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A Review of the Evolution of Geography from Non-science to Science Discipline since the History of Geographic Thought

L'évolution de la Géographie de la Discipline Non Scientifique à la Discipline Scientifique Depuis La Naissance De La Géographie En Tant Que Domaine D'étude.

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Abstract

Drawing from secondary data, the paper reviewed the evolution of geography from non-science to science discipline since the history of geographic thought. The objectives for this study were to examine geography as a science discipline and examine the contributions and achievements of great scholar during the pre-colonial and classical period. Science is aimed at understanding the world around us and attempt to discover regularities and order among the sometimes whirling buzzing chaos of experience. This involve correlation of certain characteristics and scientist attempts to formalize and generalize regularities. The methodology employed was a combination of content analysis of literature review and documentary materials. Findings from the study revealed that ancient scholars observed and projected geography as a science subject since time immemorial. This was due to its better methods of handling geographic data and techniques of solving problems and application of mathematical and statistical methods to attain a desired objective. In each of the sequential phases of pre-colonial (pre 19th Century)*, classical (*19th Century)*, modern* 20th Century *and contemporary 21st* Century *periods, geographic thought were more scientific in approach but mainly during the 20th and 21st century as Geographers made used of the tools of quantitative techniques of mathematics and statistics to solve geographical problems and these transformations and developments help to position Geography as science.*

Keywords: Evolution, Geography, Geographic Thought, Non-Science, Science Methods and Review.

Résumé

En s'appuyant sur des données secondaires, l'article examine l'évolution de la géographie de la discipline non scientifique à la discipline scientifique depuis l'histoire de la connaissance de la géographie. L'objectif de cette étude est d'examiner la géographie en tant que discipline scientifique et d'étudier les contributions et les réalisations des grands savants dans le domaine de la géographie depuis la période précoloniale et classique jusqu'à nos jours. La science vise à comprendre le monde qui nous entoure et à tenter de découvrir des régularités et de l'ordre dans le bourdonnement des expériences chaotiques. Cela implique la corrélation de certaines caractéristiques et les tentatives des scientifiques de formaliser et de généraliser les régularités. La méthodologie employée est une combinaison d'analyse des œuvres et de documents. Les résultats de l'étude ont révélé que les anciens savants ont observé et projeté la géographie en tant que sujet scientifique depuis des temps immémoriaux. Cela était dû à ses meilleures méthodes de traitement des données géographiques et aux techniques de résolution des problèmes et d'application des méthodes mathématiques et statistiques pour atteindre un objectif souhaité. Dans chacune des périodes successives de l'ère précoloniale (avant le XIXe siècle), classique (XIXe siècle), moderne (XXe siècle) et contemporaine (XXIe siècle), la connaissance de la géographie est devenue plus scientifique dans son approche. En particulier au 20e et au 21e siècle, les géographes ont utilisé les outils des techniques quantitatives des mathématiques et des statistiques pour résoudre des problèmes géographiques et ces transformations et développements contribuent à positionner la géographie comme une science.

Mots-clés : Évolution, la connaissance géographique, Non-science, Méthodes scientifiques et Révision.

Introduction

Geographic thinking started with the creation of the world 800 years before Christ (B.C) and has a history of 21800 years of study. During this era, geographic thought were purely descriptive and listing of

geographic phenomena being an Art discipline. Geography during the ancient time was termed as "Gazetteer Geography" that is, discovering, identifying and naming of places of the world, making of maps of varied types. These maps were used to identify places, ease of direction, measurement of objects, calculation of distance of places and ascertaining the reasons for aerial differentiation of places of the earth. Cream of earliest scholars likes; Herodotus, Gratton, Strabo and Ptolemy were described as arm-chair Geographers because they contributed mainly to the history and philosophy of geography and they were best described as Fathers of Ethnography. In their studies of geography, they were completely silent on the area of mathematics and statistical technique in geography because they were deficient in arithmetic studies during their days in school. Their approach and methodology of study were non-scientific and their findings were based on self-ideology of their individual findings (Hartshorne, 1939; Onokorhoraye, 1994; Akinbode 1995; Holt-Jenson, 1999; Duana, 2010; Duana, 2014; Agbebaku, 2018).

