



RESEARCH ARTICLE

Domesticating the ATVET Model in Ogun State: A Geospatial Study for Enhancing Agricultural Productivity

Alausa Olalekan A.¹, Adewara Monsur B.², and Lasisi Ademola L.³

^{1&2}Department of Surveying and Geoinformatics, The Federal Polytechnic Ilaro, Ogun State, Nigeria

³Department of Urban & Regional Planning, The Federal Polytechnic Ilaro, Ogun State, Nigeria

*Corresponding author email: olalekan.alausa@federalpolyilaro.edu.ng

Abstract

In emerging economies, access to agricultural knowledge, a great driver of productivity, is constrained by the remoteness of agricultural training institutions from agrarian communities. This study is aimed at spatially locating Agricultural training institutions and domesticating the Agriculture Technical Vocational Education and Training (ATVET) model with a view to improving access of rural farmers to agricultural technological knowledge for enhanced productivity and self-sufficiency in food production. The objectives are to identify the location of existing agricultural training institutions in the State; determine the spatial distribution of these training institutions; and investigate the implementation level and achievements of ATVET in 12 pilot African countries. These were achieved through the deployment of the Geographic Information System (GIS) to conduct spatial analysis to identify the location of agricultural training institutions and determine their geospatial distribution. Also, the achievements of ATVET in the 12 pilot African countries from the literature were investigated, with inherent positive lessons mainstreamed as a model for creating sustainable training clusters for existing farm settlements and locating Agricultural Training Centers (ATCs) in these clusters. Findings, inter alia, show that Ogun State has 12 agricultural institutions, including research institutes, polytechnics, and universities, making the state the most equipped for agricultural expansion in Nigeria, also the Nearest Neighborhood Analysis shows spatial distributions of the agricultural training and research institutions in the study area are dispersed with Nearest Neighborhood Ratio (NNR) of 1.152158, Z-score of 1.863874, and P-value of 0.062339. The study recommends the creation of training clusters and training centers to link existing agricultural institutions for enhanced access to agricultural technological knowledge, innovations, and extension services.

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1. INTRODUCTION

The global need for food security has successfully made the agricultural sector a vital and effective force in enhancing economic stability, yet its contribution to environmental degradation and climate change, with practices such as unsustainable water use, deforestation, chemical fertilizers, etc., has increased the need for skill development through Agricultural Technical Vocational Education and Training (ATVET) (Kross *et al.*, 2022). Such skills have been communicated in some developed countries. China's Ministry of Agriculture and Rural Affairs launched an initiative in 2015 to eliminate the use of chemical fertilizers and pesticides, with the target of no growth. By 2020, China successfully met this target, achieving significant reductions and efficiency gains in the use of these chemicals (Chi *et al.*, 2022).

Establishing an agricultural training institute requires strategic geolocation to serve both urban and rural farmers effectively (Xiang *et al.*, 2024). However, urbanization trends have led decision-makers to prioritize urban centers for such initiatives. Interestingly, research by Michael & Rienow (2025) highlights how urbanization patterns impact settlement types; hence, maximizing the institute's impact, it's crucial to consider the urbanization pace and its effects on surrounding settlements. Invariably, the agricultural training institute can be positioned to address the unique needs of both urban and rural farming communities, ultimately promoting sustainable agricultural practices and food security (Xiang *et al.*, 2024).

In Ethiopia, ATVET colleges are on the growth path, striving to enhance their capacity to produce skilled graduates who can propel commercial agriculture growth, contributing to global food security and economic development (Masha *et al.*, 2024). This initiative aims to encourage youth participation in agriculture through a collaborative effort, while Dalhousie University's Faculty of Agriculture and other partners are supporting Ethiopian ATVET goals by delivering industry-aligned education programs tailored to the country's national priorities, ensuring a sustainable food system and improved food security, and improving the sustainable economy. This measure can be emulated (Francisca *et al.*, 2021; Stephanie, 2022).

Nigeria's agricultural sector, despite its economic importance, faces numerous challenges that hinder its productivity. These challenges include inadequate land tenure systems, climate change, land degradation, and inefficient agricultural practices (Njoku *et al.*, 2025). To address these issues, in 2013, the Agricultural Technical Vocational Education and Training (ATVET) program, a flagship project of the New Partnership for Africa's Development (NEPAD) Agency's Skills and Employment for Youth (SEFY) program, aimed to enhance vocational and technical agricultural skills (ATVET, 2013). This initiative seeks to revolutionize modern agricultural practices, ultimately contributing to food security in tropical Africa, yet, till the present moment, only a few measures have been achieved.

Although, ATVET, remains a commendable African Union Development Agency-NEPAD (AUDA-NEPAD) program, but has encountered and documented difficulties while being tested in 12 African nations (Kenya, Malawi, Ghana, Benin, Togo, Burkina Faso, Tunisia, Sierra Leone, Namibia, South Africa, Rwanda and Uganda), including limited access for women to training in rural areas, the overrating of academic qualifications over professional capabilities and technical/vocational skills, and the weak connections between agricultural and research-based institutions and private/public institutions among others (ATVET, 2013; Kross *et al.*, 2022; McGrath *et al.*, 2020).

