AN ANALYSIS OF AGRO-CLUSTERS FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT IN ANAMBRA STATE, NIGERIA

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Abstract

The study aimed at identifying and analysing agro-clusters in Anambra state, Nigeria. The objectives of the study were: to determine agricultural factors suitable for agro-clustering and to assess agro-clusters as a strategy for sustainable agricultural development, in Anambra state. In achieving the objectives above, a survey research design was adopted and data collected on farming practice, environmental conditions and socio-economic characteristics of farmers. A total of 312 respondents were sampled across the state using multi-stage sampling technique. The study identified eight factors extracted through factor analysis technique and were subsequently used for agro-clustering. These factors were named Farm productivity factor, edaphic and extension services factor, climatic factor, farm enhancement factor, labour service factor, farm methods factor, farm professionalism factor and farm finances factor. Three agro-clusters were determined to be inherent in the state using cluster analysis technique and named Main farming Cluster (MFC), Average Farming Cluster (AFC) and Low Farming Cluster (LFC). Findings from the study revealed that members of LFC performed poorly on agro factors, while AFC performed moderately on agro factors and MFC performed highly on agro factors which were used to delineate clusters based on shared similarities and dissimilarities. It was also found that 54.1% of the state made up the MFC and dominates the entire northern part of the state, covering Oyi LGA to Ayamelum LGA and extending down south to Ogbaru and Ihiala LGAs. The AFC consists of 19.1% of the state and located at Onitsha and Nnewi LGAs, while the LFC is found at around the Dunkofia LGA extending southwest towards Aguata LGA and make up 23.8% of the state. Hence, the study recommended that key problems identified in each cluster should be addressed to boost agriculture in the state.

Keywords: Agro-cluster, sustainable development, agricultural development

Introduction

The concept of clusters is very flexible and can be used to delineate regions such as agricultural regions, technological regions, industrial regions, etc. Moreover, the spatial extent of clusters can vary from very small clusters at the local economy level with employment measured in tenths to those across national boundaries employing millions (McCombie and Spreafico, 2014). The spatial nature of clusters is indeed a very intriguing aspect to geographers especially regional and economic geographers that seek to understand the dynamic nature of space, distance and density in economic growth (McCombie and Spreafico, 2014). According to Ketels (2017), clusters help regions better to understand

how their economies function as a system. Regional clustering is both a dynamic and systematic process, which requires the successful integration of series of different factors such as cultural, social or institutional and livelihood-based activities. The integration of these factors alongside agricultural activities delineates special agro-economic regions which can be referred to as agro clusters.

According to Wardhana, Ihle and Heijman, (2017) agro clusters can be simply defined as the geographical concentration of agricultural activities. Thus, agro-clusters can be seen as an agglomeration of similar agro-based activities that can be defined within a particular region based on their geographical location in line with available natural resource, vegetation, soil, climate, water, topography and socio-economic characteristics. Grubesic, Wei and Murray (2014) were of the view that clusters are delineated to focus and identify spatial disparities or similarities that exist within a given geographic space. Agro-clusters could be said to be an outcome of both locational attributes (ecological factors) as well as infrastructural and institutions (human factors) acting simultaneously to produce unique agricultural regions. Hence, it is expected that these unique regions would display spatial similarities that would differentiate them from other regions thereby implying variations among agro clusters. It is these differences and similarities that provide a system in which prospects, problems or challenges in regions can be identified and used as a yardstick to ensure sustainable development.

Sustainable agricultural development is the ability of present and future generations to meet their agricultural needs (Karpagan, 2010). According to Amaehi (2018) sustainable agricultural development aims at creation of sustainable improvement in the quality of agricultural development. This development will help to reduce poverty, hunger, starvation, lack, suffering, untimely death, infections and diseases in Nigeria environment. Therefore, Medugu (2006) is of the opinion that agricultural development plans and policies should take into cognizance the peculiarities of Nigeria farms and environment so that all participants can make appropriate and commensurate contributions in maintaining environmental quality as well as ensuring maximum productivity. These plans and policies can be best achieved by delineating agricultural regions based on identified peculiarities within a country or state.