Geography as science can be traced to the early 17th to late 18th Century. These periods witnessed the exploits, contributions and achievements of the works of great scholars to the history, philosophy and development of geographic thought during the ancient time and were of the opinion that geography had been a science subject from inception. Geography had been examined as a science discipline since time immemorial owning to invaluable exploits, contributions and achievements of ancient scholars during the pre-colonial and classical, modern and contemporary periods. During the pre-colonial and classical period such as the likes of; (a) Emmanuel Kant (1724-1804), (b) Eratosthenes (276-194 BC), (c) Alexandra Von Humboldt (1769 - 1859), and (d) Karl Ritter (1779 - 1859) witnessed geography as science since immemorial. In the same vain, scholars of the modern period such as the likes of; (a) Hetter Friedrich Ratzel (1858-1904), (b) Charles Darwin (1794-1859), (c) Halford Mackinde (1887-1927) and (d) Vadal Del La Blanch (1870-1874) as well as scholars of the contemporary period such as the likes of; (a) Mabogunje (1970; 1972), (b) Ade Akinbode (1995;1996), (c) Onokorhoraye (1994;1995) and (d) Afolabi Ojo (1957) believed and projected geography as more of a science discipline and spatial field of study (Hartshorne, 1939; Akinbode, 1995; Duana, 2015; Uluocha, 2015; Imanfidon, 2017; Agbebaku, 2018).

From time beyond memory, geographers have urged for the use of the right approach to identify geographic patterns over space and time (Mabogunje, 1971). Their knowledge about geographic processes has been highly inadequate. As a result, successive generations of geographers have been involved in finding out satisfactory explanations for the evolution of the varied earth characteristics (Akinbode, 1995). These reasons however served for the emergence and survival of statistical techniques in geography. Currently, the used of analytical, mathematical and statistical techniques in geographic studies to attain a desired level of precision, concision and objectivity and search for models and theories and proceed in this approach of analysis has been over emphasized and have come to stay in geography (Hartshorne, 1939; Haggett and Corley, 1969; Alamutu, 2011; Omotayo, 2014; Uluocha, 2015 and Zissis, Demitrios, Xidias, Elias, Lettas and Demitrios, 2015).

For instance, the era of Emmanuel Kant (1724 - 1804), witnessed geography as a science subject. Although, Kant was a philosopher but made great impact to Geographic study and mainly scientific Geography by helping to consolidate its place among University disciplines as a of field science. Kant was one of the earliest exponents in scientific geography and was instrumental in freeing geography from its previous close relationship with theology to the philosophy of ethics, epistemology, political theory, aesthetics and metaphysics (Harvey, 1969; Peet, 1998; Holt-Jenson, 1999). During his reigned as a philosopher and geographer, there was a qualitative revolution in scientific philosophy, scientific methodology and scientific theorization in geography. His works and discoveries were more of the dynamics and complexities of the celestial bodies of the earth. He made an important astronomical discovery about the nature of earth rotation. This discovery made him won the Berlin academy prize in 1754 as one of the greatest scientists in the history of geography. With this passion and knowledge for science of the earth, he made tremendous contributions in the areas of quantitative revolution, environmental determinism and in regional and critical geography (Hartshorne, 1939; Harvey, 1969; Peet, 1998; Holt-Jenson, 1999).

In addition, Kant (1724 - 1804), observed and projected geography as a

scientific field of study in views of the application of mathematical and statistical methods in problems solving. During his reigned, he was the first to mention in principles in the history of geographic thought on the following assumptions such as (a) inspiration of great mathematicians and physical astronomers of frictional resistance of activities of tidal currents on the earth's surface. He states that these action results to a diminution of the earth rotational speed (b) laid out the Nebular Hypothesis where he deduced that the Solar System was form, from a large spinning of Cloud of Gas known as the Nebular (c) order of the solar system conformed with the opinion of Isaac Newton Law (1642-1721), which states that the solar system was imposed from the beginning by God (d) extended the study of astronomy beyond the solar system to the galactic (upper space) and extra-galactic realms (Hartshorne, 1939; Harvey, 1969; Akinbode, 1995).