Notably, these challenges have been seen reflecting in Nigeria's agricultural sector, making visible the perennial issues plaguing Nigeria's agricultural food supply have been misdiagnosed, leading to an overemphasis on infrastructural development and agricultural value chain systems, while neglecting the crucial aspect of human capacity development. As a result, the country lacks the skilled manpower to sustain the gains of these interventions. This study seeks to geospatially adapt the Agricultural Technical Vocational Education and Training (ATVET) model to promote food sustainability in Ogun State, Nigeria. The research focus includes identifying agricultural training institutions, assessing ATVET implementation in 12 African countries, locating training centers and clusters, and leveraging lessons learned to pilot agricultural education and training in Ogun State. This study fills a significant knowledge gap by using geospatial technology to examine the distribution of agricultural training institutes and ATVET implementation in Ogun State. This provides a spatial perspective on the availability and accessibility of agricultural training programs, ultimately impacting regional food sustainability policies.

Furthermore, previous research has proposed solutions to address the challenges in Nigeria's agricultural sector, including the creation of a rural agricultural platform for women and youth to bridge training gaps and foster collaboration between research institutions, ATVET centers, and public-private initiatives (Björn & Gesine, 2022; Chi *et al.*, 2022; Lolita *et al.*, 2025; Opeifa *et al.*, 2025; Vitung, 2020). However, existing studies have overlooked the critical role of human capacity development in agricultural growth. This study investigates the potential of the ATVET model to enhance food sustainability in Ogun State, leveraging geospatial technology to provide a fresh perspective on the spatial distribution of agricultural training institutions and informing evidence-based decision-making. Knowing that geospatial analysis has grown to be a powerful technique used in geographic information systems (GIS), and various other fields to examine and comprehend patterns, relationships, and distribution of geolocational studies (Alausa *et al.*, 2023).

ATVET Roles in Sustaining Food in Ogun State, Nigeria

According to the literature, certain factors are undeniably answerable for food sustenance, one of the most important being farmers' knowledge and skills in food sustainability (Adeoye, 2020; Chi *et al.*, 2022b; Musa *et al.*, 2023). Farmers' expertise and abilities have continued to play an important role in overcoming food sustainability difficulties, particularly in the face of climate change. This cannot be overstated, as evidenced by various case studies and lessons learned scenarios from African countries (Monteiro *et al.*, 2021). A synthesized report by the International Fund for Agricultural Development (IFAD) and the United Nations Educational, Scientific, and Cultural Organization (UNESCO) re-emphasized the relevance of knowledge and skills in improving rural agricultural livelihoods, with a case study of Cambodia, Egypt, and Ethiopia. (IFAD & UNESCO, 2021). This study aimed to identify education and learning gaps required to solve the existing high rates of adolescent unemployment in rural areas, low women's engagement in agriculture, rural poverty, and food security.

As significant as this knowledge base is, it is urgent to further develop this knowledge base among farmers through a robust and actionable capacity development procedure, reinforce traditional data sharing pathways through community-based networking, and increase commitment and investment of more youth and women groups (Mgendi *et al.*, 2021; Wang *et al.*, 2025). Loss of investments in agriculture for food sustenance is not only due to a bad economy, poor infrastructure, insufficient capital, etc., as always reported, but it has been proven that lack of knowledge and skills has significantly contributed to agricultural disappointments (Zhao *et al.*, 2025). While the consequences of these other factors are undeniable and enormous, with the required knowledge and skills, these consequences can be better managed. Despite these consequences, a few agribusinesses have triumphed and are on the path of expansion, as witnessed in the agribusiness breakthrough by the Agric and Bioengineering Technology (ABET) department of the Federal Polytechnic Ilaro. The department will create a niche for itself as the food basket of the town by the production and supply of poultry foods, palm oil, fruits, and cash crops. Another development is in Obafemi Owode local government area of Ogun state, southwest, with the construction of 40 acres of broiler farm and a broiler processing factory in Isiun-Asipa-Ponlade axis, hence the need to embrace challenges in agribusiness from a knowledge and skills perspective using the ATVET model. This may require a review of the existing framework for agricultural education and training programs with a view to inculcating lessons from the ATVET implementations in 12 African countries.

Summary of the ATVET framework

- i. Support to continental, regional, and national actors (Ministries of Agriculture, Education, Labour, and national TVET systems) to establish demand-driven agricultural vocational education and training systems, curricula, and training measures
- ii. Knowledge management through co-creation, collation, and dissemination of good practices and lessons learnt in agricultural training and skills development from the partner countries for upscaling to other countries.
- iii. Facilitating dialogue and synergies between the private and public sectors, farmers' organizations, and other key actors in TVET through multi-stakeholder platforms to reform vocational training systems in the agricultural sector.
- iv. Supporting public and private Agricultural Training Centers (ATCs) in developing demand-driven training services through the delivery of labour market-oriented curricula for formal, non-formal, and informal learning delivery mechanisms.
- v. Developing training courses for youth self-employment with an emphasis on entrepreneurial competencies, as well as modular vocational training courses V for the training of farmers.

2. MATERIALS AND METHODS

2.1 The Study Area

Ogun State, located in western Nigeria, was established in 1976 from the former Abeokuta and Ijebu provinces of the Western State. According to the Ogun state government report in 2022, the state's economy is primarily driven by agriculture and mining, with major crops including rice, maize, cassava, yams, and plantains. Cash crops such as cocoa, kola nuts, rubber, and palm oil are also significant contributors to the state's economy (Adeoye, 2020). The state's mineral resources, including limestone, chalk, and phosphates, support various industries, such as cement production (Adeyemi, 2023). With a

total area of approximately 16,980.55 km² within latitude 7°00' North and longitude 3°35' East. Ogun State remains a vital economic hub in Nigeria with an annual GDP of about \$12.1 billion, as released in the World Bank, 2022 report.

