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Using Digital Map With Geographical Information System For Ranches Search, Secure And Rescue (SSaR)

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ABSTRACT
The current threat to life and property by the herdsmen demands an urgent solution by the Nigerian government. The menace has obviously defied the national security and is sure a great enemy to national development. This is so because throughout the world, many regions facing intense conflict are mostly limit from equitable and sustainable growth opportunities. It is the custom for herdsmen to travel about in search for ranches for their livestock. The problems can be blamed on the seizure of land meant for cattle routes and grazing areas marked for herdsmen by some persons that led to the escalation of the crisis between farmers and herdsmen. Spatial database in ranches land in the establishment area located in all parts of the State, Nigeria, will be studied using geographic information system (GIS) technique. GIS, a tool which is used for storing, analyzing and displaying spatial data is also used for studying ranches land allocated for the herdsmen. For this research, grazing routes and ranches land area will be created from 36 states and FCT which represents the total covered area. The land marks will be investigated for a green pasture, which is the most important part for the ranches land. The proposed ranches land quality information maps of the study area will be prepared using GIS spatial utterance technique for the entire considered environment. The spatial database established in GIS will be helpful for searching; securing and rescuing the grazing routes and ranches land area, herdsman and the events command personnel.

Keywords: Digital map, Ranches land, Geographical Information System (GIS), Secure, Search

1. INTRODUCTION

One major issue that has attracted much national attention recently is the threat of Fulani herdsmen in various parts of the country, destroying farmlands, looting, raping, abducting and killing farmers and villagers. Certainly, the atrocities committed by the Fulani herdsmen are not new, as they have been occurring occasionally across the country for well over 15 years. What are perhaps new are the rapid escalation and spread, and the frightening trend that it has assumed in recent times, as well as the increasing use of sophisticated weapons by the rampaging herdsmen. In contemporary time, the menace of the Fulani herdsmen only rivals the Boko Haram atrocities in terms of the casualties and carnage.

Several thousands of people are believed to have died in the hands of the Fulani herdsmen across the country. The recent incident that has attracted significant attention is the attack by suspected Fulani herdsmen on Ukpabi Nimbo community in Uzo-Uwani area of Enugu State on Monday April 25, 2016, which left about 50 persons dead. Hundreds of people had also been killed in various communities of Benue State, as well as in Edo, Ondo, Delta, Plateau, Kwara, Oyo, etc.

GIS, according to Esri, is defined thus: "An integrated collection of computer software and data used to view and manage information about geographic places, analyze spatial relationships and model spatial processes". A GIS provides a framework for gathering and organizing spatial data and related information so that it can be captured, stored, checked, integrated, manipulated, analyzed and displayed data which are spatially referenced to the Earth." (GIS) expertise provides the means for both efficient handling of huge data and effective spatial analysis competencies [2]. From this perception, GIS is rooted in the digital nature of the computerized map.

During the early 1980's, the change in format and computer environment of mapped data was utilized. Spatial database management systems (SDBMS) were developed that linked computer mapping capabilities with traditional database management capabilities [4] [5]. In these systems, identification numbers are assigned to each geographic feature, such as a timber harvest unit or wildlife management parcel. For example, a user is able to point to any location on a map and instantly retrieve information about that location [1]. Alternatively, a user can specify a set of conditions, such as a specific vegetation and soil combination, and all locations meeting the criteria of the geographic search are displayed as a map. A map is not the territory it represents, but if correct, it has a similar structure to the territory, which accounts for its usefulness.

The problem of clashes between farmers and herdsmen is now a major regional and practically African problem now. There is one called Al Qaeda; there is Boko Haram and so on. It is a governmental project now to trace, disarm, try and discipline them." It is a well-known fact that the herdsmen roam about to feed their cattle and they are complaining that the cattle routes and grazing areas marked for herdsmen had been taken over and turned to farms by some influential persons. When people took over the land meant for cattle routes and grazing areas, compartments of clashes between farmers and herders exploded in some parts of the country.

With the establishment proposed National Grazing Reserve Commission, if the bill is established, it will checkmate the problems of herdsmen in the country and the establishment of grazing routes and ranches across the country could even reduce the menace of the Fulani herdsmen if not totally eradicated. The paper therefore propose a Search, Secure and Rescue GIS for the grazing routes and ranches land meant for herdsmen so that the farmers will not be able to tamper with their land.