Kant (1724 - 1804), achievements to geography cut across both the physical and human spheres of geography but his assumptions were more to physical than human geography. He was the first to introduced that geography should be more of a science than a social science discipline. This is due to the used of quantitative and analytical tools and techniques (scientific influences) to solved geographic problems such as environmental degradation, calculation of distance, pollution, waste management and climate change. These tools and techniques aid the ease of classifications and understandings of geographic phenomena. For example, the used of mathematic and statistical tools (regression analysis, correlation, and factor and component analysis), computerized statistical techniques (multivariate's analysis, econometrics), critical geography (a critique of inductive and deductive reasoning), regional geography (unique characteristics of places and patterns) environmental determinism (climatic determinism to human behaviors and activities) and systematic geography (formulation of general laws and principles that regulates the two divisions of geography) to solve environmental problems which are still in use to date (Unwin, 1992; Onokorhoraye, 1994; Uluocha, 2015).

Secondly, the era of Eratosthenes (276 – 194 B.C), witnessed geography as a scientific field of study as geography was more of a science than Art or Social Science. Eratosthenes during his reigned was labeled as a mathematician before geographers and a geographer before

mathematician. He was named Beta meaning an Encyclopedia of Knowledge due to his prowess, contributions and achievements in geography (Harvey, 1969; Dauna, 2014; Agbebaku, 2018). Till date, the achievements of Eratosthenes (276 – 194 B.C) remain the focal and reference point in modern geography among the likes of Karl Ritter (1779 - 1859) and Alexandra Von Humboldt (1769 - 1859), (Peet, 1998; Egerton, 2007). Eratosthenes achievements in geography as a scientific field of study were great, invaluable and significant to geography. Eratosthenes earned his reputation in physical geography because the physical arm of geography made used of mathematics and statistical techniques. The major high-point of Eratosthenes contributions to geography was that his observations and measurements were absolutely accurate and were of high esteemed; these served as the focal and referenced points of geographic thought during the ancient time. In addition, Eratosthenes was the first to use the word geography as the study of the earth and of places and phenomena of the earth's surface. He yearned to understand the dynamics and complexities of the world.

Eratosthenes was the first to introduce the termed sieve in geography method of identifying prime numbers. He was the first to measure and calculates the radius and circumference of the earth. He applied a measuring system known as "stadia" without leaving Egypt to determine the angle of the sun. He was able to achieve this angle with aid of sunbeam and gnomons which were the standard and earliest unit of measurement as at that time. Eratosthenes added that, at local noon of the summer solstice and the sun was directly overhead. Furthermore, he ascertained through the shadow of someone looking down a deep well at that time in Syene, blocked the reflection of the sun on the water at right angle. He was the first to measure the sun's angle of elevation at noon on the same day in Alexandria. The method of measurement was to make a scale drawing of that triangle which included a right angle between a vertical rod and its shadow which turned out to be $1/50^{th}$ of a circle. He therefore concluded that the earth's circumference was fifty times that distance. He was the first to calculate the tilt of the earth axis and also the distance of the earth to the sun. He was also the first to describe the size and shape of the earth. He divided the earth into five (5) climatic zones, two freezing zones (towards the poles), two temperate zones (in-between the poles and equator) and a zone compassing the equator or the tropics and all these were made possible due to his background in

science (Hartshorne, 1939; Onokorhoraye, 1994; Akinbode, 1995; Duana, 2015 and Omofonmwan and Agbebaku, 2017).