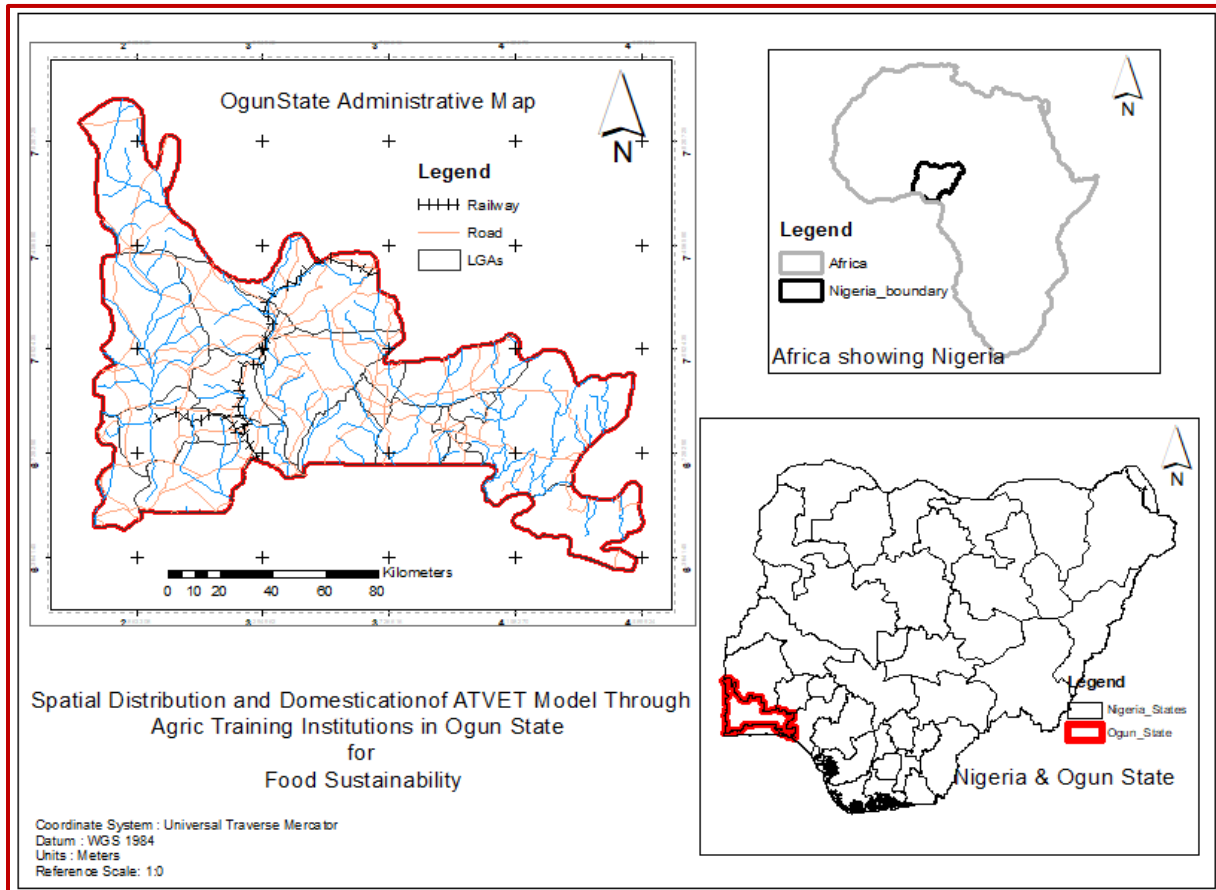


Figure 1. ArcGIS-generated Study Area Map

2.2 Data Collection

Data was obtained from the archives of the Joint Admissions Matriculation Board (JAMB). The locations of the agricultural training institutions were identified after being plotted in the ArcGIS environment, and the assessment of their spatial distributions was carried out. Currently, Nigeria has one hundred and thirty-three (133) institutions offering agricultural disciplines (19 Colleges of Education, 14 colleges of agriculture, 40 polytechnics, and 60 Universities) distributed across the country, Figure 2. Ogun state is home to Twelve (12) of these Agricultural training and research institutions; Federal polytechnic Ilaro, Federal University of Agriculture, Abeokuta, Babcock University, Ilisan Remo, Crawford University, Igbesa, Olabisi Onabanjo University, Ago Iwoye, D.S. Adegbenro ICT Polytechnic, Itori, Moshood Abiola Poly, Abeokuta, Institute of Food Security, Environmental Resources and Agricultural Research (IFSERAR) Abeokuta, Federal Agricultural Research Centre Abeokuta, Institute of Agricultural Research And Training, IAR&T, Ikenne, and World Bank Center For Agricultural Development And Sustainable Environment, Abeokuta. Nearest neighborhood analysis was performed for the agricultural training and research institutions in Ogun state, and the results showed that the spatial distribution of the institutions is dispersed (Figures 2, 3 & 4). Spatial analysis enables us to answer complex spatial questions to determine if the location patterns of the Agricultural institutions are significant and calculate the suitability of agricultural training centers, as well as address critically important questions and decisions that are beyond the scope of simple visual analysis.

