14 CONDUCTING EMPIRICAL RESEARCH WITH MAP-BASED DATA: A GEOGRAPHICAL OPTION

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INTRODUCTION

People must have assistance in observing and studying the great variety of phenomena that surround them. Some objects are very tiny and we require sophisticated electronic and optical devices (like microscope) to enlarge them so as to understand their configuration and structural relationships.

In contrast, geographical "things" are so extensive that we must somehow reduce them to bring them into view (Robinson 1984). Maps are useful in bringing environmental phenomena into view. Therefore, the map is a geographer's tool. A map, according to Pritchard (1984), is a flat piece of paper on which is printed a representation of part of the earth's surface at a reduced scale.

There are many types of maps. These include topographical maps, climatic maps, cadastral maps, land use maps, vegetation maps, soil maps, guide maps and tourist maps, to mention just a few. These maps allow us to, among other things, extend the normal range of vision, thereby making it possible to see the broader spatial relations that exist over an area. The selection of the most appropriate map for any particular study, depends on the nature and purpose of such a study.

The main focus of this paper is to show that the map is a very versatile storage device for all geographic and related information and, consequently, a fundamental research tool which has been under-utilized.

THEORETICAL FRAMEWORK

Research is a scholarly investigation aimed at the discovery of facts. There are many methods of research but, according to Haring et al (1975), it is the accepted part of twentieth century thought that science and its research methods are of the utmost social value. The scientific method is commonly credited to Sir Francis Bacon (1561-1626) who set forth its tenets in his work Novum Organum (or the new method). He espoused a process which began with the problem for which a solution or hypothesis would be suggested. This hypothesis, assumption or educated guess, then guided the research through observation, analysis, synthesis and finally to the conclusion. The conclusion then would come only after the hypothesis was thoroughly tested. On the basis of the evidence gathered, the hypothesis would be accepted or rejected as an answer to the research questions. Geography, today follows procedure very much like those set forth by Bacon. Being a science, its research technique utilize empirical scientific methods and produces results based on previously generated hypotheses.

A research in geography, therefore, consists essentially of completing a series of specific tasks or steps. First, the problem is expressed, then formulated as a hypothesis. A decision is then taken regarding the type and amount of information needed to test the hypothesis as well as where and how to collect such information or data. The data are then collected either in the field or in the laboratory from maps or other published materials. These data are then processed by the application of appropriate statistical and cartographic methods. The final step is testing the formulated hypothesis and drawing of conclusions (Haring et al 1975).

As a fundamental tool in scientific geographical enquiry (Ajaegbu et al 1973, Pritchard 1984, Adalemo 1982), if well prepared, the map can be useful for recording, calculating, displaying, analyzing phenomena to facilitate understanding the interrelation of phenomena in their spatial relationships (Robinson 1984). Duru (1985) observes that maps, at a glance could give the locations, quantities and manner of spread of various things studied in geographic space. Maps, therefore, save a great deal of reading time and make clear, pictures of the subject being studied. According to Keates (1989), maps break down our inhibitions, stimulate our

glands, stir our imagination, loosen our tongues and speak across the barriers of language.

The map is, therefore, a very versatile information device that is essential to research. Some of the aforesaid qualities are demonstrated in this paper using steps in scientific research as guide.

CONDUCTING RESEARCH WITH MAPS

As there are many different types of maps, their selections for a particular study depends on the map content.

The different kinds of maps and their contents are summarized in table 1.

Table I: Kinds of Maps and Their Content

	Kinds of Maps	Basic map content or data
a	Topographical map	Physical and cultural features - rivers, hills, mountains, lakes, valleys, ocean, shore lines, forest, roads, tracks, railways, canal, buildings, farms, settlements, vegetation etc.
b	Political/Administrative map	Administrative divisions in an area - countries in a continent, states in a country, LGAs in a state etc. Also network of roads linking important towns within such divisions may be shown.
c	Cadastral Map	Parcels of land in an area together with the names of owners, building and any important features within plots.
d	Geological map	Nature and age of rocks in an area are shown among other things e.g. possible mineral deposits etc.
e	Climatic maps	Shows relationship of climatic elements such as temperature, precipitation, wind direction and velocity, humidity, atmospheric pressure, cloud, sunshine etc.
f	Soil maps	Various types of soils in an area.
g	Vegetation map	Types of plant cover over an area.
h	Landuse Map	Shows various uses into which land in an area is put.
i	Guide/road map	Shows nature and types of roads in an area as well as the location of important socio-economic activity centres.
j	Tourist map	In addition to information in (i) above, the location of important tourist attractions in an area are shown.
k	Utility maps	Shows location of gas pipes, electricity and telephone cables, water pipes, and their terminals and junctions, control points etc.
l	Population map	Shows how people are distributed over an area.

