxygen	Dilution

The laboratory results were thereafter subjected to disruptive statistical analysis. To compare the degree of water pollution in the study settlements, each of the study parameter is scored between 1 and 5 with 1 representing the comparatively least quality and 5, the all comparatively best quality. All the scores obtained by each settlement for all the parameters were thereafter summed-up to reveal the comparative quality rating of groundwater in the studied communities.

RESULT AND DISCUSSION

PHYSICO-CHEMICAL AND BIOLOGIC QUALITY OF WATER IN THE STUDY SETTLEMENTS

Table 2 shows the result for the laboratory analysis of the studied parameters. The pH values of water in the settlements range between 7.20 observed in Sabotunga and 7.7 observed in Batagi while temperature ranges between 28.70 observed in Kusokpan and 28.90°C observed in Batagi. pH remains one of the most important water quality parameters; this is because, most

biochemical activities in water are pH dependent. All the pH values in the five sampled well fall within the NSDWQ (2015) limit of between 6.5 and 8.5. This thus means that ground water in the studied settlements are slightly acidic to neutral. This result may not be unconnected with the mineral composition of the bedrock in the study area.

Although NSDWQ (2015) do not give specific acceptable limit for temperature, all the water samples taken from the five villages exceeded the average room temperature of between 20 and 25°C. The fairly high water temperature in the study area calls for concern as this can easily trigger chemical reaction. Temperature affects physical, biological and chemical activities in water. High temperature decreases the solubility of some gases such as O_2 and CO_2. It negatively impact water quality by enhancing the growth of microorganisms which may result in taste, colour odour and corrosion problems (UNICEF, 2008).

Table 2. Concentration of Physico-chemical and Biologic Parameters of wells in the Study Area

Parameters Sample Points (Km)	pH Value	Temp (^{O}C)	Turbidity (NTU)	$N0^{-}_{3}$ (mg/L)	$S0^{2}_{4}$- (mg/L)	$P0^{3}_{4}$- (mg/L)	Cl^{-} (mg/L)	Electrical Conductivity ($\mu S\ cm^{-1}$)	TDS (mg/L)	BOD (mg/L)	DO (mg/L)
Batagi	7.70	28.90	5.84	0.55	22.80	0.040	4.40	102.20	317.20	38.60	260.00
Sabontuga	7.25	28.50	5.75	0.66	23.45	0.046	4.24	120.60	309	36.20	244.80
Kusogi	7.50	28.70	5.36	0.33	18.92	0.003	2.40	105.80	359.00	26.40	206.40
Lwa'afu	7.20	28.40	5.46	0.06	21.55	0.036	4.72	101.20	470	29.50	209.60
Kusokpan	7.50	28.70	5.40	0.05	20.72	0.030	3.12	105.40	340.00	26.80	208.00
Total	37.76	135.20	27.81	1.45	107.44	0.155	18.88	535.20	1791.0	157.70	1128.80
Range	0.5	0.5	0.48	0.03	4.53	0.043	2.32	19.4	153.1	12.2	53.6
Mean	7.45	27.04	5.56	0.29	21.49	0.031	3.77	107.04	358.20	31.50	225.76
Standard Deviation	0.23	3.5	3.54	0.26	1.8	0.24	0.98	7.83	65.93	5.58	24.93
CV (%)	3.08	12.94	63.67	89.66	8.38	61.54	25.99	7.31	19.70	17.71	11.04

Turbidity refers to cloudiness of water. This parameter is very important in pollution abatement as high turbidity is often associated with high production rate of disease causing microorganisms such as bacteria and other parasites (Shittu et al., 2008). Highest turbidity value of 5.84 Nephelometric Turbidity Unit (NTU) was obtained in Batagi settlement while the lowest (5.40 NTU) obtained in Kusokpan. Groundwater sample from all the five studied settlements exceeded both the WHO (2014) and NSDWQ (2015) acceptable limit of 5 NTU.

Nitrate which is one of diseases causing parameters of water is highest in concentration (0.66 mg/L) was in Sabotunga settlement while its lowest concentration of 0.05 mg/L recorded in Kusokpan settlement. The highest value of this parameter falls within both NSDWQ (2015) and WHO acceptable limit of 50 mg/L. Nitrate usually get into water through chemical fertilizers, animal droppings and explosives (WHO, 2014).

The compound which is soluble in water can enter surface water through runoff and get into groundwater through leaching. Nitrate is a normal component of human diet and its relatively non-toxic which when swallowed, is converted to nitrite which react with the haemoglobin in the blood. Its consumption in high concentration in water causes a reduction in oxygen carrying capacity of the blood, thereby leading to health condition called methaemoglobinaemia or the blue baby disease which is usually fatal in young babies (Hamill and Bell, 1987; Rao, 2006). High concentration of nitrate has also been linked with gastric and oesophagal cancer, because of the reaction of nitrate with amines in the diet forming carcinogenic nitrosamines (WHO, 2017; Chettri and Smith, 1995).

The sulphate concentration in groundwater in all the five settlements investigated fall below NSDWQ (2015) maximum limit of 200 mg/L. Its highest concentration of 23.45 mg/L was recorded in Sabotunga while the lowest concentration value of 18.92 mg/L was recorded in Kusogi. High level of sulphate in water may be harmful to human health as it can lead to laxative effect in man (Subramani et al., 2005).

While the natural levels of phosphate usually range between 0.0005 and 0.05 mg/L, the concentration of phosphate the study area range between 0.003 mg/L observed in Kusogi and 0.046 mg/L observed in Sabotunga. Although the NSDWQ (2015) and WHO (2014) do not give any limit for the amount of phosphate that is healthy to ingest, high concentration of phosphorous in drinking may lead to osteoporosis and poor bore maintenance while its excessive consumption have been associated with increased risk of cardiovascular disease (Pourfalleh et al., 2014). Result obtain on phosphorous in this study is in line with the earlier finding of Pourfallah et al (2014) which obtained the values of between 0.001 and 0.4 mg/L for Tehran, Pakistan.

Chloride is mainly obtained from the dissolution of salts of hydrochloric acid as table salt, NaCl and $NaC0_2$ which are added through agricultural and industrial wastes. It is important for metabolic activities in the human body and other physiological processes. The highest concentration of chloride (4.40 mg/L) was recorded in Batagi while the lowest concentration of 2.40 mg/L was recorded in Kusogi. Groundwater in all the five settlements investigated recorded chloride concentration that fall below the NSDWQ (2015) standard of 250 mg/L. Although excessive chloride ions in water may not pose any health risk when injected by man, high concentration of chloride with sodium ions in water may interact to produce sodium chloride which may cause salty taste of water. The implication of the result from this study is that, water collected from all the sampled wells cannot be kept for a long period before consumption because of the likely chance of being polluted. High chloride concentration in water usually damage metallic pipes and other infrastructure as well as causing harm to growing plants (Mohsin et al., 2012).

Electrical conductivity, which is a measure of dissolved ions in water is ranged in value from O to 50,000µ Scm^{-1}. Above 2,500µ Scm^{-1}, such water is not safe for human consumption. Electrical conductivity of water samples examined in this study range from 101.2 to 120.6µ Scm^{-1} with the highest conductivity of 120.6µ Scm^{-1} recorded at Sabotunga and the lowest value of 101.2µ Scm^{-1} recorded Lwa'afu. The electrical conductivity of all the sampled water falls within the acceptable value 1000µ Scm-1 recommended by NSDWQ (2015). This result thus implies that all the water samples investigation have low mineral content; hence the water can be regarded as fresh water. However, such water can only be classified as safe for consumption when the level of inorganic pollution is low.

Total dissolved solids (TDS) are derived from dissolved organic and inorganic substances such as nitrate and carbonate. Catroll (1962), Freeze and Cherry (1979) have earlier highlighted the importance of classifying the hydro chemical properties of ground water based on their TDS values in order to determine their appropriateness for any purpose. TDS is majorly composed of calcium, potassium, chlorides, magnesium, potassium, sodium, bicarbonates and sulphate (Vitksten, 2016). High concentration of TDs in water makes it unsafe for consumption without treatment because it may cause stomach upset. Its presence in water may affect taste (WHO, 2017). The higher concentration of TDS in the five study villages was less than 500 mg/L value given by NSDWQ (2015). The highest TDS concentration of 470 mg/L was recorded in Lwa'afu while the lowest concentration of 309 mg/L was recorded in Sabotunga. Mustapha et al., (2013) reported that drinking water with high concentration of TDS may be unpleasant because of its flat insipid taste.

Bio-chemical Oxygen Demand (BOD) is a measure of the amount of biodegradable organic chemicals in water. Organic compounds are biodegradable when bacteria can utilize them as source of energy or food. When these are discharge into groundwater, bacteria will bio-chemically combine them with oxygen dissolved in the water to produce bacteria cells. This reduces the amount of dissolved oxygen in water. The highest BOD value of 38.6 mg/L was recorded in Batagi while the lowest (26.4 mg/L) was recorded in Kusogi. All BOD values from the wells in the settlements investigated are above the acceptable range of between 10.0 and 20.4 mg/L given by NSDWQ (2015). The high BOD level observed in this study may not be unconnected with pollution problem from agricultural activities.

Dissolved Oxygen (DO) which indicate the portability of water range in this study between 206 mg/L observed in Kusogi and 260 mg/L observed in Batagi. Although NSDWQ (2015) do not

specify an acceptable range for DO, all the DO values obtained from the five settlements are considered not ideal enough, this is because, the values indicates conducive conditions for active microorganism activities. This thus implies that the wells in the five settlements investigated are not free from organic contamination which can affect human health.

Degree of Water Pollution in the Study Settlements

This analysis aided in explaining the spatial variation in groundwater quality in the study settlements. Table 4 shows the comparative grading of water quality parameters in the study area.

Table 4. Graded Quality of Study Parameter

Study Settlements	Distance from Irrigation Scheme	pH	Temp (°C)	Turbidity (NTU)	Nitrate (mg/L)	Sulphate (mg/L)	Phosphate (mg/L)	Chloride (mg/L)	Elect Cond.	TDS	BOD	DO	Total
Batagi	0.25km	1	1	1	2	2	2	2	4	4	1	1	21
Sabontuga	0.80km	4	4	2	1	1	1	3	1	5	2	2	26
Kusogi	1.20km	3	3	4	3	5	5	5	2	2	5	3	40
Lwa'afu	2.40km	5	5	3	4	3	3	1	5	1	3	4	37
Kusokpan	6.20km	3	3	5	5	4	4	4	3	3	4	5	43

The table generally indicates an increasing number of points as distance from the irrigation scheme increases. Out of the 55 quality obtainable points, Batagi which is located at 0.25 km from the irrigation scheme had the least (21 points) while Kusokpan which is located at a distance of 6.2 km from the irrigation scheme obtained the highest (43 points). Although Kusogi which is located at 1.2 km from the irrigation scheme had higher points than Lwa'afu which is located at 2.4 km; The general variation in points recorded by each of the five settlements may not be unconnected with factor of distance from the irrigation scheme as can be seen on figure 3.

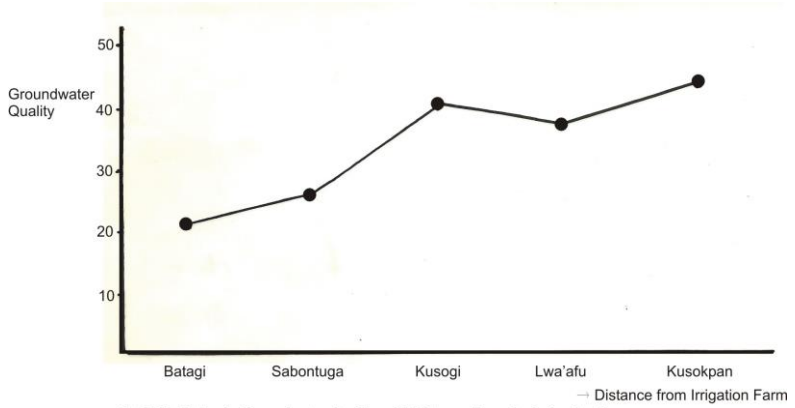

Figure 3. Variation in Groundeater Quality with Distance form the Irrigation Farm

Comparatively therefore, groundwater quality in Kusokpan can be adjudged to be the best among the five settlements investigated while groundwater in Bategi has the least quality. Rate of groundwater contamination has being on the increase in recent times due to anthropogenic activities, especially those directly related to landuse. Among the activities which are contaminating the groundwater according to Egboka et al (1989) includes mining, waste disposal, and agriculture. According to WHO (2014) drinking water is the major cause of many diseases, especially in developing countries where more than six million people die annually from water related illness with about 20, 000 death of children per day.

CONCLUSION

The rate of practice of irrigation agriculture has been increasing yearly in Nigeria and in some other countries of the world, most especially, India, China, Mexico, Turkey etc. The increasing importance of irrigation for food security is being driven by climate change impacts and global economic and population growths. As global population continue to rise, it is expected that more irrigation schemes will be developed especially in developing countries where the gap between the rates of food production and population increase is getting wider. It is thus important for agencies concerned to make sure that new irrigation schemes which are being developed are to higher standards and with greater consideration for both the local people and the environment.

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MULTI-CRITERIA ANALYSIS OF AGRICULTURE IN A RURAL SPACE. CASE STUDY: ARGEȘ COUNTY

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Abstract: This analysis has the intention to highlight the territorial differentiation of the agricultural development's vulnerabilities in the agricultural areas from Argeș County. Thereby a determinant and eliminatory factor in agriculture is given by the average slopes greater than 20% and altitudes greater than 700 m. By consequences, 16 villages have been excluded. The study has emphasized an increasing of territorial vulnerabilities, which tend to intensify in the rural areas. The analysis of the agricultural development's growth is based on four main criteria: the use of agricultural land; the fragmentation of agricultural land; the viability of agricultural companies and the types of agricultural exploitation. Therefore, through the variety of the indicators that have been used, the analysis offers an image of the spatial layout of the agricultural development in the 95 settlements under discussion. Moreover, the degree of development for an industrial branch is observed through this problem, so common in the emerging economies**.**

Key words: Argeș County, the Hull indicator, agricultural development, rural areas

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INTRODUCTION

This paper aims to identify the development of agriculture in Argeș County, these being represented bydifferent stages of agricultural development which can affect primarily the

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population through its actions and through the external factors, thus limiting the ways of life and also the connections between these communities as a whole economic group (Bose, 2015; Filimon et al., 2014). Such a context represents the main concern for the humanistic geographers concerning the rural areas which have their main activities in the primary sector.

The poor agricultural development represents a major problem in our society. Agriculture itself has many subtle and hard to quantify characteristics, thus being difficult to extrapolate eventual unscheduled phenomena that are dependent on the existing reality. This study has into consideration offering a stringent approach of the agricultural development in the rural areas from Argeș County. Another aspect here under discussion is based on the agricultural use itself and on its dynamic in the local economy, in the county's economy, in the national and even in the global economy (Bunnell and Coe, 2001).

Based on this context, different areas without an agricultural singularity and with an economy focused on other economic sectors as having a poor agricultural development. However, these aspects need to be observed from a practical point of view and when the land characteristics require such a comparison, it is necessary that this could be achieved and also to it has to reflect possible discrepancies. The context is a much bigger one having to interact at times with the main regional economic trend, "benefitting" from the market's opportunities. We would also need to mention that the agricultural profile of the rural areas represents the only solution for the capitalism's failure, being also the only solution to maintain them (Lipton, 1997).