2. WHY USE GIS IN GRAZING LAND ALLOCATION?

The basis of SSaR is a map, and GIS and geodatabase are vital tools in every aspect of SSaR by creating maps to both visualize and analyze territory so that developers and field teams can keep track of a persistent stream of information: point last seen of the herdsman; perimeter of the entire search and the individual segments each herdsmen is assigned to; clues such as footprints, a backpack or sunglasses found; and the pathway records of the herdsman and graze teams. Prior to GIS, searchers would use acetate overlays on top of Nigeria maps to record such dynamic information. Now all that information can be recorded, projected onto a map as needed, and then archived for future use. The use of computers, GPS devices, and GIS software is a major advance in operations and is critical to effective situational awareness by event command (EC) staff. When used effectively, GIS will improve operational proficiency in five primary areas:

Field Operations: Maps are the most important resource for field teams who are critical to the successful outcome of a search, security and salvage. The primary goal when using effective GIS on SSaR is to quickly create maps with the information needed by teams to effectively carry out their assignment. By using MapSSaR with ArcGIS, SSaR planners can enter vital information (Point last seen (PLS) i.e. where herdsmen or field operation seen last by a person or CCTV camera, description of missing herdsman, locations of grazing land, weather safety message, etc.) and, using the Data Driven Pages feature, quickly produce customized team maps so field teams can start to look for the missing herdsmen or personnel. Additionally, keeping track of grazing land and workers is a major logistical problem made much easier and safer using GIS and MapSSaR.

Data and Information Management: ArcGIS and MapSSaR will capture all the information and resource flow shown in figure 1. This is critical for an ongoing operation and also to archive data in an easily retrievable structure for later review. If a herdsman is not found, a standardized and organized data structure allows future searchers to know exactly what was done and the areas searched should the action be continued.

Planning and Analysis: GIS software can utilize a variety of basemaps in both 2D and 3D to better visualize terrain for planning, including standard digital Nigeria topographic quadrangles, satellite imagery, agency brochure maps, or any other type of map that helps you plan strategy for a search. GIS also allows analysis from simple calculation of segment size and length of trails to be searched to more complex tasks like using models to potentially predict how far a person might travel based on the actual terrain (e.g., slope, vegetation, and trail availability) that the person is traveling through.

Situational Awareness: In a networked computer environment, all groups at an event command post are able to view the operation on a projected and automatically updated map, which can be viewed on a common screen or on personal computers connected to that network. Event information can be displayed, such as PLS, search perimeter, segments, team deployments, team locations, clues found, graze land location, and availability status.

Rescue Operation: The event information, such as PLS, search perimeter, segments, team deployments, team locations, clues found, graze land location, and availability status can be used in rescue operation in locating the herdsmen, event personnel and even the livestock owns by the herdsmen.

3. TOOLS USED IN DESIGNING THE PROPOSED SYSTEM

Unified Modeling language (UML): The research involves the use of a descriptive conceptual approach which includes using Unified Modeling Language (UML) tools such as Use case models, activity diagrams & sequence diagrams for the design of the proposed system. The work will be implemented using the following:

ArcGIS Explorer Desktop: This is the free mapping software accessible from Esri's website. ArcGIS Explorer Desktop is a robust and flexible mapping viewer. The advantage it has over other related mapping software is that it can use shapefiles, which are the standard in the GIS community, to spatially represent the locations of points, lines, and polygons (for instance, roads, trails, and buildings). ArcGIS Explorer Desktop system also can download a wide variety of basemaps from Esri's free ArcGIS Online site (sign-up required), or you can use satellite imagery or Nigeria topographic maps available free from a variety of online sources. There is no proprietary data required. The maps and data you create can be exported to ArcGIS 10 for Desktop for more advanced analysis or uploaded to any ArcGIS Online group to be shared [3]

ArcGIS for Desktop: ArcGIS for Desktop is a software collection comprising of a group of GIS software products from Esri. The primary program that will be use is ArcGIS 10 for Desktop, which consists of ArcMap, ArcCatalog, and ArcToolbox. The SSaR teams might be able to obtain ArcGIS 10 at little to no cost, and a general overview of how to use it [6]