This demonstrates that Ogun State's agricultural institutions are widely scattered, reflecting the state's unequal spatial accessibility.

2.5 Criteria for Site Suitability Analysis

A multi-criteria geographical evaluation approach was used to determine the locations of additional Agricultural Training Centers (TCs) and Training Clusters (TCLs). Among the factors considered are:

- Land area (LGA and ward size)
- Road network proximity (accessibility)
- The distance to towns and settlements
- Infrastructure accessibility (power supply and basic amenities)
- The current distribution of educational institutions

To create suitability maps, these data were combined using GIS-based spatial overlay and proximity analysis methods. Considering this analysis.

- The 20 Local Government Areas (LGAs), 41 Training Centers (TCs) were suggested.
- At least two TCs per LGA
- Three TCs maximum per LGA
- 2.05 TCs on average per LGA
- In Ogun State, 190 Training Clusters (TCLs) were distributed throughout the wards.
- One TCL per ward is the maximum.

While Training Clusters (TCLs) function as decentralized, lower-capacity extension units with the goal of enhancing grassroots access to agricultural innovations, Training Centers (TCs) were intended to be fully furnished agricultural centers with research and training facilities.

2.6 Implementation and Achievements of ATVET in the 12 African countries

Based on the implementation of ATVET in the 12 African countries, the following achievements have been recorded:

- ✓ Training of students and farmers with the inclusion of women on the qualities and attributes of entrepreneurs, vocational skills, and leadership
- ✓ Partnership of National Farmers, International NGOs, government agencies/ministries, cooperatives, marketing associations, private companies, and government ministries.

Encouraging the use of local resources, the combination of traditional and modern agricultural practices, technology adaptation, and diversification of activities

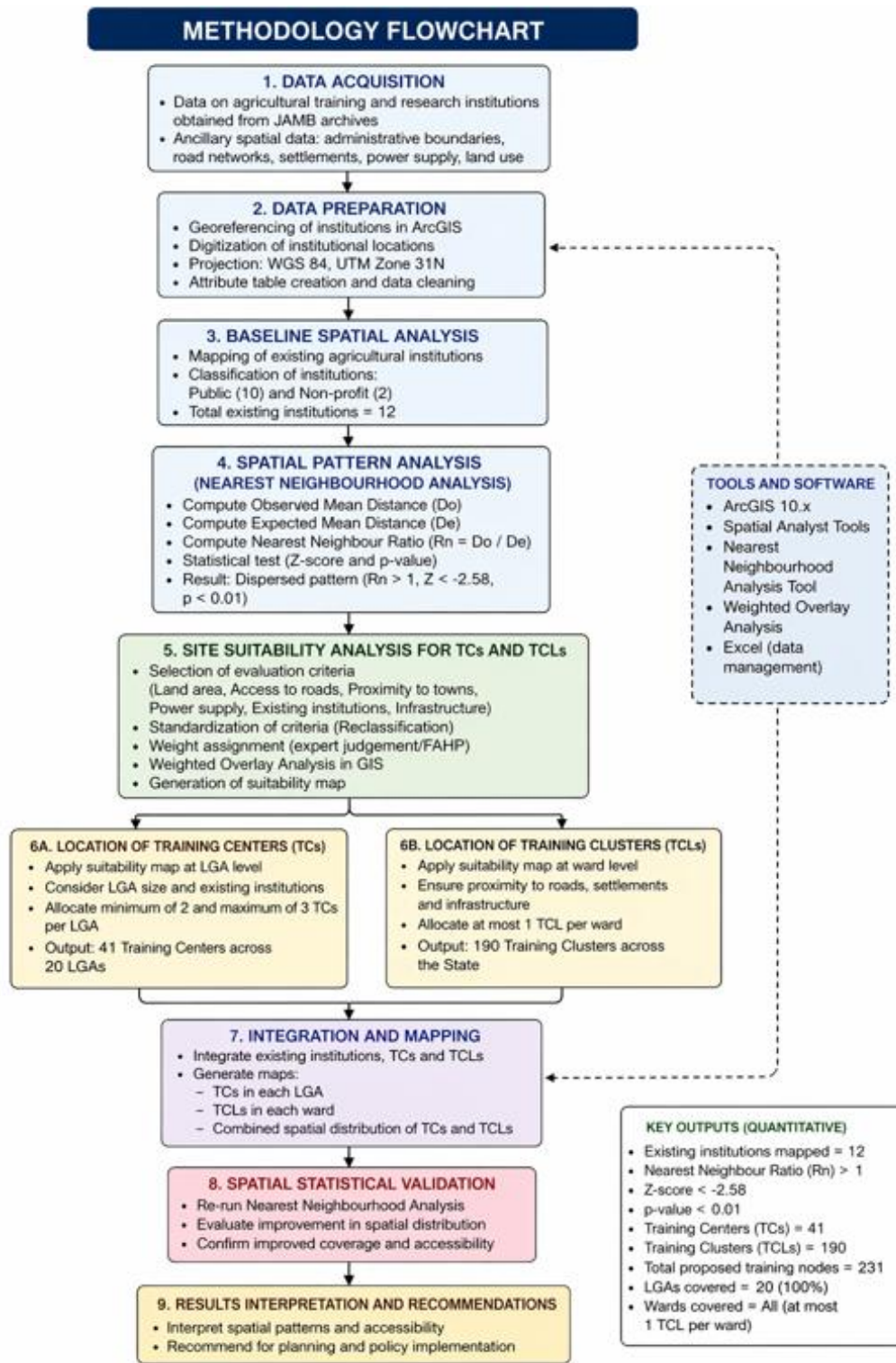


Figure 2. Methodological workflow

A reliable structure for distributing agricultural training infrastructure optimally is provided by the combination of multi-criteria decision-making and GIS-based spatial analysis. Redistribution is necessary due to the statistically significant dispersed pattern of current institutions, and the recommended allocation improves accessibility, geographical equity, and Ogun State's overall agricultural impactful development.