Anambra state has an estimated landmass of 503,100 hectares with net cultivation of 350,000 hectares (Ezeabasili, Iloghalu and Ezeabasili, 2014) presents her with agro-climatic and edaphic conditions for varieties of crop production, livestock rearing and processing of agro-products. The unique combination of these features provides a means for delineating her into regions in order to identify strength, strategies, opportunities, weakness and limitation towards achieving sustainable agricultural development in the state. Presently, the idea of sustainable agricultural development is still a far cry despite various government policies and programmes over the years, such as Green Revolution, Operation Feed the Nation, etc. This situation may be linked to the saying that not all size fits all as well as the general inconsistences in development and implementation of programmes and policies. The problem lies in the ability to channel specific development programmes leveraging on areas with unique similarities to ensure efficiency and productivity, which are not based on political boundaries but on important agricultural variables. According to John and Aidian (2013), the challenges for developing countries are to identify specific agricultural and rural development needs and opportunities, and to focus investment in areas where the greatest impact on food insecurity and poverty will be achieved. Hence, agricultural clusters can proffer the best measures and solutions in achieving sustainable agricultural development.

Objectives of the Study

The objectives of the study are as follows:

1. To identify and analysis agro-clusters in Anambra state geared towards achieving sustainable agricultural development.
2. To determine agricultural factors suitable for agro-clustering in Anambra State.
3. To assess agro-clusters as a strategy for sustainable agricultural development in Anambra state.

Theoretical Framework

The paper adopted the theory of spatial organisation propounded by Abler, Adam and Gould (1971) as framework for analysis. Their main premise was based on explaining how things are arranged and appear in space as a circularly causal relationship between spatial structure and spatial process. According to Mendel University (2018) theories of the spatial organisation seek to explain the organisation of economic activity within a certain area. Although there are many theories for understanding spatial organisation, however, it can be argued that there seems to be an understanding among scholars that every spatial location is a result of some joint optimum in the interaction of elements.

In human geography, there are four categories of factors that may be identified which influence the way man organizes space efficiently and they influence spatial distribution and spatial interaction (Jotscorll, 2017). According to Jotscorll (2017), these factors include the spatial characteristics of space, the nature of the environment; socio-economic characteristics and historical inertia. The characteristics of space take into consideration distance in terms of limits that are available to man, accessibility which can mean either physical accessibility or socio-cultural accessibility, a grouping of people or activities for mutual benefits, size and relative location usually the degree of interaction of an area with other regions. The nature of the environment involves environmental factors such as landforms, climatic factors, edaphic factors, ecological factors and natural resources; and socio-economic characteristics which include comparative advantage, cultural factors, technological factors and political factors.

Kołodziejczak (2013) stated that the spatial structure of agriculture is understood as a set of interdependent features, phenomena and processes connected with farming that hold in a given area. Its characterisation embraces a set of internal features, like the agrarian structure, intensity of organisation of agriculture, agricultural land-use pattern, agricultural production, productivity and commercialisation of agriculture, and its typology. Agricultural typology was initiated in 1964 by the IGU commission‘s report on the world types of agriculture in which it mentioned that farming as a whole cannot be considered a sum of its components. Rather, it is a highly inter-related phenomenon and process of social, organisation and production variations, that is grouped into types according to their similarities or homogenous taxonomies characteristics (Kostrowicki, 1991). Therefore, the general concept of agricultural typology is to give an adequate and systematic explanation of various attributes, a composite form and to identify or classify the real type of agriculture in its total socio-environmental setup of a region (Wahab, 2004). Thus, the major emphasis of the commission was to identify precisely the principles and methods based on which agricultural regions at various levels in the world could be delineated (Kostrowicki, 1991).

The classification of farming systems (typology) as stipulated by this framework is tied down to the philosophy of determinism. The ability to identify various agriculture attributes that give rise to the classification of groups and sub-groups of land uses are basically seen on the decision of the farmers over time and space. According to Pender, Ehui and Place (2011), farm production is based on the decision made by farm households and or collective practices made by groups of farmers and communities (Pender, Ehui and

Place, 2011). These decisions centred on deriving optimum benefits (output) in the form of yield or income earned by the farmers given a minimum (input) production cost. According to Dharmasiri (2009), scholars believe that agricultural productions contain factors of production such as labour, farming experience, fertilizer, availability and management of water and other biological factors. Hence, the classification of different farm types at any scale depends on the interaction and interrelations of farms in terms of similarity and dissimilarity that exist in their physical, cultural and economic factors. Pender, Ehui and Place (2011) suggest that those key actors who influence farm production conversely also influence physical and socio-economic characteristics of the farmer.