Source: Author June, 1997.

The information in Table 1 above are not exhaustive. According to Robinson (1984), the various geographical phenomena of the real world that may be represented on maps are almost infinite. Therefore the contents of Table 1 are to enable us appreciate the assertion by Adalemo (1982) that, depending on the purpose at hand, maps are available or can be made available for that purpose.

CARTOGRAPHICAL METHODS IN RESEARCH

The methods of geographical research, involving the use of maps, fall into a group generally referred to as cartographical methods. They include

(a) Map display methods - where the map serves only to demonstrate the results obtained by other methods.

(b) Catometric methods - where the map itself serves to get the initial information as well as to obtain the final result and,

(c) Centrographic methods - where the map offers initial information and is used to demonstrate the final result. All these are particular geographical tools and specific techniques used in geographical research.

The map listed in Table 1 could be used individually or in combinations to identify a research problem, formulate research hypothesis, indicate the nature of data, methods of collection and analysis of research data and display of the research results.

IDENTIFICATION OF RESEARCH PROBLEM(S)

Haring (1975) asserts that any material or nonmaterial thing which can be identified, classified and located is proper subject-matter for geographic study. The geographic problem contains the elements of what, where and why. In this regard, depending on our interest, it is easy to observe something questionable about features shown on the map at a glance. For instance, on a topographical map we may observe that a large part of an area shown on the map is uninhabited or that there are very few farmlands in one area compared to another. Upon such observation, we may experience a research problem. Since problems are actually unsolved questions, one way to define the specific research problem is to ask questions such as

(a) Why are certain areas on the map uninhabited?

(b) Why are there more farms in some areas than in others?

(c) Is there any relationship between the observed distribution patterns and relief? A closer look at the map will enable the researcher to provide possible answers to these questions.

GENERATION OF RESEARCH HYPOTHESIS

The statement of the problem is the identification of a felt need to know. The hypothesis is a reasonable way to meet that need. It is a proposition which is assumed to offer a possible and reasonable solution to the problem (Haring 1975). For instance considering the questions (a-c) asked in the section on research problem, the following inference statements may be made.

(a) Relief is the difference in height between the highest and the lowest points on the earth surface.

(b) There are more settlements/farms on the lower part of the area than on the higher part.

(c) Hence there is a negative relationship between the distribution of settlements/farms in the area and relief/or other likely variable like communication.

From the above statements, it is clear that the hypothesis would contain two or more variable that are measurable or potentially measurable, including the relationships among the variables. The variables are therefore, indications of the type of data required for testing the research hypothesis.

DATA COLLECTION, ANALYSIS AND PRESENTATION

The map is dependable source of primary data for geographical research. This is because map is a representation of the earth surface at a reduced scale. Map could be used to determine the matrix (areal extent of the research area), sample frame or population of the study as well as the organisation of the field work. For example, if the study area is large, it could be divided into zones for the purpose of questionnaire administration among other things.

Furthermore, data derived from mapping techniques have a high degree of accuracy compared to those obtained by interviewing or using well structured questionnaire (Pritchard 1984). According to Haring (1975), this is because the individual interviewed may not

provide the researcher with accurate information owing to the following:

(a) he may not fully understand the questions;
(b) the researcher may not fully comprehend the answer;
(c) the person interviewed may either intentionally; or unintentionally provide misleading information; or
(d) the questionnaire may not be properly structured so as to elicit unbiased response.

Quantitative analysis of maps allows the student to depend largely or entirely on the map (and on his measurements and calculations from it) and to make proved statements about the area shown, within the limits of the reliability of the map in question (Ajaegbu et al 1973). For instance, to test the validity of the hypothesis on the relationship between distribution of settlements and relief, the map being used could be covered with grids and the difference in height and number of settlements within each grid square determined by calculation and counting respectively. The data generated could then be presented in tabular form for analysis as shown in Table 2.

Table 2: Hypothetical Example of Data Generated From Grid Analysis

Height Above Sea Level (M)	Number of Settlement
1000	0
900	0
700	0
600	1
500	2
400	5
200	10
100	12

The data in Table 2 can then be represented graphically as a simple line graph (Fig. 2).