It is well knows that the vulnerability phenomena have a changing behavior (Gifford, 2011), where the social factors are compared with a living body, being crossed by a series of continuous flows (Ianoș, 2000a), therefore in the perspective of such changes, we need to take into consideration the issue of the increase in houses density and also that of the impact this might have on the land itself as there are (Herman, 2009a, 2009b, 2010), in these cases field drainages (Pompeii, 2015) and also the impact of the derived processes.

The problem with the analysis scale (Li and Farber, 2016) on the impact over agriculture show that these specific areas can compete with the much more well-developed ones from the Western Europe, which in itself, represents a real challenge, but also a problem for the Eastern regions of Europe, these ones having gaps in each of the analyzed fields. Therefore, our study will aim to present these comparisons at a local level, because the well-developed areas can hold strong impact in the areas already adapted to the national economic environment. Such an approach sustained on a lower scale represents a first step in the settlement of possible unforeseeable effects.

One of the questions one might ask is "how long is the road from rural poverty to rural development? What we can do to make it shorter?" (Chirica and Tesliuc, 1999), questions with an important socio-structural impact, in which the agricultural economy is analysed throughout a decade, which has therefore gone through different stages with a highlight encountered in a country which nowadays has two different units: a military one (N.A.T.O.) and an economic one (The European Union) which establishes a proper environment for development and also for investments, including agricultural ones (Nistor, 2014).

However, a comparison can be made between the highly disadvantaged areas and the ones that are less advantaged, the last ones being part of the first category, besides the aspects surrounding the repercussions of climatic changes, these settlements can be disadvantaged also by the structural deficit aspects (the lack of education, the poor sanitation system, the implementation of inadequate politics, illiteracy etc.) (Lemos et al., 2016).

Agriculture as an economic branch is based on the principle of returning the investments (ROI, Return of Investment) (Yet et al., 2016). This can be affected by the extreme phenomena such as drought (Zhu et al., 2016), which can have a negative impact on the irrigation system, or, on the contrary, it could be affected by heavy rains which can compromise the entire agricultural production (Latocha et al., 2016). These phenomena have an increasing incidence mainly because of the global warming. This having been said, these areas should benefit from a special status, being protected by the political authorities (Berger et al., 2016). The aim of this orientation is to

create a strong cooperation between main actors, local authorities, local population and investors, therefore creating also different proactive fields in the emergence of such calamities (Kampragou et al., 2011; Sivakumar et al., 2014; Carrao et al., 2016). Such a collaboration is remarkable, however, the political interests and also the bureaucracy make it hard to be implemented.

DATA AND METHODOLOGY

As for the methodology used in this paper, a series of steps have been followed. The first one was the relativity of basic indicators, based on dividing the indicators and the number of population from 2012, and then with the help of the resulted values, the numbers have been standardized with the following formula: $\frac{Vreal-Vmin}{Vmax-Vmin}$, where: V_{real} is the value from the list of numbers; V_{min} is the minimum; V_{max} is the maximum. The standardized values are between 0 and 1. After processing the data, these have been calculated with the aid of the Hull indicator (Ianoș, 1997), the function used being the following: $I_{Hull}=50+14*(i_1+i_2+i_3....-i_1-i_2-1_3...)/No.$ *of indicators*, where the medium is 50, and in our case, 5 classes have been used in a single perspective. The category comprising the poorly developed agriculture figures contains the values between 48.56 and 49.5, and it is followed by the category with average values (between 50 and 50.5), and then by the category of the highervalues (between 50.5 and 51) and then last but not least, the category with very high values (between 51 and 52.3).

Therefore, the analysis shapes the image of the agricultural development's degree in the rural areas from Arges County. The values used in this paper are, at the level of 2012, and target the villages 95 villages. The main statistical information come from the online Tempo database, which have been modelled with Excel and also ArcMap. The approach of this topic includes analysis from a scale perspective (Schelling, 2006) aimed to detail the problems encountered in agriculture, which represents such an important field in economy.

CASE STUDY

Argeș County has all the three large landscape units and also a population of 427.689 (in 2017), in which 51.28% come from rural areas. The main economic advantages are the geographic location (close to the municipality of Bucharest, to which it is connected via the A1 highway) (figure 1) and the machine building industry, well developed in Mioveni.

The case study has been made at a basic level in Argeș County. The analysis takes into account 95 communes. Also, the analysis contains a physico-geographic delimitation through the introduction of more restrictive rules such as the high average slope of 20% and an average altitude higher than 700 metres. Based on the conceptual delimitations from this analysis, we have excluded 16 rural administrative units situated in the northern part of the county.

DATA COLLECTION

For the study under discussion, we have used data from the National Institute of Statistics, statistical yearbooks from Argeș County and also some other documents, analyzing 2012 as a reference year.

METHODS

This paper analyzes the development level of agriculture in Argeș County (figure 1). Given the fact that the economy is mainly based on agriculture, other social aspects of the area are influenced by agriculture as well. The degree of development in agriculture shows the main disposal of well-developed areas and also their particularities. Moreover, based on the relief features in the other more poorly developed areas, the development of other economic fields or the development of agriculture might emerge (Ianoș, 2000b; Austrhein et al., 2016). In our case, the areas which have not reached the physico-geographic parameters have a small population (7.79% of the total population from Argeș County).

As one can see (figure 2), based on the spatial distribution, four categories of agricultural development have been identified, each of these having one or more indicators concerning agricultural aspects.

The first one is way in which the land is used, represented in its turn by the arable surfaces, by meadows and pastures; by the number of unproductive lands; the degree of fragmentation of agricultural surfaces represented by the number of landlords and the number of agriculture companies; the viability of agricultural companies, the type of agricultural land exploitation, debts and profit; the agricultural surfaces administrated by landlords, areas in concession, on lease, with free title, in rent, or used in other ways. Based on the Hull indicator, 17 indicators have been selected.

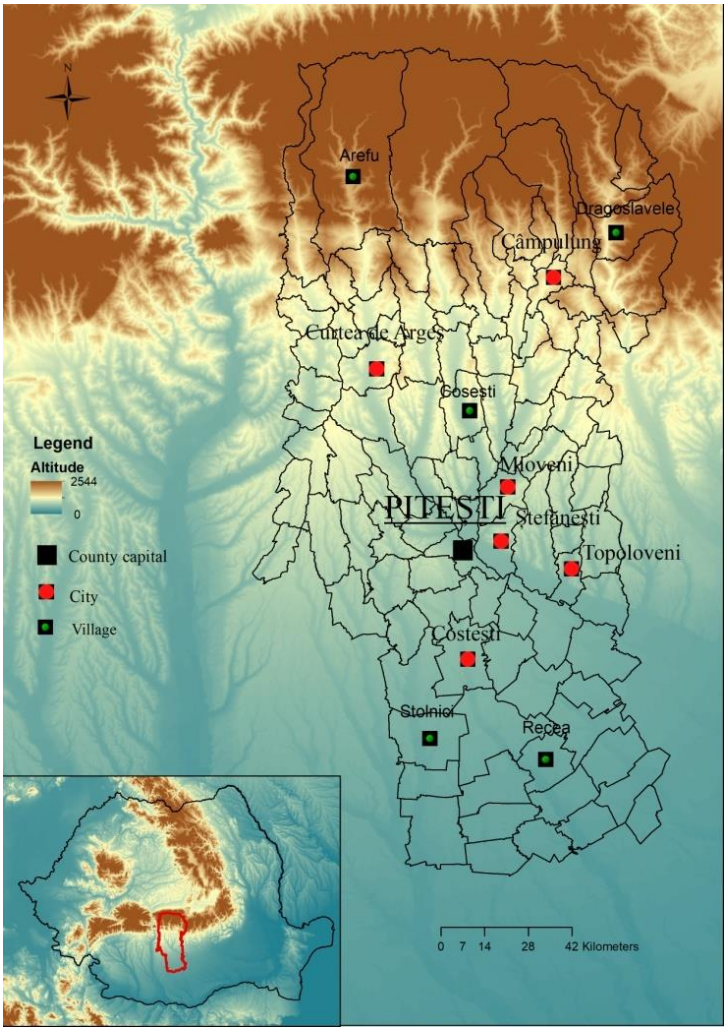

Figure 1. The geographical position of Argeș County has in Romania and in the region

The positive indicators are the vineyards, the orchards, arable lands, the farmed outlands, the leased ones, the ones with a free title, the agricultural companies' profit, the fiscal value, the number of agricultural companies. On the other hand, the negative indicators are the number of landlords, the companies' debts, the agricultural land used in other different ways by their landlords, the degraded land, the meadows and the pastures.

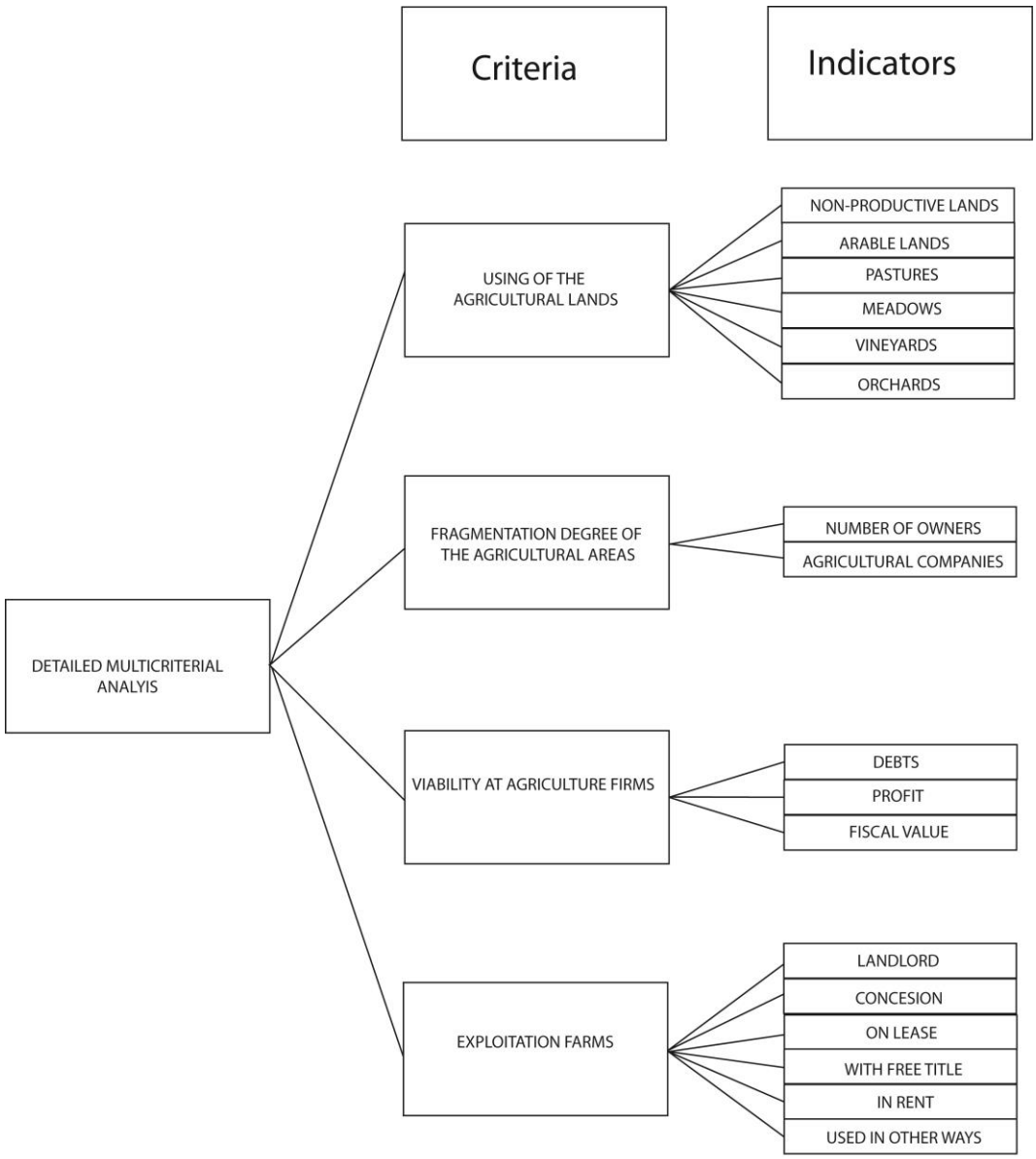

Figure 2. The agricultural development diagram

RESULTS

The first cartogram (figure 3) shows the value of the Hull indicator, which was calculated based on the rural administrative units. This has happened due to the change of the main values. If the urban settlements value had been included within the relativization and standardization the results and values of the analysis would have been completely different.

The minimum of 48.56 can be found in Călinești, and from the first category, we can find only Merișani, these ones being found in the central part of the county. The low level of

agricultural development in the two communes is given mostly by the lack of competitiveness in the agricultural field. These are based on the outsourced services in the urban area.

It can be noted that with the elimination of the administrative units such as cities and municipalities, there are lower values for the Hull indicator. Basically, by eliminating them, the issue of agricultural developmentis better outlined.

The next important category is the one with poorly-developed agriculture, containing 39 administrative units. Their share represents 40.6% from a total of 95 studied administrative units and a total percentage of 42.7% from the administrative units with a poorly-developed agriculture. The communes with negative indicators are situated in the northern-central part, which sustains the idea that, in such area the agriculture is not an important part of the economy and there are other well developed industries such as tourism or wood exploitation.

On the opposite side, there is another grouping in the southern part, based on the communes with a high degree of development in agriculture. The highest value can be found in Râca (a value of 52.3) and also in Popești, Slobozia, Izvoru, Mozăceni, Stolnici, Buzoiești, Rociu, Budeasa etc. The high degree of agricultural development in the transition economies is given by the economic profile of those administrative units where the economic structure is agrarian, predominantly. The positive values are encountered in the communes in the lowland areas where these ones take advantage from the fertile lands in terms of practicing agriculture and where businessmen have own large surfaces of agricultural land.