Study Area

Anambra state lies within the Anambra basin and has an estimated landmass of about 4,865km^2, located between longitudes 6^{0}35‘E and 7^{0}21‘E and Latitudes 5^{0}38‘N and 6^{0}47‘N (ANSG, 2018). It is bounded on the North by Kogi state, Enugu state on the east, Imo state on the south and the west by river Niger which separates her from Delta State. The climate in Anambra is that of the equatorial climate, thus it is hot and humid almost all year round with an annual relative humidity of 68%. The area has two distinct seasons, the rainy and the dry seasons. The rainy season usually falls between April to November and the dry season commences from December to March. Average annual rainfall is about 1800mm, whereas the mean annual temperature is 27^{0}C, and can go up 32^{0}C during the hot periods of the year (Chinweze, 2017).

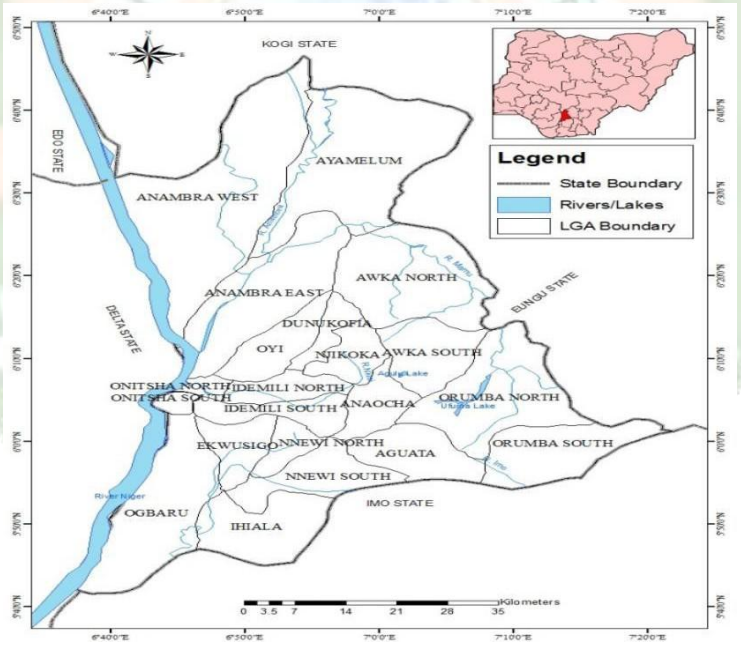


Figure 1: Map of Nigeria showing Anambra State (study area)

There are two distinct relief features in the state, namely the Awka-ldemili uplands and the River Niger Anambra lowlands (Ejikeme, Ojiako, Onwuzuligbo and Ezeh, 2017). The state is traversed by 2nd order, 3rd order and 4th order streams which include River Niger, Anambra (Omabala), Mamu, Idemili, Ubu Rivers etc. (Ezeabasil, Iloghalu and Ezeabasili, 2014). The geology of the state is made up of Cretaceous to recent sedimentary formations of the Anambra basin that are of varying aquifer potentials (Nfor, Olobaniyi and Ogala, 2007). Soils in the state are derived from the underlying Ameki Formation and Imo Shale as such comprises mainly ferallitic soils, hydromorphic soils and alluvial soils.

Alluvial soils are associated with freshwater swamp forest vegetation and is found in the low bedding plain of the Niger/Anambra river; Hydromorphic soils are associated with lowland forest vegetation comprising of tall evergreens, climbers and thick shrubs; and ferallitic soils are associated with grass species (i.e. pennistum and hyperrhennia) usually characterised by tall grasses with abundant of shrubs as well as oil palms (Anyanwu, Egbuche, Amaku, Duruora and Onwuagba, 2015).

Agricultural practices in the state range from crop production, animal husbandry, fishery, forestry, etc. One farming/planting season is usually recorded in a year and this takes place between the months of April to September. Various crops are grown in the state especially yam, cassava, cocoyam, maize, oil palm, rice, vegetables and different varieties of fruits. Overall, the agricultural sector continues to contribute to the state‘s Gross Domestic Products (GDP), which according to the National Bureau of Statistics (2017) was responsible for about 19.6% of the state's GDP.

Materials and Methods

Data used in this study were gathered from both primary and secondary sources. Primary data was collected through direct field measurements using, structured questionnaires and interviews to include information on farm inputs (labour, farm size, farm methods, farm equipment, farm experience etc.) and outputs (quantity yield, type of crops, food processing etc.). While secondary data was sourced from relevant materials and publications such as official gazette, research thesis, journals and textbooks, etc. to obtain climatic and edaphic variables.