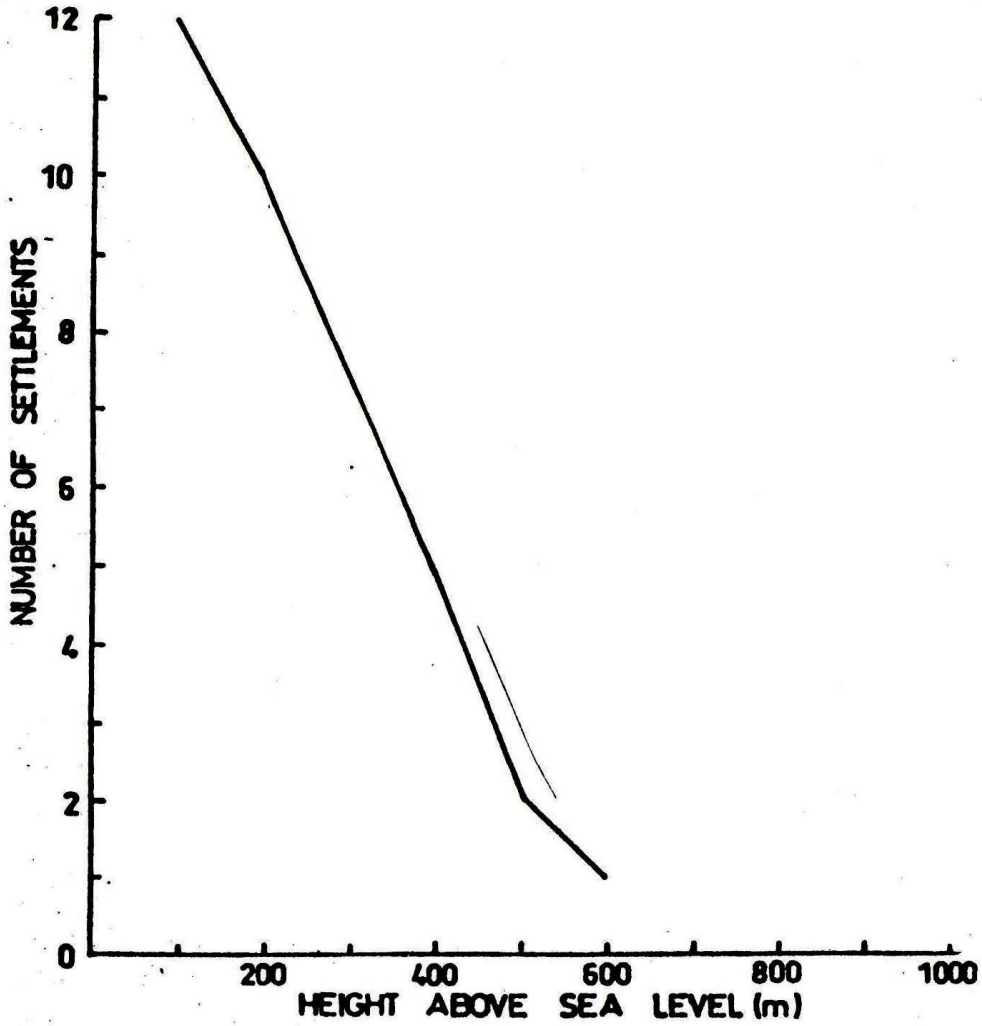

Fig.1 Graphic Plot of Settlements against Relief

At a glance, this graph confirms the hypothesis that there is a negative relationship between the distribution of settlements and relief in the area. This implies that the number of settlements in the area decreases as the height of the earth surface above sea level increases. However, other statistical tools like the Pearson Product Moment Correlation, could be used for further analysis.

Generally, quite a lot can be learnt (or guessed) about an area from maps. If we read the map of an area made at different periods, changes that have taken place can easily be observed and questions raised where necessary. Depending on the type of map, changes that may be observed and measured include those on relief, drainage, vegetation, soil climate administrative units, population, landuse, settlement pattern, landownership, agriculture, communications, and many other things that are vital to mankind continued existence and comfort. These changes could be in terms of number, form, functions, size or area, location, distribution etc. Under any of these circumstances questions could be raised and possible hypotheses generated for testing. Infact without having to live in an area, we can identify research problems, hypothesis as well as collect, analyse and present data by using maps.

It is pertinent that, the researcher be familiar with the language of maps. According to Ajaegbu et al (1973) where map analysis is set around a problem or question, the researcher should carry out the following operations:

(a) Study the map symbols and scale.

(b) Measure things that are relevant with regards to the problem or question being solved.

(c) Record the information obtained, tabulate the results logically and represent the findings on graphs and or maps as the case may be.