Thirdly, the era of Alexandra Von Humboldt (1724 - 1804), observed geography as a science in viewed of his studies of the earth resources. Alexandra Von Humboldt studied geography at first but later transverse to other scientific disciplines as Geology, Botany, Chemistry, Anatomy, Physics and Physiology. All this he was able to achieve due to his quest for scientific techniques and knowledge for the study of natural science (Imanfidon, 2017; Agbebaku, 2018). Humboldt was a dedicated field worker, a great explorer, traveler and physiographer. He travelled widely with over 43 instruments for measurements and observations of systematic and comparative components of geography such as soil, size, distance, vegetation, oceanography and climatic patterns. In addition, Humboldt discovered and measured the Peruvian current in 1745, during his reigned he made used of instruments as; Thermometers, Barometers, Quadrants and Sextants, Telescopes, A Balance Scale, Chronometers, Compasses, Rain-Gauge, Electric Batteries, A Leyden Jar, Theodolites, Hydrometer, A Dip Needle and Eudiometers among others for measurement and recording of data (Harvey, 1969; Helferich, 2004; Imanfidon, 2017). Furthermore, he was the first to establish the Notion of Association and propose a classification of life forms, to create the concepts of isothermal line and to prove the existence in the mountains of different vegetal zones, using the temperature as the main determining factor (Onokorhoraye, 1994; Imanfidon, 2017).

In addition, Humboldt demonstrated the importance of classification and instrumentation of data as well as the comparative description of observed phenomena with precision and clarity. With his scientific knowledge Humboldt quoted that "*He shall find out how the forces of nature interact upon one another and how the geographic environment influence plants and animal's life*" (Botting, 1973; Imanfidon, 2017; Agbebaku, 2018). He contributed to the development of meteorology and climatology when he developed the charts with isobar lines to indicate barometric pressures. He established a meteorological station linking East to West in Russia. He helped to develop a branch of medical geography where till today, his methods and outlook is being applied in the branch of medicine known as Humboldtian Medicine (Rukpe, 1996). In a nutshell, Humboldt was scientific all through his

explanations in geography (Smith, 1921; Imanfidon, 2017; Agbebaku, 2018). There is no doubt, that Humboldt was able to achieve all these with the utilization of scientific techniques, survey and geographic methods that project geography as science (Onokorhoraye, 1994; Akinbode, 1995; Helferich, 2004; Omomfonmwan, 2006; Duana, 2015; Agbebaku, 2018).

Fourthly, the era of Karl Ritter (1779 - 1859), observed geography as a science. His first geographical publication "Krdkunde" described geography as the study of; (a) geographical (b) historical and (c) statistical. Ritter was also a dedicated field worker just like Humboldt and an ardent believed of empirical research rather than a discipline deduced from rational principle. He carried out more of his empirical research in the class as a classroom lecturer. He initiated the concept of space interaction and preceded his findings from observation to observations and not from hypothesis to observation of the facts of the earth. Ritter studied hydrology and viewed geography as an empirical science. He maintained that its methodology requires procedures from one observation to another. He conducted a lot of surveying and teleologist of the earth resources. Ritter divided the earth surface on universal consideration (Botting, 1973; Onokorhoraye, 1994; Akinbode, 1995; Duana, 2010; Duana, 2015; Imanfidon, 2017). In addition, his style of geography was said to be part of epistemological renewal by adopting a comparative procedure to geography thereby offering a new scientific landscape in the study of geography as an academic and science discipline (Duana, 2015; Imandifon, 2017). In order to achieve the aim of this research, the main objectives of this paper will be to ascertain human's knowledge and perception of people that geography has been a science discipline since the history of geographic thought of the ancient world.

The era of modern geography were observed during the period late 18th to 1920 Century. Great scholars during these periods such as the likes of; Hetter Friedrich Ratzel (1858-1904), Charles Darwin (1794-1859), Halford Mackinde (1887-1927) and Vadal Del La Blanch (1870-1874), made great impact and modified the approach and methodology of the study of geography. During the era, there was a shift in the approach and methods of geography from the doctrine of environmentalism to regional approach and of the techniques of understanding and solving

geographic problem. The era witnessed the development of theories and models to the approach of geographic phenomena. In addition, there were the emergence of changing methodology, expansion of human knowledge, fresh ideas and concepts began to out-weigh the old, shift from qualitative revolution to critical approach and attainment of advance scientific techniques that portrait geography as science discipline (Onokorhoraye, 1994; Akinbode, 1995; Helferich, 2004; Omomfonmwan, 2006; Duana, 2015; Agbebaku, 2018).