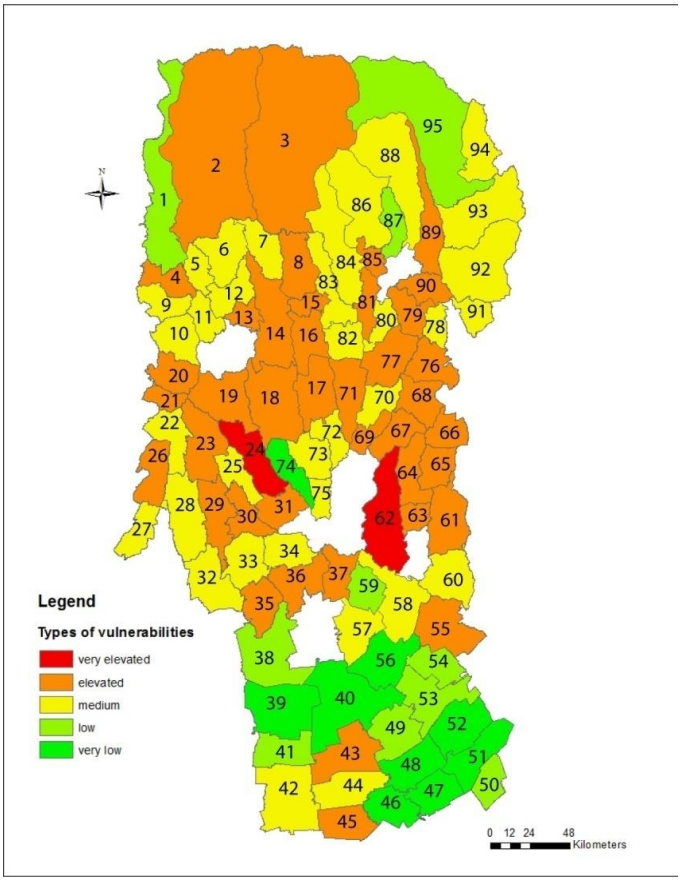

Figure 3. The level of agricultural developement in the rural areas from Argeș County
(Source: INSSE, Statistical Yearbooks from Argeș County)

The settlements in Arges County marked with numbers in figure 3 are: 1 Sălătrucu, 2 Arefu, 3 Nucșoara, 4 Șuici, 5 Cicănești, 6 Corbeni, 7 Brăduleț, 8 Corbi, 9 Cepari, 10 Tigveni, 11 Valea Danului, 12 Albeștii de Argeș, 13 Valea Iașului, 14 Musătești, 15 Domnești, 16 Pietroșani, 17 Coseşti, 18 Mălureni, 19 Băiculești, 20 Ciofringeni, 21 Poienarii de Argeș, 22 Morărești, 23 Cotmeana, 24 Merișani, 25 Drăganu, 26 Cuca, 27 Ciomăgești, 28 Uda, 29 Cocu, 30 Babana, 31 Bascov, 32 Vedea, 33 Poiana Lacului, 34 Moșoaia, 35 Sapata, 36 Albota, 37 Bradu, 38 Lunca Corbului, 39 Stolnici, 40 Buzoiești, 41 Hârsești, 42 Bârla, 43 Ungheni, 44 Căldăraru, 45 Miroși, 46 Râca, 47 Popești, 48 Izvoru, 49 Recea, 50 Ștefan cel Mare, 51 Slobozia, 52 Mozăceni, 53 Negrași, 54 Teiu, 55 Rătești, 56 Rociu, 57 Suseni, 58 Cățeasca, 59 Oarja, 60 Leordeni, 61 Bogați, 62 Călinești, 63 Priboieni, 64 Beleți Negrești, 65 Dobrești, 66 Boțești, 67 Davidești, 68 Vulturești, 69 Țițești, 70 Stâlpeni, 71 Bălilești, 72 Dârmănești, 73 Micești, 74 Budeasa, 75 Mărăcineni, 76 Vulturești, 77 Mihești, 78 Boteni, 79 Poienarii de Mușcel, 80 Schitu Golești, 81 Godeni, 82 Vlădești, 83 Aninoasa, 84 Berevoiești, 85 Bughea de Jos, 86 Albeștii de Mușcel, 87 Bughea de Sus, 88 Lerești, 89 Valea Mare Pravăț, 90 Mioare, 91 Cetățeni, 92 Stoenești, 93 Dragoslavele, 94 Dâmbovicioara și 95 Rucăr.

The physical issues encountered in the mountain areas in terms of agricultural development have led to the implementation of special actions within the European Union (Renwick et al., 2013; Hinojosa et al., 2016). Given the fact that Romania is one of the poorest countries in the EU (the second to last place in the EU in terms of the GDP/per capita in 2015, according to the World Bank), having a lower experience compared with other states (1st of January 2007), and also having profoundly disadvantaged rural areas, only the areas with a favorable altitude for agricultural development have been included. An eloquent example in determining the agricultural areas is represented by the French Alps, which have "a minimum average altitude of 700 m or slopes larger than 20% (figure 4 and figure 5). Alternatively, the requirement is "a minimum average altitude of 500 m and an average slope of 15%" (Hinojosa et al., 2016: 117-118). Based on these parameters, we have determined which are the communes that do not have the specific physical characteristics to the plant cultivation. The established level was that of the average slope at the commune level of over 20 degrees and an average altitude of less than 700 meters.

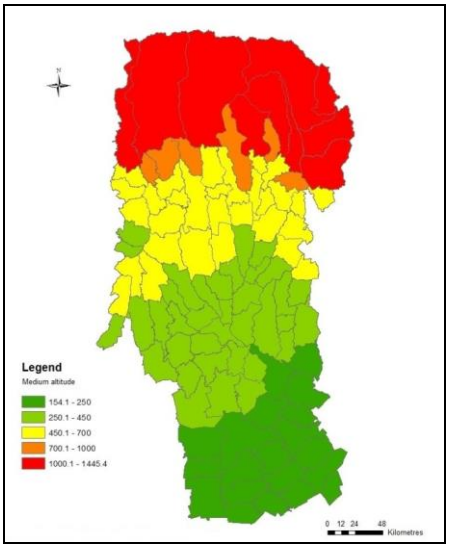

Figure 4. The average analysis of the average altitudes in Argeș County

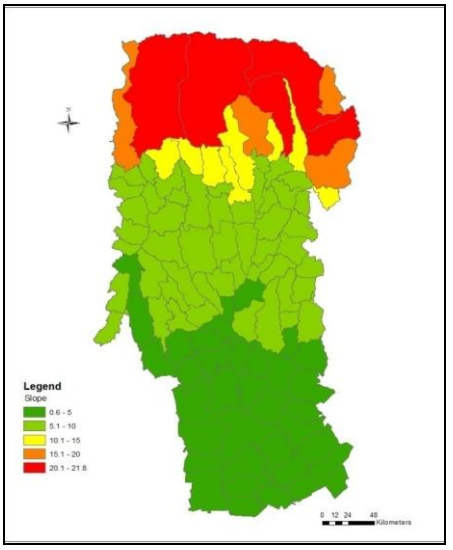

Figure 5. The average analysis of the slopes in Argeș County

As a result of the conceptual delimitation, 16 rural administrative units appeared in the analysis. They are situated in the northern part of Argeş County.

The portraying of low agricultural development due to the urban environment in the central part of Arges County creates a major problem at the level of crop cultivation.

Even though the county has 3 different landforms, the Carpathian Mountains (in the north), the Piedmont Plateau (in the centre), the Romanian Plain (in the south), we cannot consider it a typically agrarian county. It is assumed that the administrative units located in the central part of the county overlap with landforms such as plains. Regarding the relative values used in the obtaining the Hull indicator, it's simple to observe the similarities between their divisions and the communes' grouping by the number of inhabitants. The localities from the southern part of Argeș have an average population much more elevated and a much more extended agricultural surface. On the other hand, the communes in the center of the county have a smaller average population (except the ones closer to cities/towns) and a smaller agricultural surface. Therefore, we can consider that the disposal of agricultural development in this analysis is not related with the fragmentation but more with the economic character of the administrative units (the manufacturing industry).

CONCLUSIONS

Among the ways in which the living standard could be increased in some areas, there is the awareness of the population regarding their capacity to be organized in associations. In this respect, there needs to be a longer process treating a sensitive subject for the Romanian mentality, with thinking reminiscences coming from the interwar period (Ianoș and Braghină, 2006). At the same time, the rhythm in which this new information is assimilated and also the implementation of new technologies confirm that Romania is a dynamic competitor and an important hub for the regional agriculture, and they also show the important relationships our country has in the Middle East and also in the Western Europe.

The fertile lands in Romania (Popa et al., 2016) and the small areas of polluted soil (Juravle et al., 2016) offer credibility to those mentioned earlier in this paper, having the perfect development framework in this direction, therefore they can be the basis for a long-term development where the alternatives of support through agriculture are built on the new trends, such as agro-tourism (Kazeminia et al., 2016) or ecotourism (Ciolac et al., 2015; Dincă et al., 2012) much more sustainable from a financial point of view.

There are different ways in which these localities can benefit from development and from a limitation of these economic development, and we can here mention the role of associative form of administrative units such as G.A.L.s (Local Action Groups). These are manifested through the encouragement of entrepreneurship, of associating institutions and private companies so as to access European funds for a specific economic sector. Therefore, the association initiatives which might determine the development of this area are encouraged through the community and national legislation (governmental decision 725/2010, 244/2008, 74/2009 or the Board Rules 1975/2006. 1698/2005 etc.). In our opinion, the GALs have not been effective due to lack of information on their capacity to push the agriculture development in rural areas. Most of the times, they have many localities included, therefore the decision factor represents an impediment. Another issue is that not all the GALs respect the law, including and working together with a small town.

It is possible that some of the elevated values from the Hull indicator are registered in the southern part of the county because those areas depend on the agricultural economy. The spectrum of this analysis does not allow a comparison with the much more developed areas from the agricultural infrastructure point of view. On the other hand, such problems could not be so visible statistically speaking.

Therefore, this particular analysis can be a foundation for the development of future projects in the agricultural field, through the local institutions and especially through local public figures. These limit the phenomenon of vulnerability in this economic sector, through awareness of problems and the implementation of related measures that could limit the economic development,

too. Also, the prevention methods do not necessarily forecast the development of agriculture in all territorial units, because the economic structure needs to be varied and it would be essential to have inside a high value for the market products.

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Author contribution

All the authors had equal contribution.

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CONTINUITY AND DEMOGRAPHIC CYCLING IN THE ROMANIAN CARPATHIAN SPACE IN THE PERIOD 1930-2011

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Abstract: Through this article we wanted to conduct a research on the demographic component in the Romanian Carpathians by dividing the Carpathian Oicumenical into the Internal Carpathian Oicumena and External Carpathian Oicumena. We also wanted to identify cycles of demographic evolution and involutivity in the Romanian Carpathian space, and in parallel to identify several causes of different orgini that underwent the continuity and the demographic cyclical. The studied Period is 1930-2011, with statistical data taken from four censused: 1930, 1977, 1992 and 2011. Their processing was done using the Microsoft Excel 2013 program, calculating demographic increases. Then, the resulting increases served in the implementation of the database, and their processing was done through geographic information systems (ArcGis 10.3), making maps representative of the intended purpose. In 1930, the urban environment was little represented in the Romanian Carpathians, but after the establishment of socialism, the number of cities increased greatly. Instead, the rural environment began to be gradually disintegrated by the communist regime, with the population having to migrate to urban centres. On the whole, the population of the Romanian Carpathians rose from 1930 to 1977 and 1992, with the beginning of the demographic decline, with the establishment of capitalism. In the period 1977-1992, the Carpathian population increased by 5%, and from 1992 to 2011, decreased by 16%.

Key words: continuity, cyclical, demography, Carpathian Space, Romania

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INTRODUCTION

The diversity of geologico-geomorphological processes carried out in the Romanian Carpathians area-imposed discontinuities through the presence of depression and valley corridors. Due to the high degree of geomorphological fragmentation of the Romanian Carpathians relief, the deities and valley lanes provided favorable conditions for the placement of the settlements in the Paleolithic period. The carpathian demographic component retained its historical cycle, evolving

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under the character of continuity until the contemporary period. From a structural point of view, Giurcăneanu (1988) divided the Carpathian Oicumena into: Marginal Oicumena and Internal Oicumena. I believe that these two formulations lie under the sign of ambiguity, because of the precise inaccuracy of the geographical area (Carpathian) in the composition of structures. Also, the Marginal Oicumena can lead us to something that exists outside the Carpathians, which does not belong to the Carpathian space. Thus, I propose to improve the two structures, on their merits two already mentioned, in the Internal Carpathian Oicumena and External Carpathian Oicumena. In the first structure are classified intracarpatic depression regardless of dimensions and hydrographic corridor. In the second structure, all the Carpathian space surrounding the geographical elements mentioned in the first structure, namely the high mountain areas with more or less high degree of geomorphological fragmentation (figure 1).

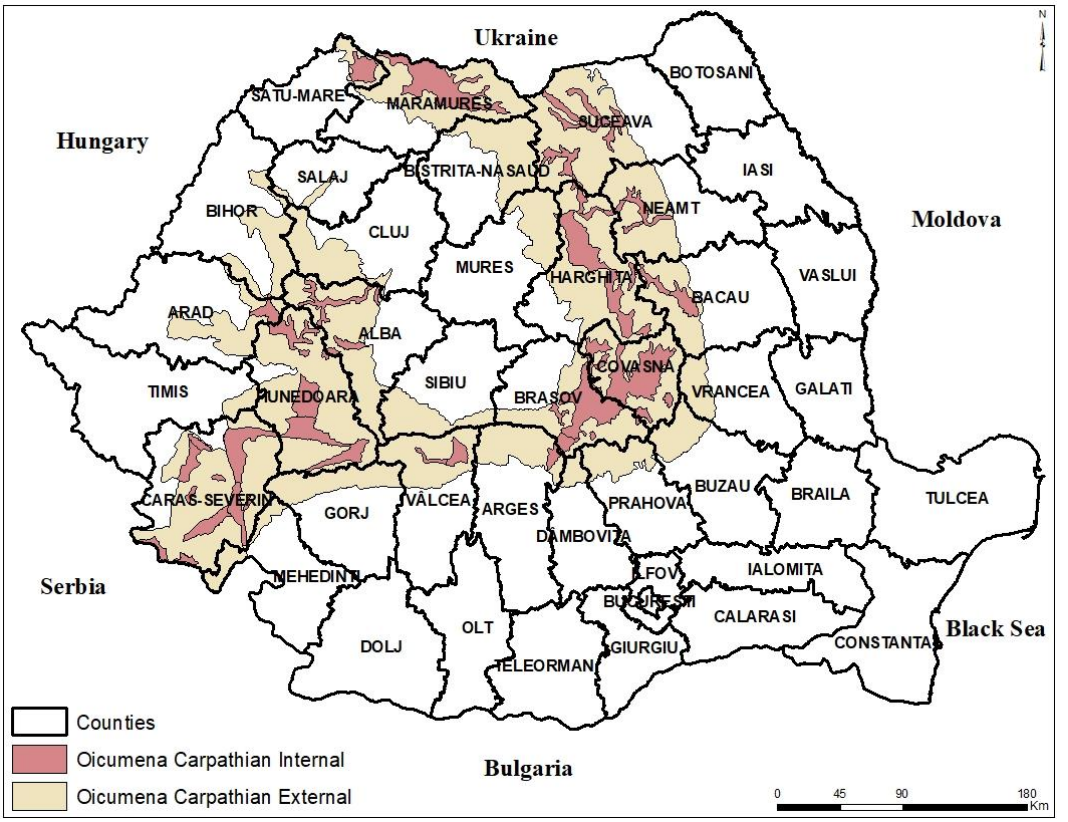

Figure 1. Oicumaines of Romanian Carpathians
(Source: own study based on Posea, Badea, 1974)

By achieving a comparative retrospective between the Romanian Carpathians and other mountainous regions, we have the opportunity to observe demographic developments and factors that have been the basis for the dynamics of the anthropogenic component. In general, mountainous regions are subject to the risk of depopulation by migrating the population from high altitudes to lower altitudes. Risk demographic phenomena have spread to many mountainous regions around the world.