3. RESULTS

In Ogun State, Southwest Nigeria, there are established institutions providing agricultural education and training. This study proposed the location of additional training Centers in each local government area, as well as locating training clusters in each ward based on land size, accessibility to roads, and nearness to towns.

The spatial distribution of these institutions is dispersed. This implies that there is less than 1% likelihood that this dispersed pattern could be the result of random chance (Figure 5). The institutions can be categorized as follows

- Public institutions – dedicated government establishments for providing agricultural training at the federal, state, and local government levels. This includes the higher institutions of learning (universities, polytechnics, colleges of education, vocational training centers, etc.)
 - Federal University of Agriculture, Abeokuta,
 - Babcock University, Ilesan Remo,
 - Crawford University, Igbesa,
 - Olabisi Onabanjo University, Ago Iwoye
 - Federal Polytechnic Ilaro,
 - Moshood Abiola Polytechnic, Abeokuta,
 - D.S Adegbenro ICT Polytechnic, Abeokuta
 - Federal College of Education, Abeokuta,
 - Federal Agricultural Research Centre, Abeokuta,
 - Institute of Food Security, Environmental Resources and Agricultural Research (IFSERAR), Abeokuta,
- Non-profit institutions – both national and international non-governmental organizations such as UN agencies (IITA, WFP, FAO, etc.)
 - World Bank Center for Agricultural Development and Sustainable Environment, Abeokuta,
 - Institute of Agricultural Research and Training, IAR&T, Ikenne,

Location of Training Centers (TC) and Training Clusters (TCL)

A training Center has all agricultural facilities to conduct Agricultural training and research. They are located closer to the rural communities. The idea behind the establishment of Training clusters is to bridge the gap between the local farmer and agricultural technology. A total of 41 training centers and 190 training clusters have been distributed across the study area. They are located as close as possible to access roads, power supplies, and other amenities that can facilitate agricultural training. Existing agricultural research and training institutions in the study area were considered as Training centers. Training clusters, unlike training centers, have the same training facilities but lesser capacities for trainees.

Several factors were considered in the location of Training Centers and Clusters according to the size of each local government area and each ward, geographic location of existing Agricultural training institutions, access to roads, power supply, and other infrastructures. In this study, a minimum of two training centers and a maximum of three training centers are in each local government area, and at most one training cluster is in a ward.

Table 2. The TCs and TCLs Result Table

Component	Indicator	Result / Value	Interpretation
Statistical and Spatial Analysis Results			
Existing Institutions	Total number in Ogun State	12	Limited baseline distribution
	Public Institutions	10 (83.3%)	Dominance of government-owned institutions
	Non-profit Institutions	2 (16.7%)	Minimal NGO/international presence
Spatial Pattern (NNA)	Nearest Neighbour Ratio (R_n)	> 1	Dispersed distribution
	Z-score	< -2.58	Statistically significant pattern <1% probability of randomness
	p-value	< 0.01	
	Flood/Infrastructure Insight	Spatial implication	Uneven accessibility

Component	Indicator	Result / Value	Interpretation
Planning Outputs and Proposed Spatial Interventions			
Proposed Centers (TCs)	Training Total number	41	Expanded infrastructure
	Allocation per LGA	2–3 centers	Balanced distribution
	Coverage	20 LGAs (100%)	Full administrative coverage
Proposed Clusters (TCLs)	Training Total number	190	High local-level penetration
	Allocation per ward	≤ 1 per ward	Decentralized access
Overall Infrastructure Growth	Total nodes (existing + proposed)	231	Significant expansion
	Increase rate	> 240%	Improved spatial equity
Accessibility Outcome	Proximity to roads & settlements	Optimized	Enhanced farmer access
Overall Spatial Outcome	Distribution pattern (post-intervention)	Improved coverage	Reduced spatial inequality