A sample size of 330 farmers was obtained using the Bill Godden formulae (Godden, 2014) from the population of farmers in Anambra state. The study population comprised of 356,919 farmers which was projected from 339,721 farmers (ASADEP cited in Taiwo, Okafor, Okorobuike, 2016) using 2.8% growth rate by assuming that the number of farmers grew alongside the state population. Multi-stage sampling technique involving three stages was employed for this study. The first stage involved a stratified random sampling technique of which twenty-one Local Government Areas of Anambra state made up a stratum. The next stage entailed the selection of four communities from each stratum using simple random sampling techniques. In the final stage, four respondents were purposively selected from each of the communities. This was done to ensure that only farming households were selected and used for the study.

The use of factor analysis techniques was employed to determine agricultural factors that would be deemed suitable for agro-clustering. This was done to achieve parsimony of data description by reducing large ecological and socio-economic variables into more meaningful set. Agro-clusters inherent in Anambra State were derived through the cluster analysis technique. This analysis was employed to group clusters with a high degree of natural association using defined agricultural factors as well as assess group membership. GIS (ArcMap 9.2) software was used as a tool to map and display statistical data and analysis presented via shaded patterns or symbols to show geographical/spatial patterns and distribution of agro-clusters.

Results and Discussions

Determinants of Agricultural Factors in Anambra State

The result of the factor analysis on twenty-three agricultural variables is presented in Table 1.

Table 1: Rotated factor matrix of agricultural variables

	D1	D2	D3	D4	D5	D6	D7	D8	COMMULATIES
CASH CROP	0.426	0.278	-0.057	0.053	0.240	0.400	0.050	-0.015	0.485
FOOD CROP	-0.131	-0.226	-0.104	0.071	0.021	**0.589**	0.289	-0.164	0.541
FARM EXP	0.229	-0.097	0.056	-0.061	0.013	-0.087	**0.797**	-0.008	0.712
FARM METHODS	0.268	-0.064	0.302	0.053	-0.023	**0.659**	-0.133	0.025	0.623
PROD. QUANTITY	**0.825**	-0.037	0.011	0.053	-0.071	0.091	0.177	-0.001	0.730
TYPE OF LABOUR	0.135	-0.013	0.152	0.094	**-0.754**	-0.092	0.012	-0.019	0.628
SIZE OF LABOUR	**0.689**	-0.078	0.011	0.013	0.156	-0.030	0.225	0.122	0.572
FARM SIZE	**0.806**	-0.078	-0.005	-0.017	-0.127	-0.010	0.141	0.100	0.703
FARM HOLDINGS	-0.341	0.004	-0.026	-0.222	0.014	0.389	0.080	0.384	0.471
FARM EQIP	0.166	-0.054	0.071	-0.270	0.224	-0.018	-0.011	-0.093	0.168
CREDIT	0.143	-0.028	-0.034	-0.011	-0.098	-0.132	0.152	**0.719**	0.590
USAGE OF CREDIT	0.035	-0.238	0.151	-0.049	0.392	-0.223	0.015	**-0.516**	0.553
MEMBERSHIP	0.185	-0.058	0.028	0.077	-0.036	0.106	**0.832**	0.082	0.755
EXT. SERVICES	-0.038	**0.964**	0.035	-0.028	0.013	-0.026	-0.043	0.005	0.936
MRK DISTANCE	0.097	0.001	0.110	0.199	**-0.479**	0.064	0.189	0.380	0.475
NATURE OF PROD.	0.143	-0.005	-0.075	0.004	0.341	-0.019	-0.105	**0.613**	0.531
PEST/DISEASES	0.173	0.062	0.142	0.418	**0.447**	-0.225	0.185	0.071	0.509
PEST CONTROL	0.020	-0.083	0.067	**0.853**	0.019	0.059	-0.005	0.048	0.746
FERTILIZER	-0.012	-0.034	0.077	**-0.811**	0.134	0.002	-0.015	0.063	0.687
SOIL TYPE	-0.046	**0.967**	0.037	-0.004	-0.014	-0.031	-0.058	0.014	0.944
RAINFALL	0.032	-0.050	**-0.927**	0.016	0.017	-0.042	-0.066	0.016	0.869
TEMPERATURE	0.031	0.031	**0.922**	0.027	-0.060	0.014	-0.006	-0.044	0.860
Eigenvalue	3.105	2.166	1.957	1.759	1.597	1.216	1.152	1.136	
Variability (%)	14.115	9.845	8.894	7.993	7.258	5.526	5.238	5.161	
Cumulative %	14.115	23.961	32.854	40.848	48.106	53.632	58.870	64.031	