Since the post-war period, the rural population of the mountains in Macedonia has fallen by 50%. With the demographic decline in the rural area, dysfunctions occurred in the dimensional structure of the villages, passing from the upper class, in the lower class, due to the population

losses (Madzevic and Toshevska, 2016). The situation of the population in the Bulgarian Mountains is similar to that of Macedonia. The depopulation of mountainous regions in Bulgaria began after the end of the last world conflagrations, preserving its continuity until 1985. After this year, it followed an intensification of the depopulation of mountainous regions, which resulted in the emergence and diversification of demographic risk phenomena (Mladenov and Ilieva, 2012). The Carpathian Mountains on the territory of Slovakia, Poland and Ukraine have depopulated especially after the disintegration of the Soviet Union. It was the starting time of a transitional period, as a result of which the mountain population abandoned land and work in the forest. The process had similar steps for the Slovak and Polish Carpathian parts (Kuemmerle et al., 2008; Angelstam et al., 2013; Warchalska-Troll and Troll, 2014; Chovankova and Mladek, 2002; Meessen et al., 2015; Solar et al., 2016; Kozak et al., 2007). The Caucasus Mountains, especially the central part, face demographic problems similar to the Romanian Carpathians. The phenomenon of depopulation, is flanked by emigration and negative natural growth, plus the continuous decline in birth rates. Following these, the phenomenon of demographic ageing occurs, 37.3% of the population having over 65 years of age. The Georgia Authorities carried out the Georgian Mountain Law, which was formulated and adopted by Parliament in 2015 and which enters into force in 2016 and 2017. The Georgian State wants to support the mountain population and again encourage the central population of the Caucasus Mountains, providing exemption for 3-year taxes on investments that promote the sustainable use of local resources and employment labour force (UNDP Georgia, 2015; Kohler et al., 2017). Demographic failures, destabilise including Western Europe, specifically mountainous regions of the Iberic Peninsula. The mountainous Region of Aragon, has been heavily depopulated during the twentieth century, from 1860 to 2000, depopulating with 56%, thus many uninhabited villages have emerged (Acin and Pinilla, 1995). The mountain economy of the Aragonzeze region is very identical to the mountain economy of the Romanian Carpathians. In comparison, both economies have two similarities: each have an autarchic model, in which the population is accustomed to obtaining all the necessary ones in their own garden, and also the population of both mountainous regions, develops economic activities traditional-rural areas such as transhumance and the realization of subsistence farming. Ayuda and Pinilla (2003), identified for the region of Aragon three decisive factors that underwent mountain depopulation (poor transport infrastructure, difficult accessibility to services and ecological restrictions). At least the first two factors identified by iberic researchers also stood to intensify the depopulation of the Romanian Carpathian space. For the revitalization of the Aragonese Mountain space, several possible avenues have been identified to halt depopulation: traditionally growing animals, woodworking activities, mining and energy production activities electric (Collantes and Pinilla, 2004).

We can say without a doubt that at least the European Mountainous regions, in the historical-geographic period, have evolved under the scepter of continuity and demographic cycling. The risk demographic phenomena associated with the Romanian Carpathians attracted the attention of romanian researchers, who carried out a number of important studies. The most researched Carpathian Group was and is that of the Western Carpathians, especially the Apuseni Mountains. One of the most representative works, which focused on the study of the demographical risk of the Apuseni Mountains, was carried out by Surd et al., (2007). The latest book on the research of settlements in the Apuseni Mountains, deals in depth the settlements mainly in the mining areas, areas that have functioned as a demographic attraction pole (Surd et al., 2017).

METHODOLOGY

For the demographic relief of the Romanian Carpathians after the time of the Great Union of 1918, we submit to the analysis the statistical data from the census 1930 (Manuilă, 1938) 1977 (NIS), 1992 (NIS) and 2011 (NIS). The Census of 1930 gives us an insight into the carpathian demographic evolution arising from the entry of Transylvania under the subordinations of the romanian authorities. The Census of 1977, puts us in front of a positive demographical picture,

following the anti-abortion decree promulgated a decade ago. The Last 20th-century census, made in 1992, is a statistical description of the demographic situation at the end of socialism and the beginning of capitalism. Between 1977-1992, the Carpathian demographic component was subject to large-scale population flows, predominantly in the industrial potential territories. The second census of the 21st-century, in the year 2011, cannot be omitted because of its close ties to the one in 1992. If the one in 1992 provides statistical data on the population at the beginning of the socialism-capitalism transition period, the one in 2011 provides us with statistical data on demographic evolution in the capitalist period. The statistical data was processed with the ArcGis 10.3 program, resulting in several maps from which demographic increases are apparent for each established time period. Also, several tables were generated in which there could be better emphasis on the weighting of population's demographic increases and decreases for each major group, reported in the total carpathian population and the total population of Romania.

RESULTS AND DISCUSSIONS

For the census of the year 1930, we cannot conduct a complex analysis on the two Carpathian Oicumaines or on the environments because the urban population was very low, more or less homogeneous in the Carpathian mountain space. It was only after the socialist regime was established that the network of carpathian settlements began to diversify. In the years 1954 and 1956, many cities were decreed, passing from the rank of common to the city, and during the socialist period appeared numerous new carpathian localities. The analysis desired to be carried out by us will comprise the censuses of 1977, 1992 and 2011.

In the year 1930, the Romanian Carpathians network was not very diversified, with the carpathian population of about 1,690290 inhabitants. The majority of the population was incorporated in rural areas, only about 187,095 (11%) people living in the carpathian urban environment. At national level, the carpathian population had a weight of 9.3%, and the largest share of the carpathian anthropogenic component reported in the total population of the country was 5.0%. Thus, the majority of the population was widespread in the area of the Eastern Carpathians, registering 912,161 inhabitants. The Western Carpathians had a share of the national total of 2.8%, ranking in the aftermath of the Eastern Carpathians, with the 518,340 inhabitants. The Southern Carpathians were the least populated, with 259,789 inhabitants, with a national share of only 1.4%. By 1930, the Eastern Carpathians were more populated than the other carpathian groups, with a network of more branted settlements (table 1). The documentary attestations of localities provide information about the age of the habitats, and for Eastern Carpathians, two parallels could be identified. Thus, the settlements on the Transylvanian side of the Eastern Carpathians are of early attestation, and the settlements from the Moldavian side are of a younger genesis.

Table 1. Evolutions of the Romanian Carpathians population in the census of the year 1930

	Population number	Weight (%) carpathian population of total population Romania	
Romania	18 057 028	9.3	
Romanian Carpathians	1 690 290		
		Weight (%) of total Romania per group of Carpathians	Weight (%) of the carpathian population on each mountain group
Eastern Carpathians	912 161	5.0	53.9
Southern Carpathians	259 789	1.4	15.3
Western Carpathians	518 340	2.8	30.6

From The census of 1930 to the census of 1977, the carpathian population has risen considerably, from figure 2 to note that there have been many localities where the population has grown, more or less. Most localities had demographic increases between 0-50%, which were distributed throughout the territory of the Romanian Carpathians.

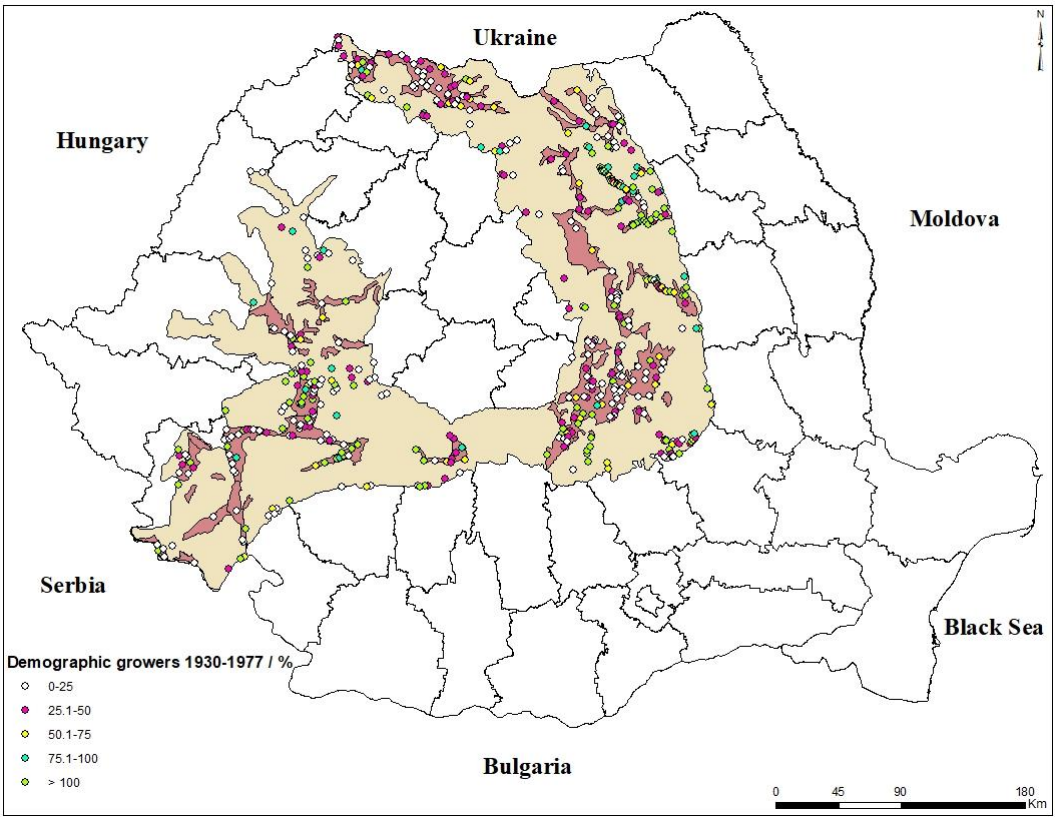

Figure 2. Demographic growth in the Romanian Carpathians in the period 1930-1977
(Source: data processed after the Manuilă, 1938; NIS)

Predominantly, the population increases occurred following the romanian leadership of the socialist regime, with the year 1948. Socialism played an important role in romania's birth, with a diverse range of solutions for demographic growth. In conjunction with the demographic solutions, a number of investments were made in the industrial sector, so that many carpathian localities, in terms of the resources they had in the administrative perimeter, were to move from the rank of common to the rank of city. Thus, the most significant demographic growth of more than 100%, were mostly concentrated in new cities or in rural localities from their immediate proximity. The population increases of urban centres in the Petroșani Depression, the Prahova Valley and the Haţeg-Hunedoara Depression can be distinguished. In the eastern part of the Eastern Carpathians were formed in the period of 47 years, three nucleuses of demographic explosion. The three cores have at least one resemblance, so this is given by the linear shape of the geographic positioning, running in the longitudinal course of a hydrographic artery. The northern most nucleus was formed in the hydrographical course of Bistriţei, around the village of Broșteni. In the area of this locality, mining activities were undertaken, which boosted the workforce in neighbouring localities, to train in underground work. Mining has provided stable employment and the population has been able to evolve numerically. Along the Bicaz river is the second nucleus, constituted largely following the

start of the construction work of the anthropic dam Izvoru Muntelui. The main settlement was the town of Bicaz, which, shortly after the completion of the works at the dam, was decreed the city. A large workforce was needed to achieve the great dam, which was brought from neighbouring localities and from other localities. In this second case, demographic prosperity was due to the hydropower industry, through the construction of the dam and the hydropower plant for electricity production. The third nucleus runs symmetrically on one side and another of the Trotușului, respectively in the area of the Comăneşti Depression, the localities thrive due to the carbononiferous deposits. We can note that the main localities of the three cores (Broşteni, Bicaz, Comăneşti) arrived in time from the status of rural locality, to the status of urban locality. Thus, we can consider them to be local polarizing centres, with exchanges of demographic flows, information, transport with neighbouring localities.

In 1977, the Romanian Carpathian settlement network was very diversified, with a significant number of localities, compared to the census of 1930. The total carpathian population was about 2,743149 inhabitants, with a share of 12.7% of Romania's total demographics. The carpathian demographic component was distributed roughly equally between the Southern Carpathians and the Western Carpathians, and more than half of the carpathian demographic was positioned in the Eastern Carpathians, relative to the total population of the Carpathians Romanian (table 2).

Table 2. Evolutions of the Romanian Carpathians population in the census of the year 1977
(Source: data processed after the NIS)

	Population number	Weight (%) carpathian population of total population Romania	
Romania	21 559 910	12.7	
Romanian Carpathians	2 743 149		
		Weight (%) of total Romania per group of Carpathians	Weight (%) of the Carpathian population on each mountain group
Eastern Carpathians	1 597 310	7.4	58.2
Southern Carpathians	540 910	2.5	19.7
Western Carpathians	604 929	2.8	22.0

Table 3. Evolutions of the Romanian Carpathians population in the census of the year 1992

	Population number	Weight (%) carpathian population of total population Romania	
Romania	22 810 035	12.6	
Romanian Carpathians	2 892 098		
		Weight (%) of total Romania per group of Carpathians	Weight (%) of the carpathian population on each mountain group
Eastern Carpathians	1 753 862	7.6	60.6
Southern Carpathians	585 411	2.5	20.2
Western Carpathians	552 825	2.4	19.1

The Census of the year 1992 was recorded the highest effective of the carpathian population. Compared to the census of 1977, the population of the Romanian Carpathians had a demographic increase of 5%. We note, the decrease in the population in Western Carpathians due

to the beginning of the reforms to the gold mining in the Apuseni Mountains. The temporary cessation and subsequent closure of the extraction and processing activities of the auro-argentiferous resources in the basement of the Apuseni led to the emergence of urban demographic failures. The urban area of Apuseni was first affected immediately after the fall of socialism, in terms of loss of jobs in the gold industry, resulting in the reorientation of the population to other cities and abroad (table 3).

Since the last census of the twentieth century, made in the year 1992, until the second census of the 21st-century, carried out in the year 2011, the carpathian population decreased, being recorded the demographic minimum of the period 1977-2011 (table 4). The Carpathian Space depopulated from 1992 to 2011 by 16%, while registering the lowest share of the total population of Romania. The carpathian demographic component had 2011, 11.9% of the total population of Romania. One of the causes that led to a decrease in the population was the repeal of Decree 770 of 1966 on anti-abortion, which was in conjunction with the loss of the basic economic functions of localities, in the immediate beginning of capitalism.

Table 4. Evolutions of the Romanian Carpathians population in the census of the year 2011

	Population number	Weight (%) carpathian population of total population Romania	
Romania	20 121 641	11.9	
Romanian Carpathians	2 401 906		
		Weight (%) of total Romania per group of Carpathians	Weight (%) of the carpathian population on each mountain group
Eastern Carpathians	1 525 940	7.5	63.5
Southern Carpathians	452 553	2.2	18.8
Western Carpathians	423 413	2.1	17.6

The 1977-1992 period was marked by demographic increases among the urban population both in urban localities in the Internal Carpathian Oicumena and in the localities of the External Carpathian Oicumena. The increases were especially noted in the urban carpathians in the Internal Carpathian Oicumena, where the geographical position was net influenced by the presence of subsolic resources, which socialism exploited intensively (table 5). The urban carpathian population prospered during the 15 years with 20.4%, resulting in intensification of the carpathian urbanization process.