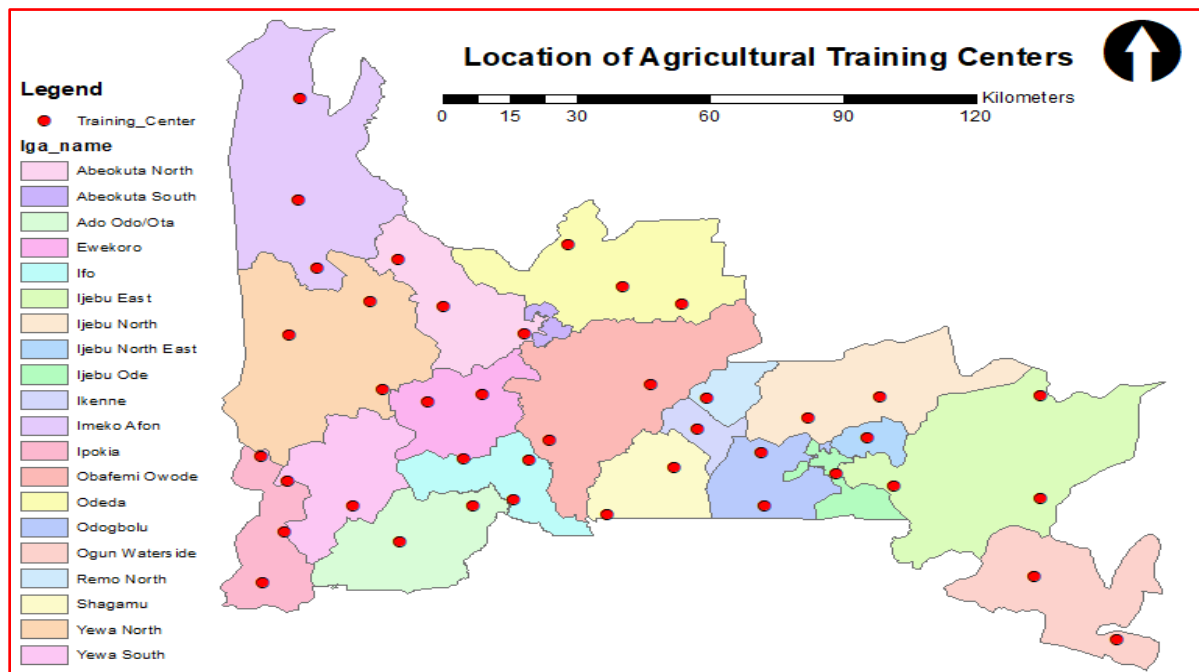


Figure 3. Proposed location of Agricultural Training Centers (TCs) in each LGA of the State

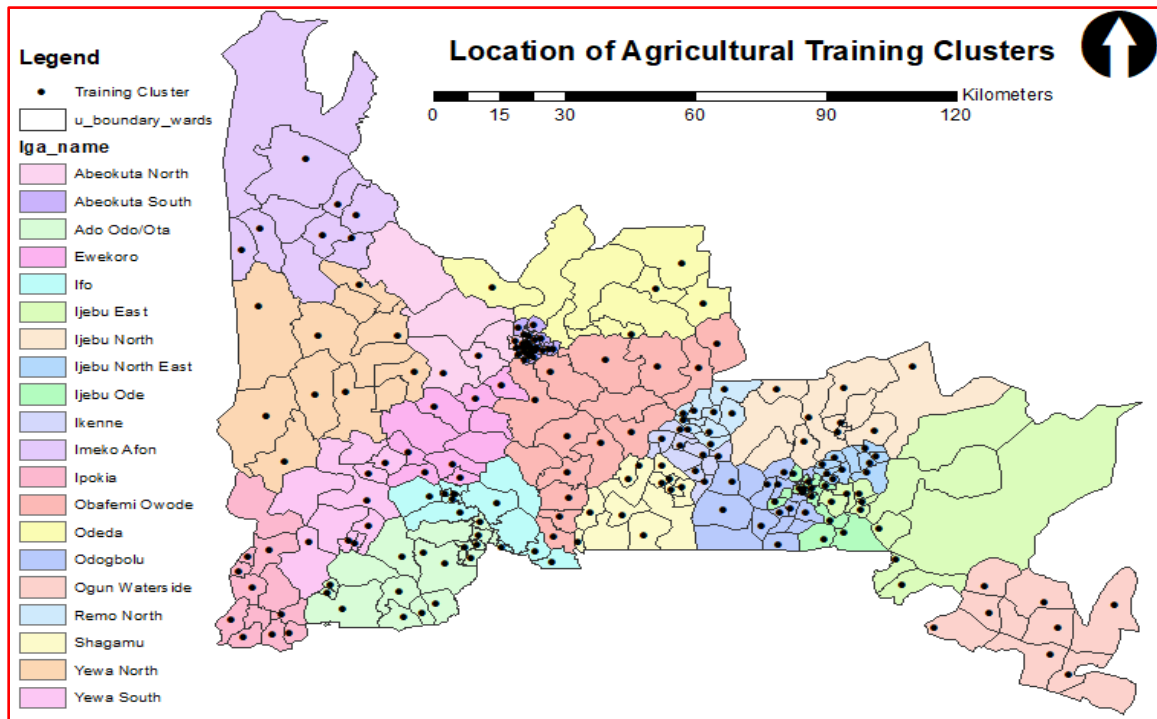


Figure 4. Proposed Agricultural Training Clusters (TCLs) in each Wards in the State