MapSSaR: MapSSaR works with ArcGIS 10 and it will be designed to capture SSaR's geospatial and incident information and then automate many of the mapping tasks. The goal of MapSSaR is to create an "enter once, use many times" data collection and workflow. Search progress can be viewed by operational period and the previous day's effort temporarily removed from the map to reduce visual clutter and possible distraction. Another great feature of MapSSaR is that it will incorporate the ArcGIS 10 Data Driven Pages feature. Once all the primary incident information has been entered and propagated throughout the database, the software automatically customizes a map for each team centered on its assignment area and with the assignment description, assigned radio call signs, weather, and other critical information printed on the map. MapSSaR works with ArcGIS 10 to help organize spatial data in a standardized format that fits the existing SSaR workflow and helps get search personnel out the door quickly, with maps in hand.

ArcGIS for Desktop and MapSSaR: To create a fully operative GIS proficiency for SSaR operations, both ArcGIS for Desktop and MapSSaR must be integrated together. The personnel should understand how to use MapSSaR in a more advanced level, which is integrated into ArcGIS 10 for Desktop.

MYSQL server: This will be used in storing data being captured during the preplanning of SSaR research especially the information about the herdsmen, filed teams' worker, ranches personnel etc., folder to store and backup copies of the database, map documents, or files. This is very important.