Table 5. Evolution of the carpathian urban population in the period 1977-1992
(Source: data processed after the NIS)

	Internal Carpathian Urban Population 1977	Internal Carpathian Urban Population 1992	Increases/decreases 1977-1992 %	% of total 1977	% of total 1992
Eastern Carpathians	673 585	854 687	26.8	48.4	51.0
Southern Carpathians	313 351	372 299	18.8	22.5	22.2
Western Carpathians	181 761	206 787	13.7	13.0	12.3
	External Carpathian Urban Population 1977	External Carpathian Urban Population 1992			
Eastern Carpathians	118 897	128 247	7.8	8.5	7.6
Southern Carpathians	54 116	67 432	24.6	3.8	4.0
Western Carpathians	48 043	44 855	-6.6	3.4	2.6
Total	1 389 753	1 674 307	20.4		

The Communist Era was a thriving period for Romania, with socialism putting great emphasis on urbanization. The Romanian Carpathians were more urbanised, and new cities were decreed, based on economic policies. Several urban centres were passed to the rank of the city due to the existence in the administrative territory of subsolic resources. In the Apuseni Mountains, there is probably the most eloquent example of the carpathian city formed due to the golden Subsolic resources, whose extraction, processing and marketing has begun since the Dacian period. In the course of time, Zlatna had different economic roles, which in the period of socialism brought him the title of city, considered to be a real center for exploitation, administration, processing of the auro-argentiferous resources. The genesis of other cities was the coal resources, which by the scale of the holdings were the population of demographic attraction. This is the case, the urban carboniferous centres of Petroșani Depression: Uricani, Lupeni, Petrila, Vulcan, but also of the cities of the Apusenii Bihorului: Nucet, Ştei, Vaşcău.

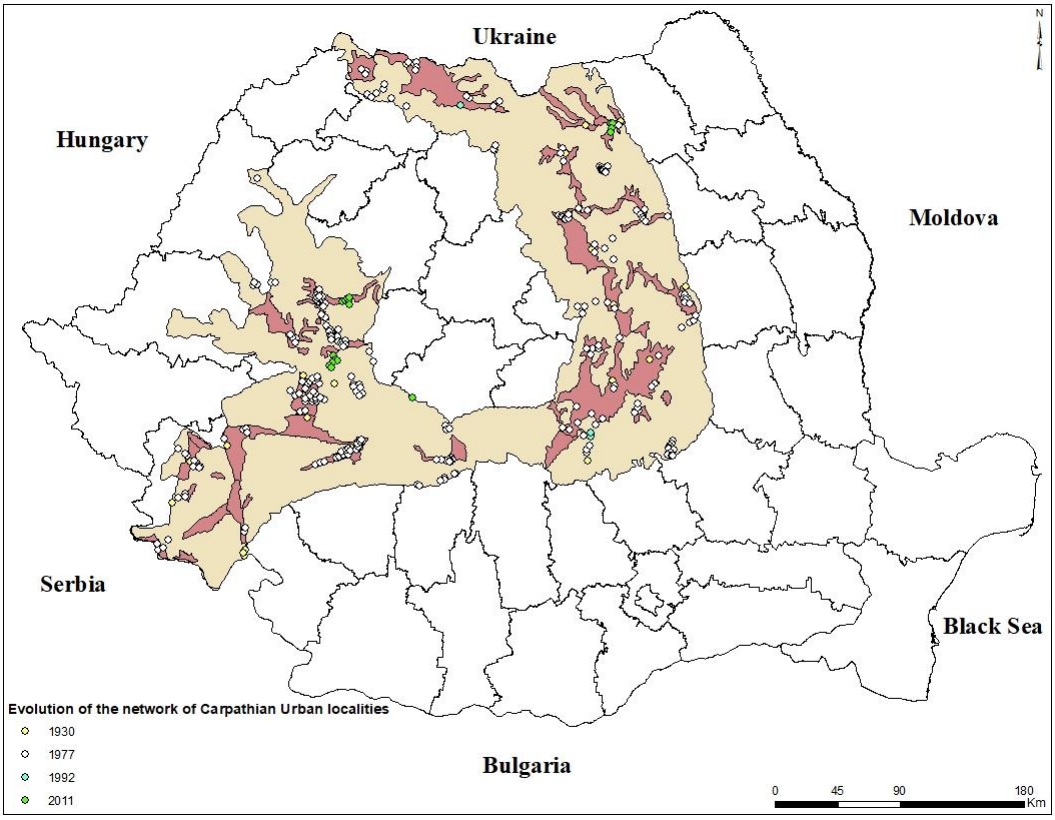

Figure 3. Evolution of the urban localities network in the Romanian Carpathians in the period 1930-2011 (Source: data processed after the Suciu, 1967-1968; Manuilă, 1938)

An important evidence of the urbanization of the Romanian Carpathians, is the documentary attestations of urban localities, from which we can see the evolution of the network of urban carpathian localities. At the census in the year 1930, the first, carried out after the Great Union of the year 1918, the carpathian urban environment consisted only of several localities, distributed unhomogenous in the territory. The numerical climax of urban localities in the Romanian Carpathians was recorded in the Census of the year 1977. Most of the urban explosion took place amid the subsolic resources found in the vicinity of localities, in which the authorities passed from the rank of rural village to the rank of urban locality. By this way, the Romanian

Carpathian Space has been in a period of only a few years, scraped by urban localities, expanded throughout the territory. However, urbanisation has produced something more pronounced in the ways where there have been natural resources of great importance for the good economic functioning of the country. Thus, we can see, the urban carboniferous groups of the Petroșani Depression (Jiului Valley), the Haţeg-Hunedoara Depression and the urban auriferous groups in the heart of the Apuseni Mountains, developed around the tradition centers on the exploitation and processing the gold, Zlatna, Abrud and Câmpeni. The Census of the year 1992, brings few new urban (Predeal, Timiș de Sus, Săliștea de Sus) but something more than 1992, are contained in the census of 2011 (Frasin, Geoagiu-Băi, Baia de Arieș), each with their constituent localities (figure 3).

If urban space prospered from 1977-1992, the rural area began to disintegrate gradually following the reforms of communism on the systematization of rural and urban localities (table 6). The new territorial organisation, whereby the authorities wished to increase the well-being of the anthropic component and the harmonious development of the habitat, was based on Law 58 of the year 1974. To a large extent systematization was a socialist process that wanted the relocation of the rural population to cities. On the tables of evolution of the urban and rural population of the 1977-1992 gauge, we can say that the process has succeeded to some extent, since the rural population has been displaced or forced to migrate to the urban environment. As evidence, there are impressive percentage rural demographic decreases in table 6, which highlight the desired success of the socialists.

Table 6. Evolution of the carpathian rural population in the period 1977-1992
(Source: data processed after the NIS)

	Internal Carpathian Rural Population 1977	Internal Carpathian Rural Population 1992	Increases/decreases 1977-1992 %	% of total 1977	% of total 1992
Eastern Carpathians	599 446	566 161	-5.5	44.2	46.4
Southern Carpathians	82 439	69 269	-15.9	6.0	5.6
Western Carpathians	176 105	150 975	-14.2	13.0	12.4
	External Carpathian Rural Population 1977	External Carpathian Rural Population 1992			
Eastern Carpathians	205 382	204 767	-0.2	15.1	16.8
Southern Carpathians	91 004	76 411	-16	6.7	6.2
Western Carpathians	199 020	150 208	-24.5	14.7	12.3
Total	1 353 396	1 217 791	-10		

At the local level, the demographic increases in the period 1977-1992 are shown in figure 4. Compared to the previous period, we note the increased density of localities that have seen demographic growth. Most of the increases were between 0-25%, comprising almost entirely the carpathian space. In the Apuseni Mountains, there were demographic elevations in localities near the mining-argentiferous mines. Unfortunately, the desire to exploit the Western gold intensively led to the incise of the rural exodus. Villages of the type specific to these mountains, gradually depopulated, the population being constrained by the authorities to descend towards the mining tunnels.

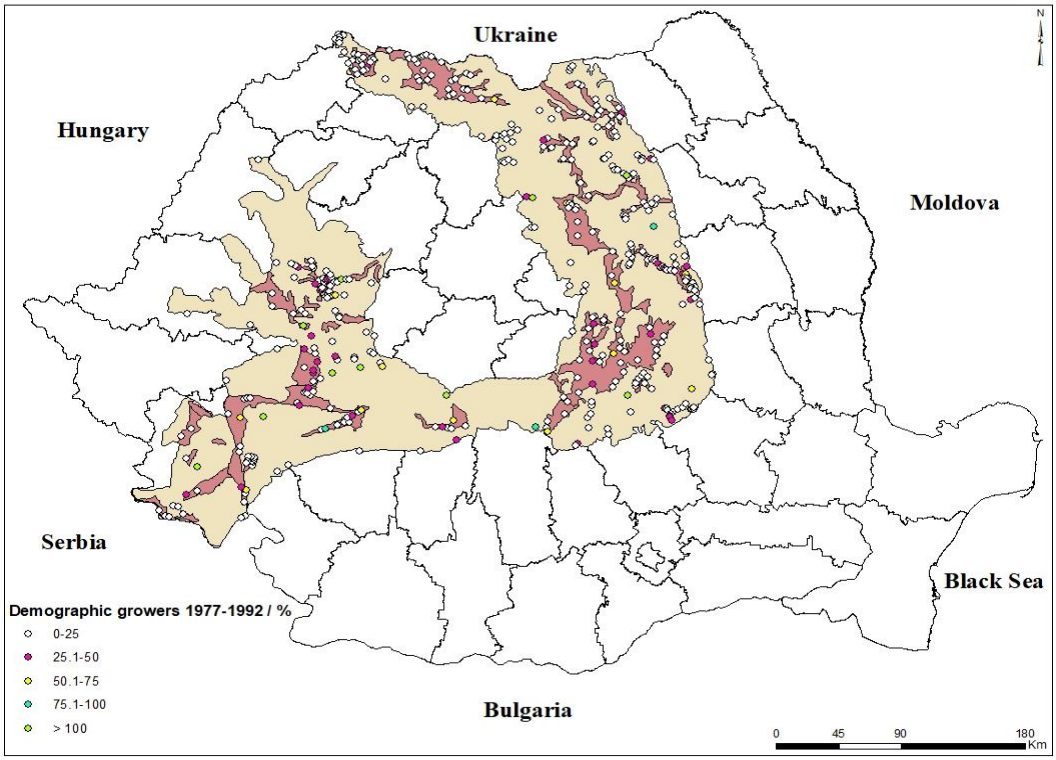

Figure 4. Demographic growth in the Romanian Carpathians in the period 1977-1992
(Source: data processed after the NIS)

From 1992 to 2011, the Romanian Carpathians began to lose significant demographic growth, both in urban and rural areas, the latter preserving the continuity of the decline begun during the Communist Era. On the weights of the decreases, the urban population of the Internal Carpathian Oicumena had slightly lower values than the urban weights of the External Carpathian Oicumena. However, the decreases are high given the short period of time. Basically, the massive urbanization of the Golden Age period began in the last decade of the twentieth century, a visible demographic decline. Each mountain group began to lose urban populations because of industrial restructuring, which had been in the past at the base of urbanisation. The urban environment of the External Carpathian Oicumena was faster and more aggressively subjected to depopulation, in the light of the fact that the geographical position did not provide them with natural resources of importance by which it could thrive (table 7).

The rural population of the Romanian Carpathians retained its downward trend throughout the 34 years, from 1977 to 2011. The Period of domination of the rural population in the carpathians ended with the abdication of King Mihai I, the moment represented by the change in the form of government in the monarchy in the republic. Also, the change in the form of government coincided with the country's leadership, the socialist regimes taking place a succession of them until 1989. From that moment on, the carpathian countryside was to enter decisively under the wand of major economic-political-social mutations, leading shortly to the beginning of the process of habitat and demographic involution. After nearly half a century of carpathian rural destructuring, neither the new world of capitalism has yet found the necessary methods of revitalizing the rural area. After 1989, the Westerners ' rural environment had the biggest dysfunctions, losing more and more young people from year to year, which migrated to urban centres where access to education, health and other services is much easier (table 8).

Table 7. Evolution of the carpathian urban population in the period 1992-2011
(Source: data processed after the NIS)

	Internal Carpathian Urban Population 1992	Internal Carpathian Urban Population 2011	Increases/decreases 1992-2011 %	% of total 2011
Eastern Carpathians	854 687	711 025	-16.8	53.3
Southern Carpathians	372 299	278 783	-25.1	20.9
Western Carpathians	206 787	161 001	-22.1	12
	External Carpathian Urban Population 1992	External Carpathian Urban Population 2011		
Eastern Carpathians	128 247	98 865	-22.9	7.4
Southern Carpathians	67 432	49 446	-26.6	3.7
Western Carpathians	44 855	34 237	-23.6	2.5
Total	1 674 307	1 333 357		

Table 8. Evolution of the carpathian rural population in the period 1992-2011
(Source: data processed after the NIS)

	Internal Carpathian Rural Population 1992	Internal Carpathian Rural Population 2011	Increases/decreases 1992-2011 %	% of total 2011
Eastern Carpathians	566 161	530 386	-6.3	49.6
Southern Carpathians	69 269	58 312	-15.8	5.4
Western Carpathians	150 975	119 855	-20.6	11.2
	External Carpathian Rural Population 1992	External Carpathian Rural Population 2011		
Eastern Carpathians	204 767	185 664	-9.3	17.3
Southern Carpathians	76 411	66 012	-13.6	6.1
Western Carpathians	150 208	108 320	-27.8	10.1
Total	1 217 791	1 068 549	-12.2	

The number of localities that have increased demographical, decreased in the post-socialist period, and increases in the period 1992-2011 are predominantly dominated by values between 0-25%. The abundance of increases concentrated in the southern parts of the Eastern Carpathians, in the central part and at the southern tip of the Apuseni Mountains. Unfortunately, the number of localities that have grown from a demographic point of view has declined from one census to another. The dominant Increases were between the values of 0-25%, and from 1992 onwards, many carpathian localities had a demographic deficit, losing the constant and continuous population (figure 5).