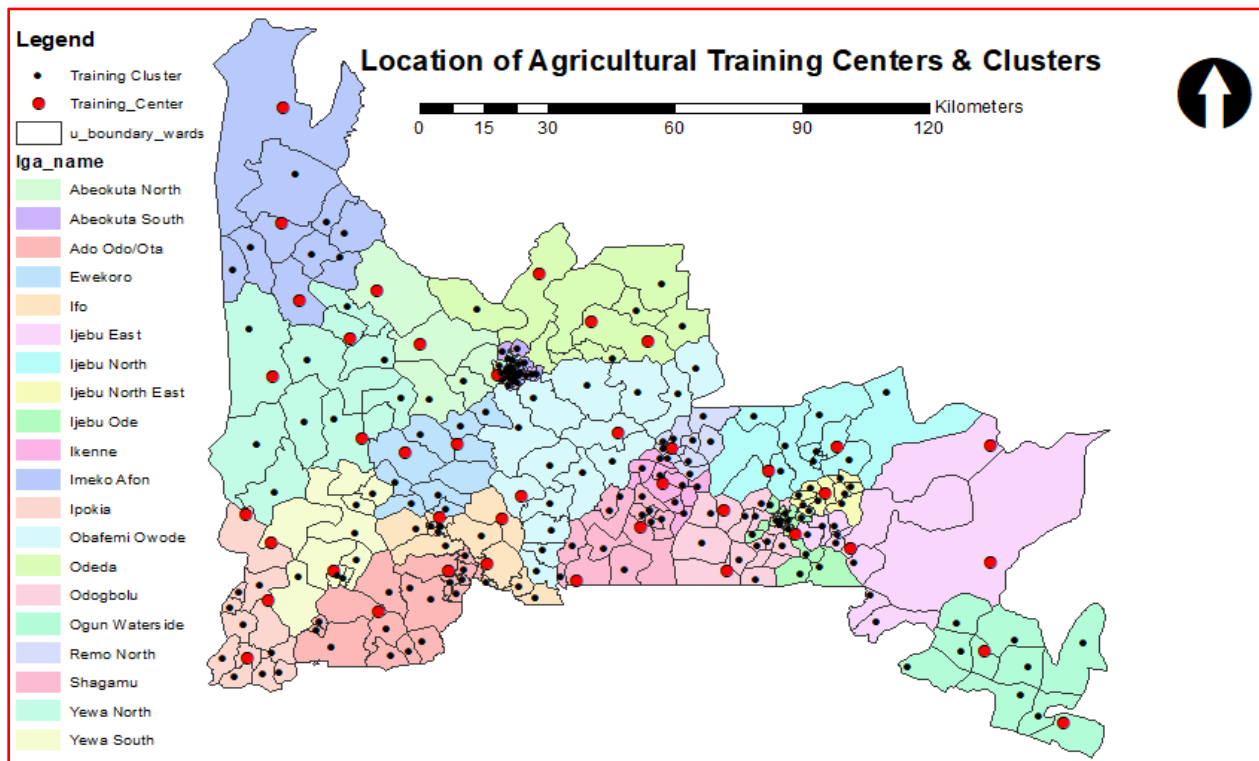


Figure 5. Spatial Locations of Agricultural Training Center (TCs) and Clusters (TCLs)

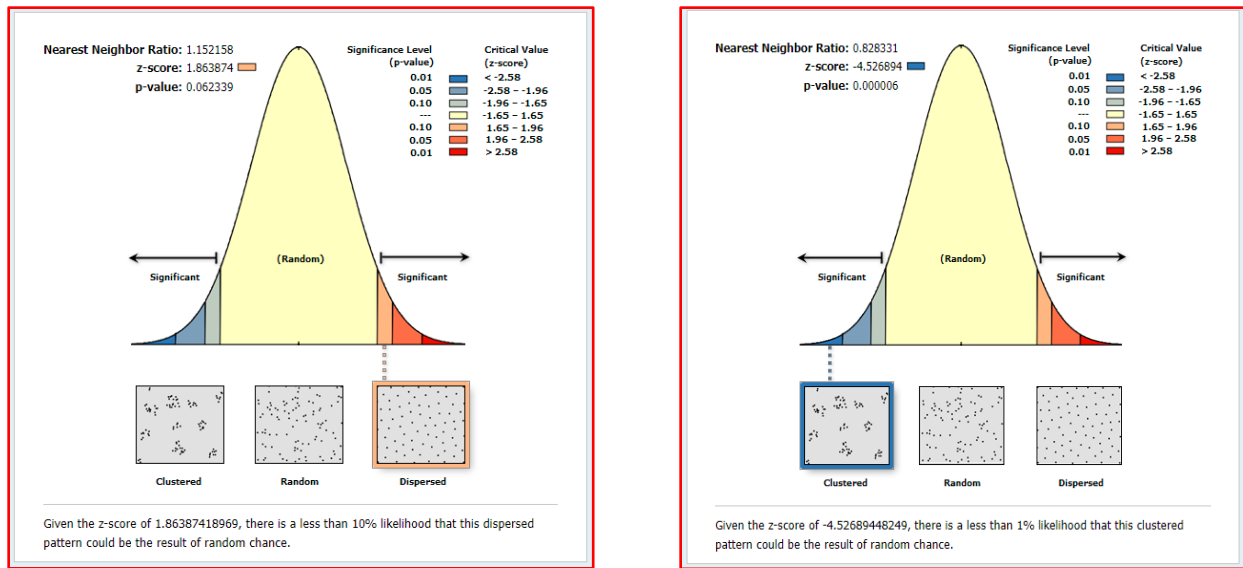


Figure 6. Nearest Neighborhood Analysis of TCs and TCLs
 TCs = NNR 1.1521, Z-score 1.8638, P-value 0.06233 TCLs= NNR 0.828, Z-score -4.526,
 P-value 0.000006

4. DISCUSSION OF FINDINGS

Ogun State has 12 agricultural institutions, including research institutes, polytechnics, and universities, making the state the most equipped for agricultural expansion in Nigeria. It accounts for around 2.4% of the country's agricultural families, with administrative breadth and structured physical distribution providing a strategic advantage in terms of accessibility and technology dissemination (National Bureau of Statistics, 2022). Evidently, a placement gap has been observed, with most institutions grouped between Abeokuta and Ilaro, a semi-urban portion of the state, lowering the closeness of rural locations within the state to this facility. This is verified by Huang & Wang (2024) and Mgendi *et al.* (2021), revealing in their study that the concentration of training centers in large metropolitan cities reduces the impact rate of agricultural inventions on rural farmers.