The era of contemporary were observed during the period 20th through the 21st Century. Great scholars during these periods that protected geography as science were the likes of; Peter Hagget (1969), Corley Richard (1969), Harvey David (1969-72), Mabogunje (1958), Akinbode (1995), Onokorhoraye (1994) and Afolabi Ojo (1957). This era was described as the water-shell as the era till date witnessed increased in quantification and proliferation of scientific techniques in geography both in theories, models, mathematics and statistical techniques. During this era, the approach and methodology of purely analytical in reasoning and solving geographic problems. In views of the above, during this era there were better methods of handling geographic data's and techniques of solving problems, the spread of quantitative revolution and the application of mathematical and statistical methods to attain a desired objectivity and less description of places/locations and more of the study of uniformities and the production of theories and models and spacing of phenomena (Onokorhoraye, 1994; Akinbode, 1995; Helferich, 2004; Omomfonmwan, 2006; Duana, 2015; Agbebaku, 2017, 2018).

In views of the above, the specific objectives for this study are to: examine geography as a science discipline and examine the contributions and achievements of great scholar during the pre-colonial and classical period with the likes of Emmanuel Kant, Eratosthenes, and Alexandra Von Humboldt and Kart Ritter, during the modern period with the likes of Hetter Friedrich Ratzel, Charles Darwin, Halford Mackinde and Vadal Del La Blanch and during contemporary period with the likes of Mabogunje, Akinbode and Onokorhoraye were they portraits and projected geography as more to science than social science since the history and philosophy of geographic thought during the ancient world.

Research Method

This paper is purely on content analysis and a review of literature of history of geographic thought during the ancient world and contributions of great scholars during the pre-colonial, classical (pre 19th to 1859 Century) modern (1920th Century) and contemporary (20th to 21st Century) periods in the history and philosophy of geographic studies to ascertained the transformations and developments have help to position geography as science since time immemorial. Secondary information was sourced mainly from existing literature and academic journals. In a nutshell, secondary data were sourced from documentary materials.

Geography as Science Subject

Prior to the pre-colonial and classical periods, the 16th Century observed that geography was science, as without this current symbols of mathematical and statistical techniques 'scientific notation' of what was obtainable now, the people of Sumerian (Egypt), understand and used arithmetic principles such as; $(a+b)^2 = a^2 + 2ab + b^2$ to solve problems. In addition, these people had enough knowledge of algebraic methods to find square root of a number and ideas about the earth circumference and radius as well as ideas about the planetary bodies of the universe. Furthermore, the construction of the Egyptian pyramid was based on scientific knowledge and understandings (Onokorhoraye, 1994; Akinbode, 1995; Agbebaku, 2017). In addition, most rulers of the ancient kingdoms had knowledge of science to govern and solve societal problems (Onokorhoraye, 1994; Akinbode, 1995; Agbebaku, 2017). Geography is without any doubt a natural science as observed by the likes of; Alexandra Von Humboldt (1724 – 1804), Eratosthenes (276-194 B.C), Emmanuel Kant (1724-1804), Karl Ritter (1779-1859), Ptolemy (127-150 A.D), Hetter Friedrich Ratzel (1858-1904), Charles Darwin (1794-1859), Captain Cook (1768-1811), Joseph Bank (1766-1812), Halford Mackinde (1887-1927), Vadal Del La Blanch (1870-1874), William Morris David (1850-1934), Mabogunje (1958), Afolabi Ojo (1957), Akinbode (1959- Date) and Onokorhoraye (1948-1998), (Onokorhoraye; 1994; Akinbode, 1995; Agbebaku, 2017). Research has shown that geographic studies mainly at the physical arm required background knowledge of other field of studies such as; Chemistry, Geology, Physics, Botany, Mathematics, Statistics and Agricultural Science as observed during the era of Humboldt (1724 - 1804) in early

17th and 18th Century (Aigbe, 2014; Imanfidon, 2017; Omonfonmwan and Agbebaku, 2017).