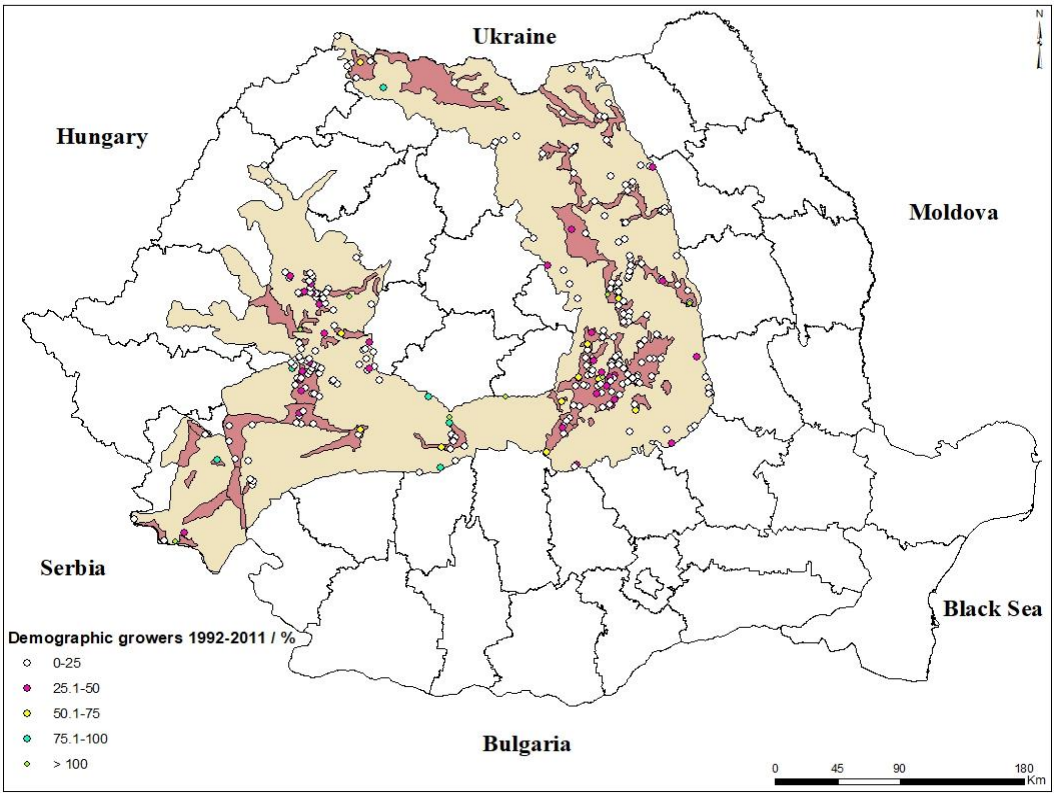

Figure 5. Demographic growth in the Romanian Carpathians in the period 1992-2011
(Source: data processed after the NIS)

CONCLUSIONS

The population of the Romanian Carpathians was continuously dynamic in the period 1930-2011, with periods of growth and decreasing periods. By dividing the period mentioned on several other sub-periods, we can identify upward and descending demographic cycles. From 1930 to 1977, the Romanian Carpathian Space, recorded a first positive demographic cycle, continued with the period 1977-1992, when the second positive demographic cycle was recorded. The 1977-1992 demographic cycle was the most prolific, with impressive demographic growth, started especially after Decree 770, on the prohibition of aborts. Also, the urban network of localities, was much diversified, amid natural resources being decreed new and new cities, taking place a broad process of carpathian urbanization. Unfortunately, in the period 1992-2011, the negative demographic cycle was identified, in which the population of the Romanian Carpathians decreased considerably. Thus, during the second decade of the interwar period, containing with the periods of socialist regimes, the carpathian population prospered continuously. The demographical impasse began with the establishment of capitalism, which came with new changes in most of the plans, adversely affecting the demographic component.

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CHALLENGES TO INCREMENTAL HOUSING DEVELOPMENT IN IBADAN MUNICIPALITY

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Abstract: Incremental housing despite been the major form of housing development for the low and middle income class, has suffered neglect on the path of housing policy makers in most developing countries. This has culminated in the plethora of problems facing incremental housing development in these countries today. This study examined challenges to incremental housing development in Ibadan municipality with a view to informing policy that could enhance the progressive building process. Data were obtained through questionnaire administration on incremental housing developers in the mention study area. The sampling procedure involved the stratification of the study area into high density, medium density and low density residential areas. Ten residential areas were randomly selected from the high density and medium density residential areas which are basically inhabited by low and middle income class who are the major practitioners of incremental housing development. One of every three incremental building was sampled after the random selection of the first building. A total of 305 incremental houses were sampled of the 915 identified during the pilot survey. The study revealed that lack of accessibility to finance is the most important difficulty against the incremental housing development process, while cost of building materials, land accessibility for house construction and approval of building plans were also highly rated as challenges in that order. The study concluded that non-availability of proper finance

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arrangement and policy support for the low and middle income housing needs are the major challenges confronting incremental housing development in the study area.

Key words: Incremental Housing, Housing Development

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INTRODUCTION

Housing is regarded as one of the basic needs. It ranks second after food and clothing. It is the pre-requisite for the survival of man (Onibokun, 1985). Housing as a unit of environment has profound influence on health, efficiency, social behaviour, satisfaction and general welfare of the community (Stone, 2006). Despite the established importance of housing, most of the urban populations in many developing countries live in dehumanizing housing environment, while those that have access to average housing do so at high cost. Most low/moderate income households therefore respond to their housing need by building as little financial resources flow in gradually. This process of gradual development/improvement of housing condition predominant among the low and middle income people is termed 'progressive housing', 'spontaneous housing' and most commonly 'incremental housing'.

Incremental housing has been describing as a 'phrased approach' for people to progressively improve their housing situation in order to achieve the constitutional right to adequate housing (Smets, 1999). For many low and middle income households, it takes a longer period of time to accumulate sufficient capital to quickly build a complete house. Most households go about the task of improving their housing condition incrementally. It is often done on a block by block and a wall by wall basis. Often the land around the home continues to accumulate building materials (stockpiling) for the next improvement project. It is an on-going process.

Challenges facing incremental housing development process in most developing countries are enormous. These problems transcend inadequate finance arrangements available for incremental housing, lack of policy support, poor level of housing infrastructure development, poor land accessibility most especially for the low and middle income households among others (Adeyeni, 2015). Aside the problem of finance, incremental housing development has suffered neglect on the path of stakeholders (including policy makers) in the housing sector (2015). Housing policy and programmes in many developing countries therefore do not recognize the abilities and motivation of the low and middle income classes of the society. The net result is the very slow pace of the incremental housing process and the resultant inadequate hosing for low/moderate income class of the society in developing countries.

As families grow and resources permit, low and middle income households build their homes step-by-step. Resources dedicated to incremental housing have to compete with other needs of the household. Not surprisingly, the incremental home building process can take low and middle income families' decades – a median of 16 years to complete a home in one study conducted in Mexico (Prahalad, 2005). Stakeholders in the housing sector have often neglected institutional arrangements concerning incremental housing development that can vastly increase the speed and performance of the progressive building process. Such institutional arrangements play an important role in incremental housing practice (Roberto, 2013). This neglect has resulted in the mirage of challenges facing incremental housing development in the developing countries of the world. This paper therefore examines the challenges to incremental housing in Ibadan municipality with a view to informing policy formulation for enhanced incremental housing development.

LITERATURE REVIEW

Various definitions of housing exist in literature. One convergence point however is that housing is basic necessity for man, a dwelling place for his kind. Housing embraces all the social services and utilities that make a community or a neighbourhood a livable environment (Agbola,

2000). According to Olotuah (2009), housing caters for man's biological (clean air, water); psychological needs (satisfaction, contentment, prestige, privacy, choice, freedom, security and social interaction with others, human development, cultural activities) among others. Housing is more than mere shelter (Olotuah, 2009). It is one of man's most precious possessions. It offers man both physical and psychological protection. It is also a symbol of man's conquest of the earth, a monument to his power and glory. Housing can be summarized as the process and substance by which the earth has been transformed from the primordial jungle into what is today a living and ever-growing testimony of man's relentless quest to make earth amore comfortable place to live in (Olayiwola, 2012). Housing represents one of the most basic human needs. As a unit of environment, housing has a profound influence on the health, efficiency, social behaviour, satisfaction and general welfare of the community (Onibokun, 1985). It is one of the best indicators of a person's standard of living and his or her place in the society (Olayiwola, 2012).

Agbola (2000) expresses he crises situation of housing condition in Nigeria when he opined that it is conspicuously glaring that most of the urban population live in dehumanizing housing environment while those that have access to average housing do so at abnormal cost. According to Onibokun (1985) and Agbola (2000), rent in major cities of Nigeria constitute amount 60% of total expenditure an average workers disposable income. This is far higher than between 20 and 30% recommended by the United Nations. Many developers have difficulty obtaining capital for their projects even in normal times. This has been attributed to a number of problems. Two of these problems are the high interest rates that contribute to the high cost of housing, and the difficulty in obtaining capital for home construction are noteworthy (UN-Habibat, 2013). In a tight money market, housing is the first area to suffer (Roberto, 2013), since neither the builder nor the consumer can readily obtain finance for housing. It is estimated that 80% of housing in the developing world are built in this manner (Roberto, 2013) – a phenomenon that has made incremental housing a recognized housing development mechanism among housing scholars.

In the 1960s and 70s, World Bank Policies on housing promoted self-help housing. This was influenced by the writings of Turner and Fichter (1972). They indicated that self-helping housing was a solution to low-income groups housing needs. Turner agrued that self-help housing is adapted to the changing needs and circumstance of its occupants, it is improved over time when family finances allow, it enables community solidarity and mutual help and above all, the owners have the autonomy to design and manage their dwellings. Turner further added that individual needs, priorities and possibilities are continually changing and that helps to even spread the cost of construction over time. The component materials needed for construction should therefore be left with individuals and households or decentralized local and small scale institutions. According to Turner's view, large organizations provide standard products which cannot deal with the enormous changing housing needs of the low-income households (Turner and Fichter, 1972). The role of government according to them was to ensure access to land, building materials and finance. These ideas were later incorporated in the World Bank lending programmes (Smets, 1999). There writings remain a major reference in promoting incremental housing development today.

According to Smets (1999), incremental building is the process by which shelter is constructed step by step and improved over a period of time in terms of quality and size. Smets argues that, this type of building process depends much on the individual household priorities and available income, and changes in accordance to the family cycle. CHF (2004) defines incremental building as a household-driven building process for acquiring, extending, improving or servicing a dwelling or group of dwellings over time, and thereby improving the quality of the household members and maximizing their choices of housing design and housing needs. The incremental/progressive building or development is also seen as the process by which low-income households make incremental investments in housing as their income permit (Hasan, 2000). What is apparent in these three definitions of incremental building is the issue of limited capacity or incomes and hence the only possibility of house ownership for the low-income household is to invest in shelter in several stages (UNCHS, 2003). Studies have reported that incremental housing

developers take to various dwelling forms depending on the opportunities and challenges surrounding the progressive dwelling process (Adeyeni, 2015).

On the basis of structure, design or layout, houses can be categorized into the following:

I. Single detached bungalow – These are houses which are completed independent of any other structure. The garage may be located within the house or in a separate structure. Detach houses are generally owner-occupied and of one floor (Jinadu, 2007). Typical examples of detached housing are the three bedroom houses found in Gwarinpa housing estate in Abuja, Nigeria.

II. Semi-detached bungalow – These are one or two family houses, with a common wall between houses for economy. They are characterized by separate and independent entrances. Semi-detached bungalows are similar to the detached ones but are located on a smaller lot. Semi-detached bungalows are usually in one floor. Construction in semi-detached are cheaper than in single detached house but it has less privacy

III. Row house – these are roomy apartments found in many cities and rural settlements in Nigeria. Common walls are used for both sides of row houses for economy. They are narrow in shape to maximize number of units in a row and are cheaper to build (Olayiwola, 2012). A typical row housing contains multiple-room facility that offers single rooms (between 6 to 10 rooms aside, separated by a narrow lobby) for rent with shared kitchen, bathroom and toilet facilities.

IV. House with more than one floor – these are houses more than a single floor. They may also be referred to as low rise buildings. They may be detached, semi-detached or rooming apartments. The common ones are the two and three storey buildings (Olayiwola, 2012).

The challenges to incremental housing as recorded in literature are enormous. Minimum housing standards and legislation are usually outside the social contexts of the low-income class (Walker, 2001). A major obstacle for housing experts is how to situate housing standards in different social contexts. Also, the real estate market rarely produces sub-divided and serviced land for low-income families (Jacobs and Savedoff, 1999). Consequently, they must access land through alternate means, such as illegal land occupation, purchases of illegal subdivisions and government programs and they must also be prepared to accept different level of security in land adequate tenure. Walker (2001) noted that a major challenge against the progressive building process is the lack of adequate resources on the part of housing developers. Aravena (2011), Farvacque and McAuslan (1992), Greene and Duran (1990) posits that while the public sector favours access to sanitation services as the most crucial need, households mostly value maximum protection against the elements (relative to their previous situation of squatting on illegal land that might be overly susceptible to natural risks) and some privacy (relative to their previously overcrowded circumstances). This may question the integrity of incremental housing development as a possible viable low income housing development option.

THE STUDY AREA

Ibadan is the capital city of Oyo state in Nigeria; the city is located in the southwestern part of the county. It is located approximately between longitudes 3°53′ and 4°10′ east of the Greenwich Meridian and latitudes 7°22′ and 7°40′ north of the Equator (figure 1). The military Jihad war of the 19th century originating from Sokoto Caliphate which caused the collapse of the old Oyo Empire provoked a huge movement of people from the north to the south of Yoruba land. Ibadan subsequently became a war camp by 1829 for warriors coming from Oyo, Ife and Ijebu (Mabogunje, 1962). Moreover, its location at the fringe of the forest promoted its emergence as a marketing centre for traders and goods from both the forest and grassland areas. The city is located on an elevation of 234 meters above sea level and it is situated on gently rolling hills running in a northwest/southwest direction (Agbola, 2000). The city succeeded in becoming a large empire from around 1860s to 1890s. Ibadan witnessed a rapid growth when it became the Western Province Headquarters in 1939. The built up area of Ibadan was said to be 38.85 sq/km in 1935; 46.40 sq/km in 1955; 77.7 sq/km in 1965; 152.80 sq/km in 1988. By the year 2000, it is estimated that Ibadan covered 400 sq/km.

According to Agbola (2000), the five local government areas that make up Ibadan municipality encompasses Ibadan North, Ibadan North East, Ibadan North West Ibadan South East and Ibadan South West with respective headquarters at Agodi-Gate, Iwo Road, Onireke, Mapo and Oluyole. The peculiarity of the five areas is that they are connected with main roads that government areas which are rural include Akinyele, Egbeda, Ido, Lagelu, Oluyola and Ona-Ara. Spatially, Ibadan sprawls over a radius of 12-15 km. At a crow fly, Ibadan is 128 km northeast of Lagos and 345 km southwest of Abuja. It enjoys the distinctive West African Monsoon climate which has two major seasons: the dry and wet, the occurrence of which is greatly influenced by its latitudinal location. Since the time of the 1986 Structural Adjustment Programme (SAP), thousands of small-scale and household industries have been established in Ibadan. Consequently, there was an increase in employment in the informal economic sector in the 1980s, the development of corruption and bad government administration increased dramatically during the military era notably during Babangida and Abacha regimes (1984-1998) (Mabogunje, 1962).

Housing and associated facilities (water, electricity, etc) have been reported to be inadequate in Ibadan, such that hundreds of households live in substandard and subhuman environments, plagued by slums, squalor, and similarly inadequate social amenities, such as schools and health and recreational facilities (Agbola, 2000). The gradual decline of social values and the breakdown of family cohesiveness and community spirit have resulted in increased levels of juvenile delinquency and crime. The level of provision of infrastructural facilities has declined, and intracity mobility is greatly hindered by poorly planned and inefficiently managed land use and a sharply reduced network of roads. The housing situation of Ibadan therefore presents a good case for studies with implication for informing policy formulation in the developing countries of the world.