Source: Authors' field data analysis

Table 1 shows the result of factor analysis (rotated factor matrix), which yielded eight factors. The eight factors were extracted based on the value of the eigenvalue greater than 1. These factors were named based on their loadings on the initial variables which values are 0.50 as they show relative high loadings to the factors extracted. The factors were named as follows:

1. Farm productivity Factor: This factor accounted for 14.11% of the total variance and the first factor extracted with an eigenvalue of 3.11. Farm size (0.806), production quantity (0.825) and size of labour (0.689) loaded highly and positively.
2. Edaphic and extension services factor: This is the second factor extracted and accounted for 9.84% of the total variance with an eigenvalue of 2.17. Two variables loaded high on this factor (soil type (0.967) and extension services (0.964)) and thus were only variables considered in the naming of this factor.

3. Climatic factor: This factor is the third factor and loaded highly on temperature (0.922) and rainfall (-0.927). The factor accounted for 8.89% of the total variance with an eigenvalue of 1.96.
4. Farm enhancement factor: This is the fourth factor extracted and was named ―farm enhancement‖ factor because of its high positive loading on pest control measure (0.853) and high negative loading on fertilizer measure (-0.811). This factor accounted for 7.99% of the total variance with an eigenvalue of 1.76.
5. Labour services factor: This is the fifth factor and accounted for 7.26% of the total variance with an eigenvalue of 1.25. Three variables loaded significantly. They are type of labour (-0 754), distance to market (-0.479) and Pest and disease problems (0.447), which can be rounded up to -0.50 and 0.50 respectively. Because type of labour had the highest value compared to the other variables, it was used in naming this factor ―labour service‖ factor.
6. Farm methods and crops factor: This is the sixth factor extracted and accounts for 5.53% of the total variance with an eigenvalue of 1.22. Two variables high moderately high positive loading on this factor. These were farm methods (0.695) and food crops (0.589) and thus named ―farm methods and crops‖ factor.
7. Farm professionalism factor: This is the seventh factor, and it loaded high and positively on years of farming (0.797) and membership of farming association (0.835), thus named ―farm professionalism‖ factor. This factor accounted for 5.24% of the total variance with an eigenvalue of 1.15.
8. Farm finances factor: the eight factor was named ―farm finances‖ factor because of its high loading on access to credit (0.719), nature of produce (0.613) and usage of credit facilities (-0.516). This factor accounted for 5.16% of the total variance with an eigenvalue of 1.14.

These factors altogether accounted for 64.03% of the total variance in the 23 original variables and may be regarded as composite indicators of agro-farming characteristics in the state based on their generally high value of the communalities (above .50). Thus the eight factors extracted were deemed adequate to represent agriculture and farming system and their corresponding factor scores an indication of the characteristics of each respondent on the factor extracted.

An Analysis ofAgro-clusters as a Strategy for Sustainable Agricultural Development in Anambra stateUsing agglomerative hierarchical method, agro-clusters were determined as the squared Euclidean distance to the centre is minimized. This method uses a similarity matrix and proceeds by grouping the most similar cases into one group. Three main agro-clusters were emerged from result of the cluster analysis as shown by the dendrogram in Figure 2.