SSaR Information and Resource Design

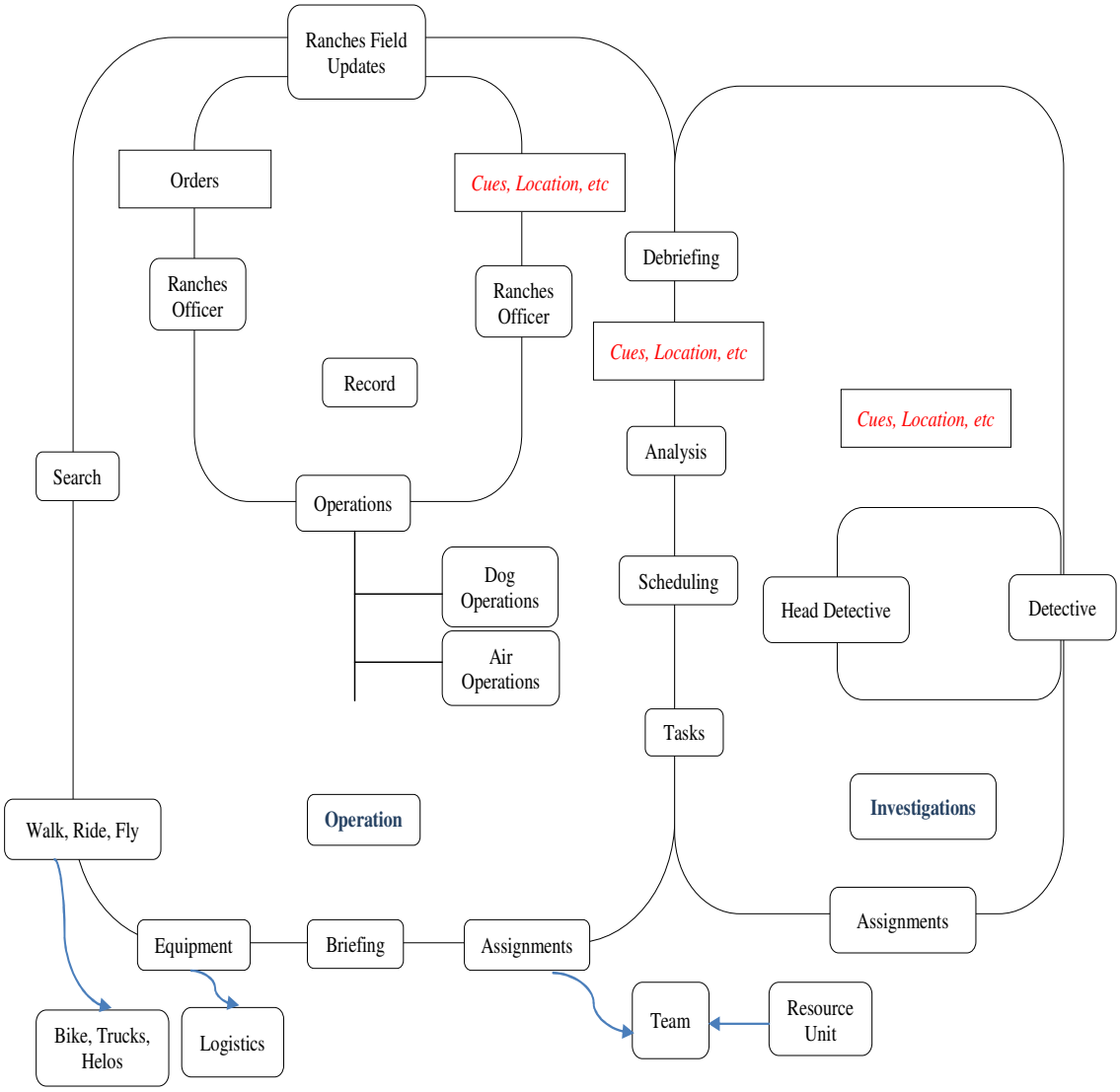

Fig. 1: Information & resource Flowchart for SSaR

Practically all phase of a search, secure and rescue consists of geospatial information, as well as other dynamic data (figure 1), that can be stored and represented graphically on a map of the search area. At its primary objective, the SSaR's task is saving lives and ranches and grazing lands. Using GIS on SSaR greatly enhances this task. It allows workers to collect, organize, and visualize complex information for more effective search strategies. Assets, Initial planning point (IPP), where the initial focus of the search is centered (This may be the PLS. The IPP may be used in the absence of a PLS. Once established, the IPP does not change.), subject information, reporting party information, team locations, clue locations, and track logs can all be gathered during an incident and then made immediately available to the Incident command post (ICP), the location at which the primary command functions are carried out (The ICP may be shared or located with the base or other incident facilities and is typically located at or in the immediate vicinity of the incident site. There is only one ICP established for each incident [3] [6]

4. DATA MODEL THEMATIC LAYERS

The map used for the data model contains many different layers or themes. These layers are road network, buildings, plantations, cross sections and many more. Using GIS effectively, the progression of the SSaR can be layered as shown in figure 1 and shown on planning maps, and specific data can be made visible or hidden to emphasize the different needs for the maps used in the field. Without the effective use of GIS on the SSaR, it is virtually impossible to keep track of the huge quantities of geospatial information coming in from such myriad sources as field groups, herdsmen, grazer workers, and plans. GIS can be used to better keep track of this mass of information, organizing it more efficiently and visualizing it more effectively to achieve a successful outcome maybe saving a life.