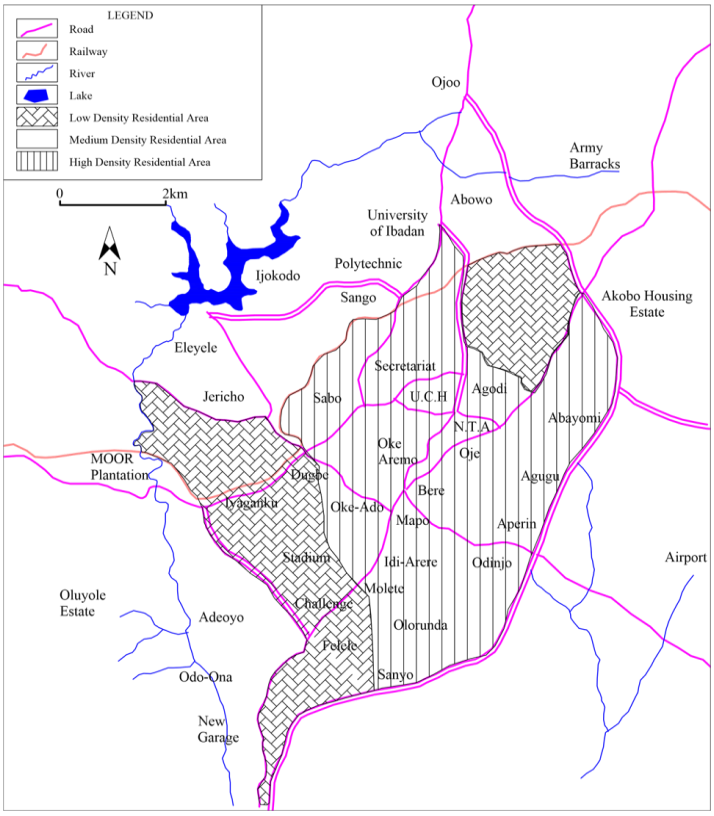

Figure 1. Map of Ibadan showing the major residential wards
Sources: Ibadan North Local Government Area Local Planning Authority Scale

RESEARCH METHODOLOGY

Data were collected from primary source for the purpose of achieving the aim of this study.

Primary data were collected through administration of questionnaire. The questionnaires were directed at the developers of incremental houses in the study area. Sample frame for this study are developers of incrementally built houses in the selected five local government areas of Ibadan municipality. Incremental houses here considered are occupied houses under construction or improvement, whose part or whole outer wall has not been plastered; and/or whose flooring has not been completed; and /or whose outer windows or doors are made of temporary materials. Multi-stage sampling technique was employed in the study. Firstly, stratification of the study area into the existing local government area delineation was carried out. In the second stage, the five local government areas were divided into the existing residential wards as defined by the National Population Commission in the conduct of census.

The residential wards were thereafter stratified into the three identifiable residential densities – low, medium and high – as employed by Adesanya (2000). Table 3.2 shows that thirty three (33) low density, sixty eight (68) medium density and sixty three (63) high density residential wards can be identifies in the five local government areas. From these, 8% of the wards in the medium and high density areas wee randomly selected to make a total of 10 wards in the two residential density areas. Aside the consideration of time and cost, the selection of one ward from each of the high and medium density residential areas was based on the belief that residential areas of the same density in each of the local government areas are nearly uniform in their housing characteristics and so information obtained from one could provide a good insight into what is obtainable in the other wards of the same density. The low density residential wards were not considered as they are mainly occupied by the high income earners who may not engage in incremental housing as such.

For the ten (10) selected residential wards, developers of incremental houses were selected using the simple process of sympathetic sampling from the nine hundred and fifteen (915) incremental houses identifies during the pilot survey. A total of 305 houses representing 33% of the sample frame were sampled. In the case, the first house sampled was selected randomly. The subsequent selection was on the basis of every 3rd incremental house. This is presented in Table 3.3. Developers of incremental housing were administered a questionnaire and direct observation carried out. The data collected were analysed using frequency distribution, percentages, ANOVA and multiple regressions.

To this end, seven major difficulties were identifiable in the study area as revealed by the self administered questionnaire. Each of the difficulties were rated using one of the five likert scales as follows: Highly Applicable (HA), Applicable (A), Just Applicable (JA), Not Applicable (NA) and Not Applicable At All (NAA). This is a personally devised rating to measure perceived difficulties against the progressive development process. For ease of measurement and understanding, the difficulties were measured using an index called Perceived Index (PI).

Identifies possible difficulties rated by the developers include: cost of building materials, land accessibility for house construction, tenure security for land before house construction, approval of plans/property documentations, accessibility to finance, housing appearance at the earlier stage of incremental construction, attitude of household members to moving into the incremental dwelling.

To arrive at an index for each difficulty, the following steps were followed:

a) A Weight Value of 5,4,3,2 and 1 were attached to each of the rating respectively;

b) Summation of Weight Value (SWV) which is the addition of the product of value attached to a rating and respective number of respondents to the rating;

c) Dividing the SWV by the number of the rated factor.

Using the above rating, the mean index for all difficulties in each residential zone and the study area were computed by summing up the index to each of the difficulties and dividing by the number of difficulties identifies (n): n=7.

ANALYSIS AND DISCUSSION

Presented in Table 1, 2 and 3 are developers' perception of how significant the identified difficulties are in the two concerned residential density areas and the study area as a whole. From this summary, difficulties against the incremental development process can be grouped into two, relative to how significant the impact is perceived. These were grouped with positive deviation and group with negative deviation from the mean index. It was evident from the tables that four difficulties against the incremental development process had a positive deviation from the mean index in the high and medium density residential areas and the study area as a whole. Three of the identified difficulties had negative deviation around the means and were so considered to have exalted title hindrance on the incremental development process.

As presented in table 1, incremental housing developers in the study area as a whole were of the opinion that accessibility to finance, cost of building materials, tenure security and land accessibility for house construction are the most important difficulties against the incremental housing developers in Ibadan municipality. Approval of building plans were rated to exalt the next most significant difficulty on the incremental development process above the two last factors which are more of socio-psychological hindrances to the incremental housing development process. The last two difficulties – attitude of household members to moving into dwelling and dwelling appearance at the earlier stage of the incremental development process – were not much rated by the developers. This corroborates the findings of Llanto (2007), who using a case of the Philippines affirmed that low and middle income household exhibits a high level of motivation to own a hose of their own and will go far in satisfying their house desire.

As recorded on table 1, accessibility to finance, cost of building materials, tenure security for land before construction, land accessibility for house construction, approval of plans/property documentations, attitude of household members to moving into the incremental dwelling and housing appearance at the earlier stage of incremental construction had indices of 4.91, 4.19, 3.66, 3.55, 3.33, 2.43 and 2.21 respectively. The computed standard deviation and co-efficient of the variation were 0.9419 and 27.09%. It could therefore be inferred that the scattering of developers' response around the mean PI was low and the result of the analysis is so considerable for making inference.

Table 1. Developers perception of how significant identifies difficulties are in the study area

Data source: Author's field survey (2015)

Difficulties	HA	A	JA	NA	NAA	SWV	PI	MD
Accessibility to finance	277	28	0	0	0	1497	4.91	1.44
Cost of building materials	110	144	51	0	0	1279	4.19	0.72
Tenure security for land before construction	101	74	63	52	10	1116	3.66	0.19
Land accessibility for house construction	83	115	66	33	8	1082	3.55	0.08
Approval of plans/property documentations	79	77	49	65	35	1015	3.33	-0.14
Attitude of household members to moving into the incremental dwelling	32	41	47	90	96	741	2.43	-1.04
Housing appearance at the earlier stage of incremental construction	20	29	43	105	118	673	2.21	-1.26

Note: highly applicable (HA), Applicable (A), Just Applicable (JA), Not Applicable (NA) and Not Applicable at all (NAA)

$$\sum \text{PI} = 24.28, \overline{\text{PI}} = \frac{\sum \text{PI}}{\text{N=7}} = \frac{28.28}{7} = 3.47$$

Standard Deviation (SD)√Variance= √0.887=0.9419

Co-efficient of Variation = $[(\frac{SD}{PI})$ x 100] % = $[(\frac{0.94}{3.47})$ x 100] % = 27.09%

Table 2 shows that incremental housing developers in the high density residential areas also rate accessibility to finance as the most significant difficulty against the progressive building process with an index of 4.92. In the order of importance as rated by the developers, other

identified difficulties are cost of building materials, tenure security for land before construction, land accessibility for house construction, approval of plans/property documentations, attitude of household members to moving into the incremental dwelling and housing appearance having an index of 4.31, 3.70, 3.61, 3.28, 2.42 and 2.12 respectively. The computed standard deviation and co-efficient of variation were 0.9866 and 28.45% respectively. It will therefore not be wrong to infer that the scattering of developers' responses around the mean PI makes the result of the analysis reliable for making inference.

Table 2. Developers perception of how significant identifies difficulties are in the high density residential areas
Data source: Author's field survey (2015)

Difficulties	HA	A	JA	NA	NAA	SWV	PI	MD
Accessibility to finance	156	14	0	0	0	836	4.92	1.44
Cost of building materials	67	88	15	0	0	732	4.31	0.83
Tenure security for land before construction	62	39	31	32	6	629	3.70	0.22
Land accessibility for house construction	41	57	44	21	7	614	3.61	0.13
Approval of plans/property documentations	38	46	32	33	21	557	3.28	-0.20
Attitude of household members to moving into the incremental dwelling	17	24	26	49	54	4111	2.42	-1.06
Housing appearance at the earlier stage of incremental construction	11	16	21	56	66	360	2.12	-1.36

Note: highly applicable (HA), Applicable (A), Just Applicable (JA), Not Applicable (NA) and Not Applicable at all (NAA)

$$\sum \text{PI} = 24.36, \bar{\text{PI}} = \frac{\sum \text{PI}}{\text{N=7}} = \frac{28.36}{7} = 3.48$$

Standard Deviation (SD) $\sqrt{\text{Variance}} = \sqrt{0.973} = 0.9866$

Co-efficient of Variation = $[(\frac{SD}{PI}) \text{ x } 100] \% = [(\frac{0.99}{3.48}) \text{ x } 100] \% = 28.45\%$

As shown in table 3, incremental housing developers in the high density residential areas also rate accessibility to finance as the most significant difficulty against the progressive building process with an index of 4.90. In the order of importance as rated by the developers, other identified difficulties are cost of building materials, tenure security for land before construction, land accessibility for house construction, approval of plans/property documentations, attitude of household members to moving into the incremental dwelling and housing appearance having an index of 4.05, 3.61, 3.47, 3.39, 244 and 2.32 respectively. The computed standard deviation and co-efficient of variation were 0.8934 and 25.80% respectively. It will therefore not be wrong to infer that the scattering of developers' responses around the mean PI makes the result of the analysis reliable for making inference.

Table 3. Developers perception of how significant identifies difficulties are in the medium density residential areas
Data source: Author's field survey (2015)

Difficulties	HA	A	JA	NA	NAA	SWV	PI	MD
Accessibility to finance	121	14	0	0	0	661	4.90	1.45
Cost of building materials	43	56	36	0	0	547	4.05	0.60
Tenure security for land before construction	43	35	32	16	4	487	3.61	0.16
Land accessibility for house construction	35	40	25	23	12	468	3.47	0.02
Approval of plans/property documentations	41	31	17	32	14	458	3.39	-0.06
Attitude of household members to moving into the incremental dwelling	15	17	21	41	42	330	2.44	-1.01
Housing appearance at the earlier stage of incremental construction	9	13	22	49	52	313	2.32	-1.13

Note: highly applicable (HA), Applicable (A), Just Applicable (JA), Not Applicable (NA) and Not Applicable at all (NAA)

$$\sum PI = 24.18, \overline{PI} = \frac{\sum PI}{N=7} = \frac{24.18}{7} = 3.45$$

Standard Deviation (SD)$\sqrt{\text{Variance}} = \sqrt{0.798} = 0.8934$

Co-efficient of Variation = $[(\frac{SD}{PI})$ x 100] % = $[(\frac{0.89}{3.45})$ x 100] % = 25.80%

From the analysis above it is obvious that a slight difference exist in the perception of difficulties the incremental development process between the high and medium density residential areas. For instance, the index of accessibility to finance in the high density residential areas is 4.92; the same index had a value of 4.90 in the medium density residential areas. It is equally noticeable that approval of building plans has a higher index than attitude of household members to moving into the incremental dwelling and housing appearance at earlier stage of incremental construction. This creates concern about the perception of the importance of physical planning by the developers.

CONCLUSION AND RECOMMENDATIONS

The study revealed that developers perceived lack of accessibility to finance as the most important difficulty against incremental housing development process, while cost of building materials, land accessibility for house construction and approval of building plans were also highly rated as challenges. It is however noteworthy that the motivation of the low and middle income households to have a roof of their own over their head has led to the development of various structures which households improve as resources permits. Thus, it can be concluded that non-availability of proper finance arrangements and policy support for the low and middle income housing needs are the major challenges confronting incremental housing development in the study area.

It is beyond doubt that most incremental housing developers would benefit enormously form technical and legal assistance provided by governmental bodies, NGOs or the private sector. The workability of microfinance for incremental housing developments can be investigated and its prospects harnessed as it has been proven to adapt to evolving needs of the low and middle income groups in developing countries of Asia and the Caribbean. Incremental housing, including its mutual form, should be better monitored and in due course, better 'assisted' by government and housing institutions, thus securing that it will become a basic part of formal housing policies. Government should develop an effective and efficient support system by involving in its through production of necessary housing facilities along with the environmental and infrastructural facilities. The advent of the Land Use Act and the instrument of Certificate of Occupancy have fuelled unprecedented speculation, private ownership and commercialization of land. The unbridled corruption and high-handedness encourage by the Act have also defeated the equity and accessibility advantages that the Act had intended to ensure. These recommendations could create a pathway towards enhanced incremental housing development in the developing world.

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GEOGRAPHICAL CONSIDERATIONS REGARDING THE TOURIST DESTINATION PĂDUREA CRAIULUI MOUNTAINS

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Abstract: The affirmation and development of local and regional tourism as a reflection of the technological advances imposed by globalization have led to a certain specialization of the spatial entities in the direction of shaping and asserting the tourist destinations. On this background, the present study aims to underline some geographic aspects that contribute to highlighting structural and functional aspects of the tourist destination Pădurea Craiului. In this respect, the transport infrastructure, tourism infrastructure, tourist services and tourism resources were analyzed, the results being transposed in textual and cartographic format.

Key words: Pădurea Craiului Mountains, tourism destination, tourism resources

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INTRODUCTION

The tourist destinations are structurally and functionally well-defined spatial entities, with roles and functions in attracting and retaining potential tourists for a certain period of time. At national and international level, the analyse and study of tourist destinations is increasingly necessary in the last period of time, due to the increasing role and importance of tourism in the

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development of local economies (Herman et al., 2017, 2018; Ilieș et al., 2010; Ilie et al., 2017) and in the conservation and economic valorization of protected natural areas (Herman et al., 2016a, 2016b; Ilieș et al., 2015, 2017a, 2017b; Siikamäki et al., 2015; Tătar et al., 2017; Tolvanen and Kangas, 2016; Wendt et al., 2019). Considering the fact that the Pădurea Craiului Mountains overlap over such protected areas, the concerns are raising, regarding the tourism in general and the development of the tourist activities in particular, knowing that the anthropic activity can have both positive and negative effects on the term short, medium and long term (Ballantyne and Pickering, 2013; Herman, 2009; Morar, 2011; Morar, 2012a; Rankin et al., 2015).