Furthermore, Figure 6 showed the locational pattern of agricultural research and training centers as indicated by the nearest neighbor analysis. The confidence level exceeded 99%, indicating that the conclusion was not a forecast. As a result, this has exposed a one-sided spread of this institution throughout the state, limiting access to essential information, particularly among rural farmers or potential farmers.

This study proposes a framework for ensuring equal access to educational agricultural delivery by establishing training centers (TCs) in each LGA and training clusters (TCLs) in all wards, totaling 41 TCs and 190 TCLs (see figures 2-4), addressing ATVET challenges that go beyond economic development (increasing productivity or expanding the education sector) to incorporate social and institutional development issues supported by (Wei *et al.*, 2026). This model is proposed to close the knowledge gap detected throughout the state. To ensure alignment with rural development plans, elements such as land availability, which is frequently the initial criterion, road accessibility, power source availability, and synchronization with functioning institutions are considered. These also contribute to the ATVET policy of promoting human capital development, improving technology transfer, and enhancing agricultural productivity with food security outcomes (IFAD and UNESCO, 2021).

The Training center facilities and the Training cluster facilities are built for multiple purposes, with the former functioning as a significant center for research and education, using proximity to existing institutions to fulfill its goals. The latter is a far more inclusive facility that facilitates community-based vocational teaching. The implementation pattern used in the 12 African countries that use the Agricultural Technical and Vocational Education and Training (ATVET) model must apply to the dual facility system created for the same operation in Nigeria. The success of these countries was based on female participation, proper attention to youth, the use of local resources, the ability to collaborate with private interests, and, most importantly, decentralization. All of these are effectively implemented in this study.

However, to ensure the long-term viability of this created paradigm (TCs and TCLs), a strategic monitoring system, ongoing tutor provision, and, finally, funds are required. Francisca *et al.* (2021) identify two significant issues with rural innovative education: a lack of stakeholder involvement and effective planning

to improve sustainability. To make this spatial paradigm a reality rather than a notion, there must be collaboration among the community, institutions, and government.

Conclusively, the spatial analysis in this study proposes a viable data-driven solution, utilizing GIS technologies and a functional ATVET countries' model, to address the knowledge gap in agricultural education in Ogun state's rural areas. The developed methodology will accelerate the development of agricultural capabilities from geolocated TCs and TCLs with a >240% increase (from 12 existing to 231 total nodes), highlighting the importance of geospatial intelligence in decision-making for long-term development initiatives.

5. CONCLUSION

Several best practices have been proposed for accomplishing the ATVET overall objectives, which are procedures or strategies that have consistently produced better outcomes than those obtained through other means. The recommended distribution, illustrated in Figure 3-5, significantly increases spatial coverage by reducing the distance between training facilities and rural farmers. Location-allocation modeling ensured that training clusters were strategically placed near rural communities, that each LGA had at least two operational training centers, and that facilities were conveniently accessible from roads and towns. Furthermore, the spatial design fosters knowledge transfer and technological adoption, shortens farmer travel distances, and ensures equal distribution of agricultural services. These best practices included finance, training, and stakeholder participation, among others. This study outcome aligns with ATVET literatures on pilot ATVET model study using, seen in the identified farm settlements in Ogun state and their training clusters, harnessing best ways to domesticate the ATVET model by profiling of the existing Agric extension workers, domestication of ATVET curriculum, creating training clusters for the existing farm settlements and Agricultural Training Centers (ATCs) in these clusters, and creating a functional linkage between.

6. RECOMMENDATIONS

To pilot the ATVET model within the existing framework for Agric education and training in Ogun state, southwest Nigeria, leveraging on the lessons learned from the ATVET implementation in the 12 African countries, the following propositions are hereby recommended

- A review of existing Agric extension service - The existing government extension service and its extension workers (EWs), as well as the ratio of EWs to farmers, would be assessed with a view to improving and complying with a modern-day reality and adaptation of ATVET best practice.
- Stakeholder engagement – Strategic engagement with government at all levels, funding partners, investors, and others, highlighting gains of ATVET implementation in the 12 African countries and the need to domesticate these gains.
- 5 years ATVET strategy plan - develop 5 years state-level plan for the establishment of farmer training centers (FTCs) in agricultural rural areas – as one of the ATVET best practices, can increase farmers' knowledge and skill to overcome prevailing challenges in the Agric business. An FTC is expected to be established in each farm settlement cluster with a linkage to the existing Agric training institutions, such as the Federal University of Agriculture, Abeokuta, Federal Polytechnic, Ilaro, Federal College of Education, Abeokuta, Federal Agricultural Research Centre, vocational centers, and others.
- Learning should be a thing of joyful experience; Vocationalization of primary and secondary education at a young age group is better served by a more general, adaptable education rather than a focus on skills for occupations.

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