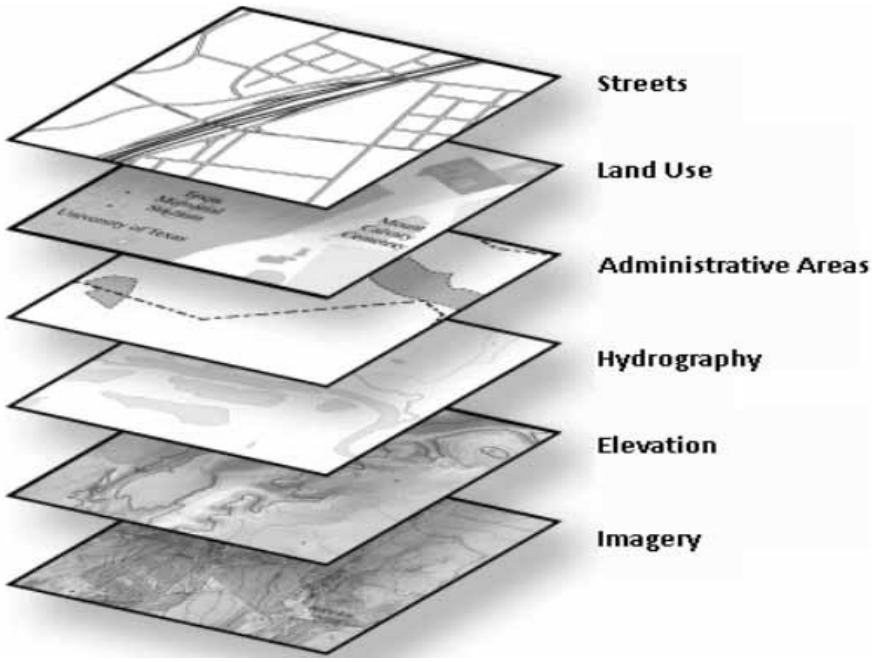

Figure 2: Data model thematic layers. GIS applies data and information in a layered structure, which also allows specific layers to be displayed or not, depending on what aspect of a SSaR needs to be visualized. Adapted from George &Vanessa, 2012.

5. STAGES IN THE DIGITAL MAP USING GIS DATABASE DEVELOPMENT

Developing a GIS database is frequently thought of as simply replicating a map in a computer. As can be inferred by the nature and detail of the activities recommended up to this point in this write-up, building a GIS database involves much more than "replicating a map." While substantial portions of the GIS database will come from map source documents, many other sources may also be used, such as aerial photos, tabular files, other digital data, etc. Also, the "map" representation is only part of the GIS database. In addition to the map representation and relational tables, a GIS can hold scanned images (drawings, plans, photos), references to other objects, names and places, and derived views from the data. The collection of data from diverse sources and its organization into a useful database requires development of procedures to cover the following major activities:

Source of Geography Information: This may include acquiring existing data from both internal and external sources, evaluating and checking the source materials for completeness and quality, and/or creating new data by planning and conducting aerial or field surveys. Often focused only on map source documents, this activity has been called "map scrubbing." Depending on the technology to be used to convert the map graphic image into its digital form, the source documents will have to meet certain standards. Some conversion processes require the map to be almost perfect which other processes attempt to automate all needed "fixes" to the map.

Converting to digital data: This is the physical process of digitizing or scanning to produce digital files in the required format. The major decision here is whether or not to use an outside data conversion contractor or to do the conversion within the organization. In either case, specifications describing the nature of the digital files should be prepared. In addition to including the physical database design, specifications should describe the following:

- Accuracy requirements (completeness required positional accuracy for spatial objects, allowable classification error rates for attributes).
- Quality control procedures that will be conducted to measure accuracy.
- Partitioning of the area covered by the GIS into working units (map sheets) and how these will be organized in the resulting database (including edge matching requirements).

Change control, most map series are not static but are updated on a periodic basis. Once a portion of the map has been sent to digitizing (or whatever process is used), a procedure must be in place to capture any updates to the map and enter these into the digital files.

Digital Map and Data Integration: Once digitizing has been completed, the sponsoring organization has a set of digital files, not an organized database. The system integration process (a subsequent guideline document) must take all the digital files and set-up the ultimate GIS database in a form that will be efficient for the users. The several considerations required for this process are covered under GIS Data Database Construction, GIS System Integration and GIS maintenance and use.