From the analysis of the specialized literature and the daily practice it was found that in the emergence, the evolution and the dynamics of the tourist destinations, an important role is played by a number of determinant factors among which we mention the transport infrastructure (Matoga and Pawłowska, 2018; Rosik et al., 2018, Więckowski et al., 2014), the tourist infrastructure (Kapera, 2018, Herman and Wendt, 2011), the tourist resources (Gaceu and Herman, 2010; Gaceu et al., 2018; Lindner-Cendrowska, 2013), the tourist perception (Bar et al., 2016; Toral et al., 2018), the competitiveness of tourist destinations (Mendola and Volo, 2017; Sainaghi et al., 2017; Gómez-Vega and Picazo-Tadeo, 2019), the structural and functional evolution of destinations (Herman and Tătar, 2015; Mariani, 2014) and by the funding opportunities (Morar, 2012b).

The present paper aims at studying the area of the Pădurea Craiului Mountains in order to analyze the attributes necessary for its nomination as a tourist destination.

The Pădurea Craiului Mountains, with an area of 1150 km², represent a fourth-order geographic unit, administratively framed by the county of Bihor, occupying the tenth part of its territory (Geography of Romania, I, 1983). The mountains descend to the North-West of the Bihor-Vlădeasa Mountains, forming along with the Codru-Moma, Plopiș, Meseș and Zarand Mountains, the so called Apuseni Peninsula (Rusu 1988), framed by Crișul Repede to the north and by Crișul Negru to the south (Figure 1).

The neighboring geographic units of the same order are the Vad-Borod Depression in the North-West, the Bihor-Vlădeasa Mountains in the East, the Beiuș Depression in the South and the Cordăului, Tășadului and Holodului Hills at the Southwest (Novac, 2006).

The Pădurea Craiului Mountains are distinguished by the massive unitary layout suspended above the surrounding relief units, aspect due to the basic level of the two neighboring depressions, Vad and Beiuș. The mountain unit is an intensely fragmented platform, in a series of isolated peaks and massifs, such as hillock and cornets, where the positive forms alternate with the negative ones, the depth of fragmentation being between 150-250 m in the Northwest and 300-600 m in South-West (Geography of Romania, III, 1987).

The altitudes are generally low, under 1000 m, the highest one occurring in the Eastern part (the peak of Hodrângusa, 1027 m). The altitudes are descending westwards to the two depressions, in the north the Vad Depression and in the south the Beiuș Depression.

Depending on the geological substrate, there are two important categories of reliefs in the Pădurea Craiului Mountains, those specific to the impermeable rocks and those specific to the limestone.

The relief developed on impermeable rocks is represented, according to the age and nature of the rocks, by high, massive shapes and by forms of relief with low altitude, in some cases they are flat, in others their personality is lacking (Rusu, 1988).

The relief developed on the karst is very varied, complex and spectacular, being represented by the whole range of exo and endokarst, generated not only by the lithology and structure, but also to special paleo-climatic conditions and by the position of the unit, in relation to the erosion base. The karst of the Pădurea Craiului Mountains is represented by all specific forms, approaching the unit to holokarst (Rusu, 1988).

Since the competitiveness and the evolution of the tourist destinations are related to the established destinations, the analysis of the transport infrastructure, the tourist infrastructure, the tourist services and the tourism resources that define the tourist destination Pădurea Craiului must be performed.

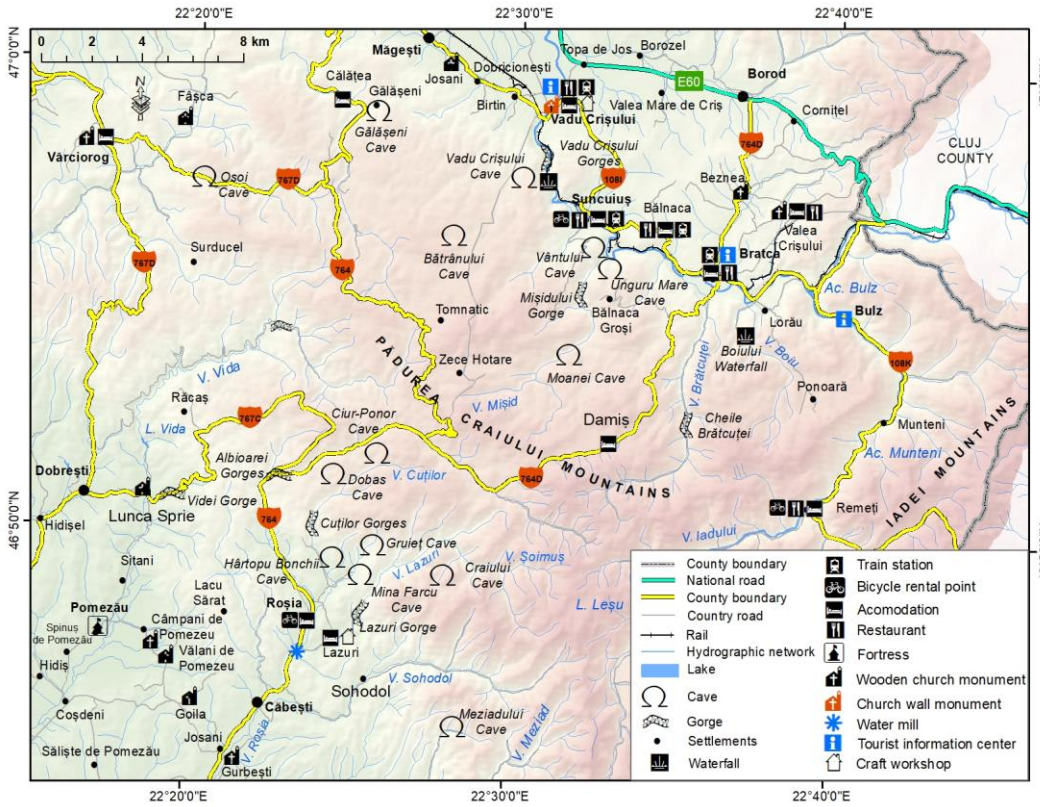

Figure 1. Synthetic map of the Tourist Destination Pădurea Craiului Mountains

THE RESEARCH METODOLOGY

The elaboration of the present study involved the spatial and relational analysis of several elements necessary for shaping the tourist destinations (transport infrastructure, tourism infrastructure, tourism services and tourism resources). The data necessary for carrying out the study, obtained from the Ministry of Tourism, from the literature and from the field work, were analyzed with ArcGis 10.6 in order to understand the spatial relations between the elements defining the tourism destination Pădurea Craiului (Herman, 2010; Ilieş et al. 2014, 2016; Romocea et al., 2018).

The results obtained consist in the creation of a synthetic map of the Pădurea Craiului tourist destination, on which the defining elements that led to the shaping of this destination, respectively of the study "Several geographical considerations regarding the Tourist Destination Pădurea Craiului Mountains" were presented.

THE TRANSPORTATION INFRASTRUCTURE

Located in the northwest of the Apuseni Mountains, between the Crişul Repede Defile, to the north, and the Depression of Beiuş to the south, the Pădurea Craiului destination can be accessed both by train and by car. The train access is provided by the railway Oradea-Cluj-Napoca-Bucharest (with the train station Bratca, Şuncuiuş, Vadu Crişului), while the car access is via the European Road 60, connecting Oradea to Cluj-Napoca, respectively the European Road 79 (Oradea-Beiuş), which continues with the county road 764 (Beiuş-Bratca).

THE TOURIST INFRASTRUCTURE

The accommodation structures are representative elements in the shaping of tourist destinations, their appearance and evolution having close links with the tourist potential of the space in which they appear and manifest (Herman and Tătar, 2015). The tourist destination Pădurea Craiului is represented by the existence of a number of 32 accommodation structures, with a capacity of 709 beds. The spatial analysis of the accommodation structures in the studied area highlighted the existence of three major groups, located in the North-East (represented by a number of 14 structures, 357 accommodation beds), in the South-West (represented by 9 accommodation bases, 195 beds) and West, in Remeți, on the Iad valley (represented by 8 structures, 145 beds). An exception to this rule is the Tourist Pension Mihaiu Sasului from Vârciorog (12 beds) (LSPTC, 2018). It should be underlined that the location of the accommodation structures is closely related to access routes, on the one hand and to the existence of tourist resources, on the other hand.

The food service operators are also representative elements in shaping the tourist destinations, complementing the accommodation structures to meet the primary needs, in connection with gastronomy and recreation. In the studied area there are nine food services operators (1270 seats), located in the North-West of Pădurea Craiului, in Vadu Crisului, Șuncuiuș, Bratca, Valea Crișului and West, in Remeți (LSPTAP, 2018). For the location of the food service operators, it can be observed the connections with the access routes and with the existence of tourism resources.

Tourist planning elements are structural elements of tourist destinations with important roles and functions in generating tourist motivation.

The first tourist facilities specific to the area under consideration dates back to 1880 when the "the father of the Bihor County tourism", Czaran Gyula, explores the Meziad Cave and undertakes the first tourist planning. Later, in 1903 he proposes and set up the first tourist route from the Pădurea Craiului, between Vadu Crișului and Șuncuiuș. In the same period, the first tourist cottage was built near the Vadu Crișului Cave, the cottage being nowadays abandoned (the Journal of the Pădurii Craiului, 2017).

Currently, the following tourist facilities have to be mentioned: four caves for tourism (respectively, Meziad Cave, Crystal Cave in Farcu mine, Ungurul Mare Cave and Vadu Crișului Cave)[1], the hiking routes (15 hiking routes, approved and maintained by the Mountain Rescue Service from Bihor County)[2], the thematic routes (four routes "Discover Roșia Valley", "Forest Stories", "No Trace!", "The Forest Livings") (Bihor Destination Management Agency, 2017, p. 13), the areas and routes for climbing and mountaineering activities (six climbing areas, located in Vadu Crișului, Șuncuiuș, Bulz, Remeți, Osoi and Lazuri, with a total of 442 routes)[3] and the via-ferrata routes (three routes, the Hodoaba Valley, Zânelor Vertical Slope and Zmăului House).[4,5] Also, there are five mountain bikes rental centers, located in Suncuiuș (at Extreme Suncuiuș tour operator, near Gradia Pension), Remeți (at the pensions Apuseni Wild and Gornicului, on the Iad Valley), Remetea (six bikes) and Roșia (six bikes).[6]

THE TOURIST SERVICES

Tourist Information and Promotion Services are defining attributions for the Tourist Information and Promotion Centers, representing through the roles and the functions performed, together with the transport and tourism infrastructure, another essential element in the emergence and development of the tourist destinations. The destination Pădurea Craiului is represented by the

[1] *https://www.padureacraiului.ro/speoturism*
[2] *http://www.salvamontbihor.ro/page/trasee-turistice*
[3] *http://alpinismbihor.ro*
[4] *http://alpinismbihor.ro*
[5] *http://salvamontbihor.ro/page/via-ferrata-vad*
[6] *https://padureacraiului.ro/rent-a-bike/*

existence of the TIPCs (23% of the total number of Bihor County centers), located in the North-East, in Bratca, Vadu Crişului and Bulz. The role and importance of TIPCs in the studied area, in the shaping and development of the Pădurea Craiului tourist destination, emergences from the researches carried out during the period 01.10.2017 - 20.04.2018 and 01.11.2018 - 30.01.2019, using sociological survey based on questionnaire and from web site analysis. The conclusions of the research show that the Tourist Information Center Vadu Crişului and Bulz have an insignificant role, while the National Tourist Information and Promotion Center Bratca has a minor role. A similar situation has also emerged from the web site analysis.

The tourist services are well coordinated and represented in the Pădurea Craiului destination, by a number of 18 operators and six specialized guides (Bihor Destination Management Agency, 2017, p. 25).

THE TOURIST RESOURCES

The natural frame is a basic element in the shaping of tourist destinations, having multiple functions, including the material support of all activities including tourism, esthetical features (landscape) and last but not least, the relief it is a tourism resource itself (Herman and Tătar, 2015; Herman and Wendt, 2011; Herman et al., 2017; Ilie et al., 2017). In this context, the analysis of the natural environment as a factor of motivation highlights the followings: the karst relief with the two networks of caves, some of them planned for tourism (Meziad Cave, Crystal Cave from Farcu Mine, Ungurul Mare Cave and Vadu Crişului Cave), other caves are not planned for tourism but they offer speoturism opportunities (Wind Cave, Bătrânului, Ciur-Ponor, Craiului, Doboş, Gălăşeni, Gruieţului, Hârtopul Bonchii, Moanei and Osoi). It also has to be mentioned the karst plateaus (from Runcuri, Zece Hotare and Damiş-Ponoraş), the gorges (Videi, Cuţilor, Lazurilor, Sohodol, Albioarei, Mişidului, Brătcuţei), the waterfalls (Cailor Waterfall, on the Boiului Valley and Vadu Crişului Waterfall, on the Crişul Repede Valley).

Strongly related to the characteristics of the natural frame and viewed from the perspective of physical life support for the local communities, a series of anthropic attractions have to be mentioned, such as the wooden churches, historical monuments (from the villages of Beznea, Valea Crisului, Josani, Hotar, Vârciorog, Fasca, and Petreasa, Gurbeşti, Goila, Câmpani de Pomezeu, Vălani de Pomezău etc), the historical stone church from Vadu Crişului, the Roşia water mill, the workshops for pottery in Vadu Crişului and for egg painting in Drăgoteni, the horn violin from Lazuri de Roşia (figure 1).

It is clear from the previous analyses, that the natural and anthropic tourism potential of the Pădurea Craiului Mountains (through its features like the low altitudes, the accessibility, the presence of the karst relief, the traditional villages) is significant. This mountain area belongs to the most favorable category for the emergence and development of all forms and types of tourism. Among them, considering older times and the number of participants, we mention speoturism, climbing and mountain hiking, and of relatively recent times, rafting, via-ferrata, cyclotourism and tyrolean.

CONCLUSIONS

Pădurea Craiului Mountains have a remarkable potential for sport and adventure tourism, this could be turning them in a top destination. Efforts that have been made over the last decade in this direction are becoming visible. Unfortunately, there is no integrated tourism development strategy for the whole area, therefore the local individual actions do not reach the maximum level of capitalization. There are deficiencies in the tourism and communication infrastructure, as well as in the needed facilities for tourism orientation and information. However, there is a positive evolution, as the number of operators in the Pădurea Craiului Mountains is increasing. In tourism development it is desirable to consider the principle of sustainable development in the overall planning of the mountain area, taking into account the valuable and fragile natural and cultural heritage. The recreational tourism in all its forms is very well integrated into this concept. A concrete example is the touristic capitalization of the ten speoturistic caves, they are opened to the

public under a controlled access, the planning of the caves is limited to minimal elements just to ensure access. In terms of mountaineering, in recent years we can notice the valorization of the old trails by re-equipping them according to the escalade and climbing standards. In parallel, new climbing areas were created doubling this way the existing tourist offer, for example in the Osoi area (on the wall close to the homonymous Cave from Vârciorog) and Lazuri Gorges (from Roșia commune). Further, the lack of bike routes, or their overlapping with the sectors of intensely circulated public roads may jeopardize the safety of tourists, being a downside part to this form of tourism, although the potential is very high. Finally, the water sports have an upward trend, especially rafting, which is the most popular sport in the area. In 2018, rafting held 44.91% of the total number of activities offered by the local tourism operators.

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