Studies have shown that science is fundamentally a rational, logical and scientific explanation that must make sense (Needham, 1986; Omofonmwan, 2006). Religious studies may rest on revelations and customary tradition, but science must rest on logical reason. In the logic of science, it is impossible for an object to have two mutually exclusive qualities. For instance, the flip of a coin cannot be present in both head and tail. Also getting a college education cannot make a person rich and the same time make him poor. These are two mutually exclusive results. In addition, there are two distinct logical systems important to scientific quest referred to as deductive logic and inductive logic (a) Inductive reasoning or logic is from particular to general principle, from false to truth, for example all men are mortal, Socrates is a man, and therefore Socrates is a mortal (b) Deductive reasoning or logic is from general to particular, for example all men are mortal, Socrates is a man, and therefore Socrates is a mortal. In induction one starts from observed data and develops a generalization which explains the relationships between the objects observed. On the other hand, in deductive reasoning one starts from some general laws and applies it to a particular (Mabogunje, 1971; Needham, 1986; Omofonmwan, 2006; Agbebaku, 2017).

For a discipline to be regarded as science, the following assumptions are logical facts that will be tested and ascertained, that; **(a)** Science is Deterministic**:** Science is based on the assumption that all events have antecedent's causes that are subject to identification and logical understanding for the scientist, nothing just happen, it happens for reason. If a man catches cold, it remains to the scientist to assume that each of these events is susceptible to a rational explanation (b) Science is General: Science aims at general understanding rather than explanation of individual events (c) Science is Parsimonious: Scientists spend much of their efforts in the attempt to discover the factors that determine types of events. At some time the attempts to discover those factors that are not deterministic. The events for instance in determining the acceleration of a falling object we discard its color as being irrelevant (d) Science is Specific: In conducting a research project, all the topics of prejudice, theory the science must generate a specific operationalization of the concept prejudice for example, agreement with

several questionnaire statement seem to indicate, and (e) Science is empirically verifiable.

In addition, science at it most elegant results in formulization of general results or equations describing the world around us, such formulizations however are not useful if they cannot be verified through the collection and manipulation of empirical data (f) Science is Inter Subjective: It is frequently asserted science is objective, but such an assertion typically results in a good deal of confusion as to what objectivity is. Inter subjective means that two scientists with different subjective orientation would arrive at the same conclusion if each conducted the same experiment (g) Science is Open to Modification: Many theories of the past have subsequently been disapproved and replaced by better ones. Current theories will eventually be replaced by better ones. The social scientist is bound by many of the same logical constraints as the physical scientist. In views of these, many works of the past and theories have been reviewed and replace with better once, for instance, the doctrines on the evolution of man, earth and planetary bodies and the paradigm shift in solving environmental issues (Needham, 1986; Onokorhoraye, 1994; Akinbode, 1995 and Omofonmwan, 2006; Aigbe, 2014; Agbebaku, 2017).

Science is aimed at understanding the world around us. Components of science to understands this activity are; (a) Description; scientist observes and describes objects and events appearing in the world. Such descriptions are guided by the goals of accuracy and utility (b) Scientist attempt to discover regularities and order among sometimes whirling buzzing chaos of experience. This may involve correlation of certain characteristics and (c) Scientist attempts to formalize and generalize the regularities he discovers in the physical world (Mabogunje, 1971; Onokorhoraye, 1994; Akinbode, 1995). Physical geographer made use of scientific tools, techniques and methods and deductive reasons to drive their observations and findings to a logical conclusion. A growing number of geographers became aware that mathematics and statistical tools could be applied to geographical problems. These provide precise tools to test theories and analyze data. For example, the specialties of physical geography such as geomorphology, climatology, hydrology and soil studies make used of analytical tools such as mathematical and statistical techniques. These techniques are more rigorous in nature, for

example regression analysis, correlation, and factor and component analysis. In addition, in line with the theme of geography which is aimed to analyze the physical world, investigate inter-relationship and interaction between man and examine regional differences and account for them. In view of the above, geography deserves more space and attention simply for that reason. Geography is more to science than social science. Particularly if we consider subjects like psychology to be science subjects (Onokorhoraye, 1994; Akinbode, 1995; Agbebaku, 2017).