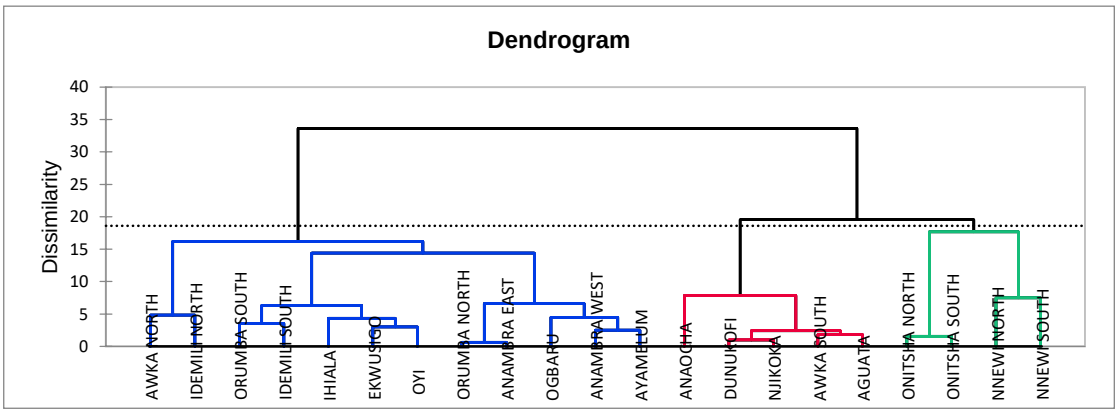


Figure 2: Dendrogram for cluster analysis involving LGAs in Anambra state

Figure 2 presents the dendrogram showing viable clustering formation for Cluster 1 (5 LGAs), Cluster 2 (12 LGAs) and Cluster 3 (4 LGAs). The results also indicate that group members of Cluster 1 is made up of Awka South, Dunukofia, Aguata, Anaocha and Nijoka LGAs; group members of Cluster 2 is made up of Awka North, Idemili North, Ekwusigo, Ihiala, Orumba North, Orumba South, Ogbaru, Idemili South, Oyi, Anambra West, Anambra East and Ayamelum; and group members of Cluster 3 is made up of Nnewi North Nnewi South, Onitsha North and Onitsha South.

The performance of each agro-cluster was evaluated based on the eight agro factors extracted. This aimed at identifying strengths as well as weakness of agricultural development in each agro-cluster. The first group consists of five LGAs (i.e. 23.8% of the state) and the characteristic of the group is presented in Table 2.

Table 2: Characteristics of group1

LGA	F1	F2	F3	F4	F5	F6	F7	F8
AWKA SOUTH	-0.68	-1.03	-0.15	-0.01	-0.27	-0.23	-0.00	-0.05
DUNUKOFIA	-0.01	-1.15	-0.05	-0.01	0.23	-0.65	-0.20	0.26
AGUATA	-0.34	-1.16	-0.19	-0.19	0.20	-0.64	-0.20	-0.43
ANAOCHA	-0.44	-1.26	-0.94	-0.36	-0.61	0.17	0.59	-0.10
NIJIKOKA	0.06	-1.22	-0.07	0.19	-0.00	-0.27	0.01	-0.02
CLASS CENTROID	-0.28	-1.16	-0.28	-0.08	-0.09	-0.32	0.03	-0.07

Source: Authors' field data analysis

Table 2 shows that class centroid of this group have deficiencies in F1 (farm productivity factor), F2 (edaphic and extension services factor), F3 (Climatic factors), F4 (farm enhancement factor), F5 (farm labour services), F6 (farm methods, and food crop factor), F7 (farm professionalism factor) and F8 (farm finances factor). This result also showed all the LGAs in this group have negative scores in at least four out of the eight agro factors extracted. The result indicated that Awka South had the weakest performance in this cluster by recording negative scores in all eight factors, while Nijikoka had the strongest performance in this cluster by recording negative scores in five out of eight factors. Overall, the group is characterised by a very weak performance and can be regarded as a cluster with the lowest agricultural development. The finding of this study is in agreement with Mosood, Ellahi and Batool (2012), as they identified unawareness about farming techniques, uncertain weather conditions, lack of capital, limited water resources, poor farming conditions are causes of low agricultural output, thus decreases the productivity and limits development in the sector. The constraint faced by farmer in this clusters can be used to

guide and discuss farm management options and to outline vibrant stragey backed by an efficient and effective sustainable yields (Shalaby et al., 2011).

Table 3: Characteristics of group 2

LGA	F1	F2	F3	F4	F5	F6	F7	F8
AWKA NORTH	0.30	0.14	-0.25	0.52	0.05	0.60	0.24	-0.79
IDEMILI NORTH	0.18	0.82	1.51	0.28	-0.14	-0.30	-0.20	-1.42
EKWUISGO	0.03	0.87	-1.41	0.15	-0.02	0.40	0.39	0.40
IHIALA	0.10	1.00	-1.48	-0.36	0.12	0.96	-0.20	-0.28
ORUMBA NORTH	0.47	-0.93	-0.11	0.02	0.19	0.51	-0.40	0.48
ORUMBA SOUTH	0.05	1.53	-0.24	-0.14	0.54	-0.39	-0.10	-0.39
OGBARU	0.31	0.86	1.46	-0.21	0.18	0.69	0.39	0.35
IDEMILI SOUTH	-0.13	0.87	-0.81	-0.48	0.58	0.01	0.21	0.62
OYI	0.83	0.44	0.60	-0.14	-0.17	-0.11	0.00	0.14
ANAMBRA WEST	0.49	-0.74	1.58	0.27	0.15	0.56	0.61	-0.22
ANAMBRA EAST	0.42	-0.48	-0.04	0.03	0.029	0.35	-0.10	0.32
AYAMELUM	0.50	-0.80	-0.09	0.20	0.52	0.75	0.32	0.15
CLASS CENTROID	0.29	0.30	-0.04	0.01	0.17	0.34	0.11	-0.08