After the significant data have been identified and isolated, the researcher may use any of the wide variety of cartographic devices to present the data in a manner which makes analysis most effective. Most of these cartographic procedure overlap with statistical devices. It is not always possible, nor is it necessary, to make distinctions since cartographic analysis supplement statistical analysis and vice versa (Haring 1975). Figure 2 shows the considerable number of cartographic/statistical techniques available

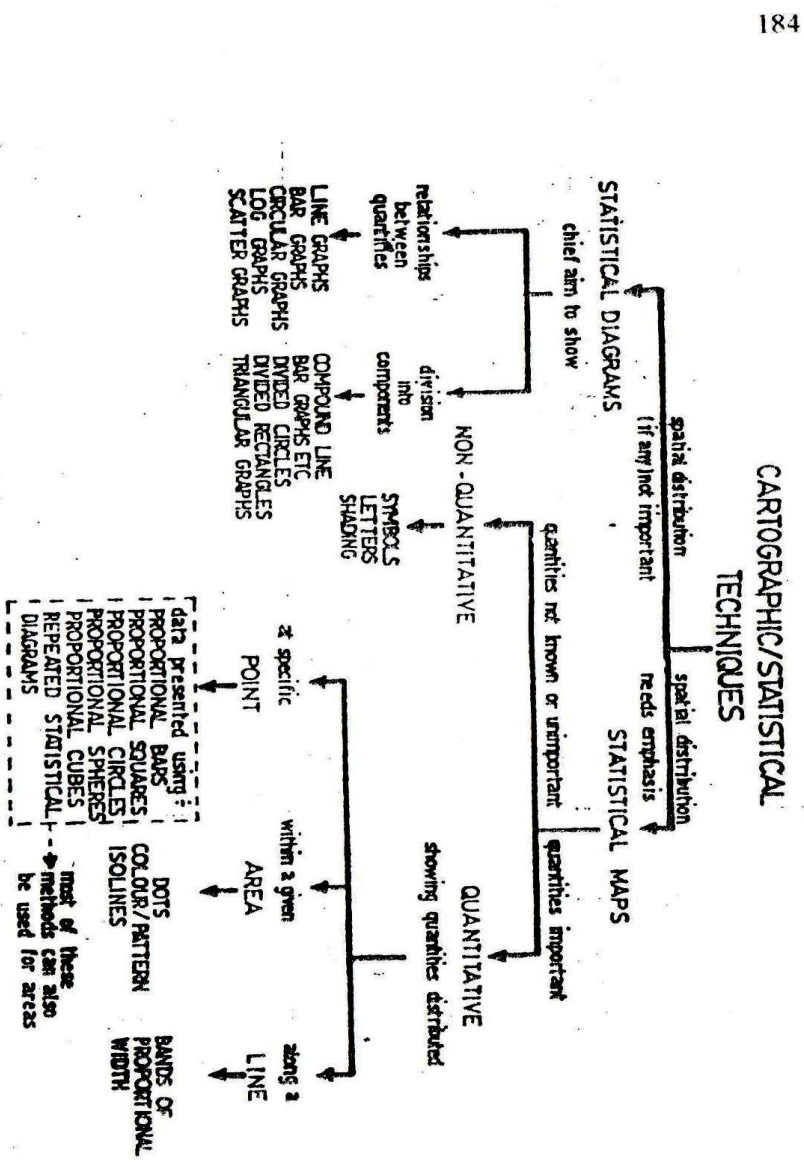

Fig. 2. Schematic Representation of Cartographic/Statistical Techniques in Geographical Research.

for use in the analysis and presentation of geographical data. The researcher must decide which one is most significant to his particular study.

The sub-division of techniques in Figure 2 are statistical maps and statistical diagrams. In the former category, the statistics to be represented must contain an element of spatial distribution which is either so important or so complicated that a base map is needed on which the distribution can be recorded at specific points, within areas or along specific lines using qualitative or quantitative symbols.

Techniques falling into the second broad category (statistical diagrams) can be divided into two major groups although this division is not a precise one. The distinction is basically between those methods which are concerned with showing the relationships between varying quantities and those which indicate the portion of the whole formed by several component parts. The division into maps and diagrams is not entirely a rigid one. This is because statistical diagrams are often incorporated into technique which have a map as their basis.

CONCLUSION

This paper has shown that maps are a versatile tool for empirical scientific research. In spite of this fact, a great number of researchers do not use maps because of the erroneous belief that maps are very difficulty to read and interpret.

Maps use symbols to represent observable or measurable facts. The map legend usually identifies all symbols that require explanation. This implies that since map legends are self explanatory, information can be extracted by researchers in any discipline without formal training on how to use maps.

Since the map is a graphic representation of the earths features and surface patterns, it is a more reliable source of information for all such attempts to investigate the great multiplicity of objects and or phenomena now found necessary for the sustainable development of the earth and of its peoples.

Duru (1985) asserts that those who are not interested in maps invariably make poor geographers and earth scientists. Phenomena studied in the field are so complex and diverse that it would be

extremely difficult to fully comprehend, let alone accurately describe them, without the aid of maps. Whether one sees geography as the study of the earth's surface, as the home of man, or as the science of location", there is no doubt that the geographer's contribution to science and national development would be meaningless without the use of maps.

The map based research methodology is therefore recommended for adoption by researchers in view of its simplicity, versatility and high level of accuracy.

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