Furthermore, geographers are those passionate for Geo-geeks (earth) and Geo-people (events) and excited about everything Geo and Management.

Studies have shown that there is a very important scientific component in geography as observed in in most of the conventional Universities in Nigeria, unlike in the past were geography was more tilted to social sciences. But in recent times and due to awareness of geography as science discipline most schools, Faculties and Departments in most Universities including Nigeria, has consented with the perspective that geography is science than social science. Furthermore, the arm of physical geography tends to have a more technical approach, closer to the earth sciences. This is due to it methods and applications of analytical tools in geographic studies.

In views of the above, the thought of geography as a science discipline started back during the era of 17th and 18th Century. These era(s) laid the bedrock of quantification in modern geography. Quantification in modern geography was based from where the discipline originate from, its path of sojourn and destination (Onokorhoraye, 1994; Akinbode, 1995 and Encyclopædia of Geography, 2014). In addition, geography of the modern period during the era of early 19th Century and contemporary period of the 20th and 21st Century make used of quantification techniques. This highly sophisticated theories and models are used to explain the occurrence and spatial organization as well as functional characteristics of geographic phenomena. Such theories and models were concerned fundamentally with analyzing associations of geographic phenomena and making comparisons among groups of these phenomena. The techniques of quantification allows for tests of

significance to can be carried out by applying mathematics and statistical functions to solve societal problems (Mabogunje, 1971; Onokorhoraye, 1994; Akinbode, 1995; Rilwani, 2005; Alamutu, 2011; Agbebaku, 2017).

Theory of quantification in geography began in the mid-1950s (Uluocha, 2015; Zissis et al, 2015). During this period, there was the proliferation of mathematical and statistical techniques to enhance geographic studies. These techniques allows for the examination and tests of significance by applying statistical functions such as X^2, F – Test or Komolgorov-Simirnov Index (Onokorhoraye, 1994; Akinbode, 1995; Omofonmwan, 2006; Agbebaku, 2017). The era of quantitative revolution further paved way for the development of geographic information systems (GIS), global positioning system (GPS) and remote sensing (RS) techniques. These tools in geographic studies are widely used today and have made research and analyses of geographic phenomena much easier (Akinbode, 1995; Alamutu, 2011 and Uluocha, 2015). Though, geography is a spatial discipline, the techniques of mathematics and statistics, geographical information system, global positing system and remote sensing are modern enhancing tools in geography that have helped the discipline of geography to be seen as a science subject (Onokorhoraye, 1994; Akinbode, 1995; Omofonmwan, 2006 and Uluocha, 2015).

In addition, geography is concerned with the act of developing concepts and building up hypothesis, laws, models and theories as in other science disciplines (Alamutu, 2011). Quantification in geographic studies involves the use of statistical techniques such as; network analysis, regression analysis, correlation and multiple analysis, linear programming, factor and component analyses, time series analysis and factorial ecology (Haggett and Corley, 1969; Hartshorne, 1939; Rilwani, 2005; Alamutu, 2011; Omotayo, 2014). In addition, geography makes use of empirical techniques for details investigation and discussions of facts and findings to drive home it findings and conclusions. Knowledge of our surroundings is important as the knowledge of Physics and Mathematics in problem solving (Onokorhoraye, 1994; Akinbode, 1995). The fact that the discipline of surveying was perhaps the mother of necessity for the development of Mathematics and Science was a perfect assertion. Humans need a much more evolved form of numbers and science to be able to keep track of their territories and this was one of the primary reasons for the development of mathematical and statistical tools in geographic studies.