Source: Authors' field data analysis

Made up of twelve LGAs (i.e. 54.1% of the state), this group‘s class centroid shows positive scores in six out of the eight extracted agro factors. The result also shows that Ogbaru LGA is the strongest link of the group, while Orumba South LGA is the weakest of the group. Overall, this group is characterised by a relatively strong performance on F1 (farm productivity), F2 (edaphic and extension services), F5 (labour services), F6 (farm methods and crops) and F7 (farm professionalism). All members of this group limned positively on F1 (farm productivity factor) except for Idemili South LGA. This entails that the major strength of this group lies in farm productivity. However, the negative scores recorded for F3 and F8 is an indicator that this group is generally deficiency in climatic and farm finance factors. This finding agrees with Wulandari, et al. (2017), where the author reported that access to finance remains one of the major challenges facing farmers in developing countries. Hence, access to credit facilities and promoting its usage maybe one of the channels to boost agricultural development in this cluster. According to Siebrecht (2020) a framework for sustainable agricultural development can only be achieved by identifying success factors as well as those factors hindering farm methods and practice.

Table 4: Characteristics of group 3

LGA	F1	F2	F3	F4	F5	F6	F7	F8
NNEWI NORTH	-0.58	0.73	-0.95	0.60	0.38	-1.78	-0.74	-0.10
NNEWI SOUTH	-0.66	0.80	-0.68	0.22	-0.81	-0.65	-0.61	0.33
ONITSHA NORTH	-0.63	0.68	1.70	-0.28	-0.77	-0.48	-0.24	0.46
ONITSHA SOUTH	-0.67	0.62	1.66	-0.33	-0.26	-0.10	-0.19	0.99
CLASS CENTROIDS	-0.64	0.71	0.43	0.05	-0.37	-0.76	-0.45	0.40

Source: Authors' field data analysis

Group 3 is made up of four LGAs (i.e. 19.1% of the state) and Table 4 shows that class centroid of this group recorded negative scores for four out of the eight agro factors. These factors were F1 (farm productivity factor), F5 (farm labour services), F6 (farm methods and food crop factor) and F7 (farm professionalism factor). However, the class centroid of this group also recorded positive scores for F2 (edaphic and extension services

factor), F3 (climatic factor), F4 (farm enhancement factor) and F8 (farm finances factor). Thus, indicating that agricultural development of this group is deficient in farm productivity, farm methods and farm professionalism factors. This finding agrees with Obasi (2013) where the authors found that agricultural productivity are often affected by factors such as years of farming, cropping patterns, etc. Strategically, improvements in these factors will define the proper approach in achieving sustainable development in this agro-cluster.

Table 5: Summary Statistics of Groups' Centroid

Class	F1	F2	F3	F4	F5	F6	F7	F8
Low Farming agro-Cluster (1)	-0.280	-1.164	-0.277	-0.076	-0.090	-0.323	0.026	-0.067
Main farming agro-Cluster (2)	0.292	0.297	-0.041	0.011	0.169	0.335	0.106	-0.076
Average farming agro-Cluster (3)	-0.635	0.708	0.434	0.052	-0.365	-0.749	-0.445	0.420

Source: Authors'data analysis, 2019

Table 5 provides a summary of the groups extracted and based on their overall mean performance the groups were named accordingly. Group 1 was named the Low Farming Agro-Cluster (LFC) because it recorded a deficiency in all but one agro factor. Group 2 was named Main Farming Agro-Cluster (MFC) because it showed the most positive loadings (six out of eight factors) amongst the three clusters delineated. Named Average Farming Agro-Cluster (AFC), group 3 showed an average performance to the factors extracted, where four factors had mean positive scores and four had mean negative scores.