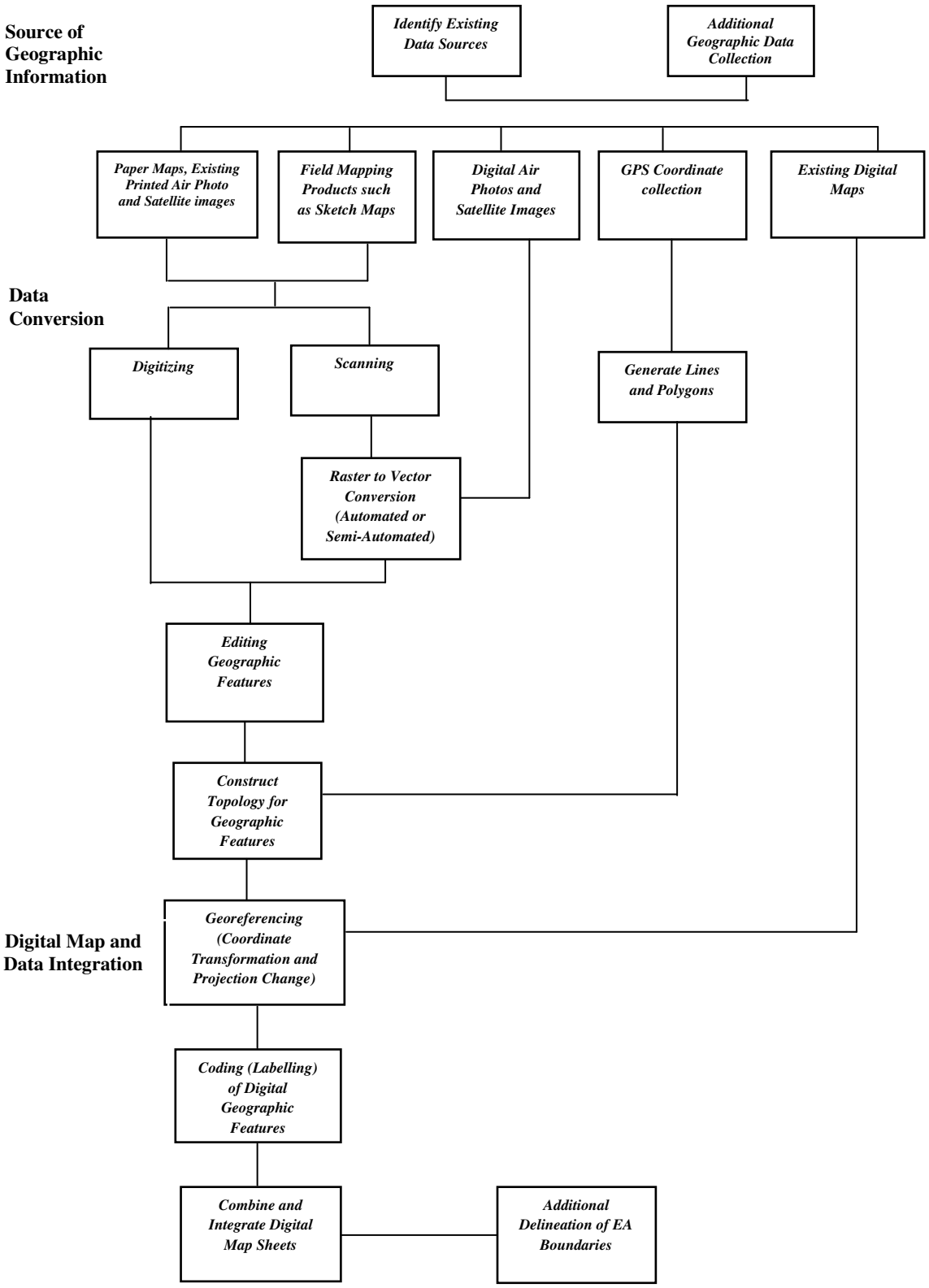

Figure 3: Stages in the Digital Map Using GIS database development

6. CONCLUSION

There is no contravening fact that there are tensions about ethnic relations in the country now over the incessant killing of farmers in their homelands by Fulani herdsmen, the only solution to this problems is the broached National Ranches and Grazing Reserve by the states in the country. But there is widely opposition to the creation of ranches and grazing reserve even before it is fully unveiled, with strong opposition to the takeover of individual and community lands across the country for the use of the Fulani herdsmen.

The computer offering a drastically different way to manage spatial data, with the used of GIS someone can easily represent a map on paper with a computer base system. The primary purpose of this paper is to develop geo-database for a spatial map that manage ranches and grazing reserve, it will search, secure and rescue the ranches lands. This phase (database design) of the GIS development process is to specify "how" the GIS will perform the required applications. Database planning and design involves defining how graphics will be symbolized (i.e. colour, weight, size, symbols, etc.), how graphics files will be structured, how non-graphic attribute files will be structured, how file directories will be organized, how files will be named, how the project area will be subdivided geographically, how GIS products will be presented (e.g., map sheet layouts, report formats, etc.) and what management and security restrictions will be imposed on file access. When design and fully implemented, the system will be very useful to both the ranches and grazing reserve owners and the herdsmen for locating ranches and grazing reserve in the nation; also this will help in search, secure and rescue the ranches workers, personnel and herdsmen, it will also help in making decision on the facilities on gazing reserve area.

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