This was an argument that took time, to be accepted (Onokorhoraye, 1994; Hartshorne, 1939; Akinbode, 1995 and Alamutu, 2011). Furthermore, the studies of Mabogunje, (1971) and Agbebaku, (2017), states that there are three broad objectives that led to the acceptance of statistical techniques in geography and this make this field of study more scientific with these assertions: (a) to sharpen students awareness of his environment by presenting him in concrete quantitative forms, information about its features and variability (b) to equip students with the art of orderly classification and arrangement of data with the aim of making rational interpretation, the drawing of logical inference and the development of genelizations, and (c) to fashion out ways of applying or testing principles or concepts and this make it possible to engage in rational flights of fancy.

Acceptance of the use of quantification in geography does not by any means suggest a complete rejection of idiographic (descriptive-inductive) approach but just the recognition of its drastic weaknesses (Akinbode, 1995; Omotayo, 2014; Agbebaku, 2018). In view of the above, different types of statistical techniques are used in geographic studies. These techniques include descriptive statistics which involves the use of network analysis, frequency distribution, measures of central tendency and measures of dispersion. The probability statistics involves the use of combination and permutation, probability of an event, addition and multiplication rules and probability distribution while inferential statistics involves estimation: point and interval estimate, estimate of means: estimation of proportions; testing of hypotheses, inferences concerning mean standard deviations and proportions, analysis of variance, correlation and multiple analysis, principal component analysis, time series, linear programming (graphical and simple method), factorial ecology, regression analysis, chi-square analysis, rank and duality theorem, transitional probability, stochastic process, point biserial correlation and komorgorov simirnov techniques (Hartshorne, 1939; Akinbode, 1995; Rilwani, 2205; Alamutu, 2011).

In addition, with the applications of mathematics and statistical techniques mainly in the physical arm of geography in the last few decades, the following assertions have led to the consideration for the study of geography as science discipline, these are; (a) Intellectual changes in the trend of geographic development (b) questioning of the past approaches of the ways things were done (c) look of old problems with new eyes and techniques (d) Better methods of handling geographic data and techniques of solving problems (e) substitution of

quantitative approaches to problems formerly treated in descriptive ways (f) The spread of quantitative revolution and the application of mathematical and statistical methods to attain a desired objectivity (g) Less description of places/locations and more of the study of uniformities and the production of theories and models and spacing of phenomena (i) techniques of regionalization to compliment methods of modern science (k) techniques of classification to enable details of a particular entity, and (l) approach of system analysis and criticism in geography (Hartshorne, 1939; Mabogunje, 1971; Alamutu, 2011; Zissis et al, 2015; Agbebaku, 2017).

Conclusion

There is no doubt that geography had been examined as science discipline since time immemorial owning to invaluable exploits, contributions and achievements of scholars likes of Emmanuel Kant, Eratosthenes, Alexandra Von Humboldt, and Karl Ritter, of 17th and 18th Century, Hetter Friedrich Ratzel, Charles Darwin, Halford Mackinde, Captian Cook and Joseph Bank and together with Vadal Del La Blanch of 19th Century and Mabogunje, Akinbode, Afolabi Ojo and Onokorhoraye of 20th and 21Century all adhered and protected that geography was more of science discipline that art. However, the Greek scholars made far-reaching efforts which lay a solid foundation for geography as science owing to discovery of celestial bodies, mathematic theorems of Archimedes and Pythagora. Modern Geography during the18th Century make used of highly sophisticated theories and models to explain occurrence and spatial organization as well as functional characteristics of geographic phenomena. Such theories and models were concerned fundamentally with analyzing associations of geographic phenomena and making comparisons among groups of these phenomena. Currently, different types of statistical techniques are used in geographic studies. These techniques include descriptive and probability statistics techniques. In recent times, theory of quantification in geography that began in mid-1950s had metamorphosed over time due to proliferation of mathematical and statistical techniques to enhance geographic studies. Finally, Geographers are aware that mathematics and statistics could be applied to solve geographical problems and these transformations and developments help to position geography as science which has been on since time immemorial.

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