Furthermore, the result of the agro-clusters was mapped to assess the spatial patternproduced by agro-clusters based on the unique combination of clusters membershipand is presented in Figure 3.

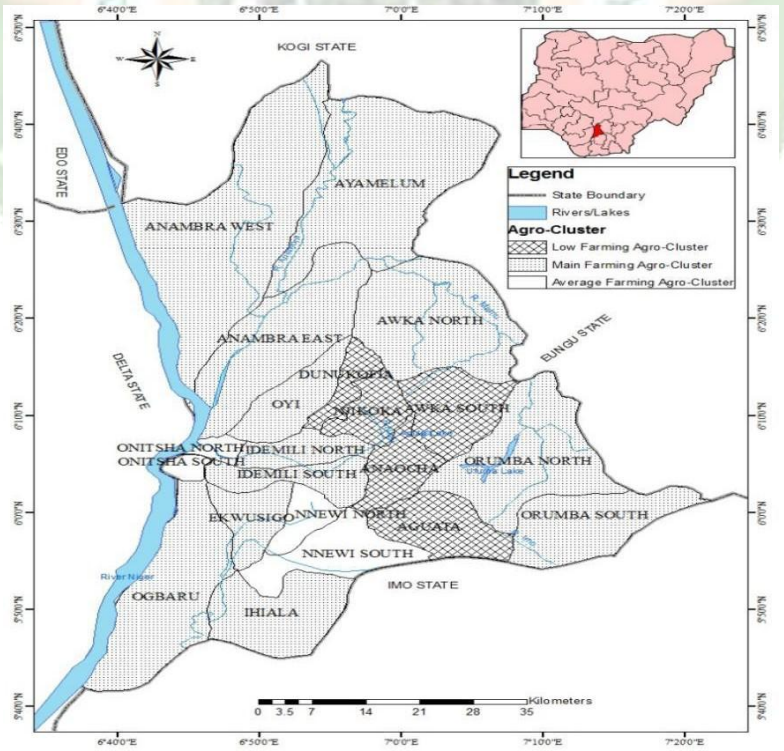


Figure 3: Spatial Distribution of Agro-Clusters in Anambra State

From Figure 3, it shows that some of Local Government Areas (LGAs) that are members of MFC were found in the northern region of the state (i.e. Anambra West, Ayamelum, Awka North, Oyi and Anambra East) while the remaining are located in the southern part of the state at Ogbaru, Orumba North and Orumba South LGAs. All the LGAs that constitute AFC are located within the south-western part of the state in Onitsha and Nnewi LGAs.Whereas members of LFC are located in the southern interior part of the state extending from Dunikofia to Aguata LGAs. The pattern displayed by agro-clusters as portrayed in the map insinuates that distributions could be tie to variations in geographical features. For example, MFC are found mostly in the northern part of the state that are dominated by hydromorphic soils, lowland forest and hyperthermia savannah, and in the southern part of the state that are characterized by alluvialsoils, freshwater swamp forest vegetation and areas drained by prominent rivers. The LFC are region predominant in ferralitic soils and pennisetum dominated grass species. However, AFC do not seem to have close similarities in terms of soil, vegetation belts, they are found in southern parts of the state and are known to be hubs of commercial activities. This finding is consistent with the Ebabu, et al. (2020) where the authors found that soil properties vary across agro-ecological zones. Hence, map such as this can constitute a useful tool for strategizing sustainable agricultural development because it segments the strengths and weakness of each agro-cluster.

Conclusion and Recommendations

Three agro-clusters were identified based on the unique combination of similarities inherent in eight derived agro factors (farm productivity, climatic, edaphic and extension service, farm labor, farm enhancement, farm methods and food crop, and farm finances). Each agro-cluster was further analysed to examine their characteristics and then named. The study revealed that the first agro-cluster named LFC was deficient in farm productivity, edaphic and extension service, farm enhancement, farm labour, farm methods and food crop, and farm finance factors. The second agro-cluster named MFC was deficient in climate and farm finance factors. While the third agro-cluster named AFC was deficient mainly in farm productivity, farm labour farm methods and professionalism factor. The study also shows that the spatial distribution of these agro-clusters seem to be influenced by geographical features such as soil types, vegetation belts and drainage patterns. Based on the findings of this study, it is recommended that proper measures should be taken to remedy deficiency found in each cluster such as provision of credits and incentives to farmers, encouraging youth participation in agriculture, provision of fertilizers, employing proper farming techniques and practices as well as integrating technological innovations etc.

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