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A THESIS REPORT ENTITLED

A MODEL FOR DETERMINATION OF COMPENSATION FOR COMPULSORILY ACQUIRED LAND IN GHANA

BY

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DECLARATION

I declare that this thesis is my own work. It is being submitted for the degree of Doctor of Philosophy in the University of Mines and Technology (UMaT), Tarkwa. It has not been submitted for any degree or examination in any other university

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Signature of candidate

27th day of May 2020

ABSTRACT

Compensation is at the heart of compulsory acquisition of land for development projects all over the world. Research shows that in developing countries, such as Ghana where most lands are customarily and privately owned, citizens abhor compulsory acquisition because compensation is seen not to be fair, adequate, and transparent and it is unnecessarily delayed. It deprives vulnerable groups of their livelihoods. This results in tension, tenure insecurity, litigation, destruction of property, loss of lives, poverty and delays in project implementation. This research set out to develop a compensation model that addresses the challenges in compensation in Ghana. The study employed remote sensing techniques such as satellite imagery and drone technology, Global Position System (GPS), Geographic Information System (GIS) and Open Data Kit (ODK) to map out and create a geo-database of major resources that need to be compensated when lands are compulsorily acquired. Focusing on a typical case study, focus group discussions with major stakeholders, interviews and extensive literature review across the globe revealed protocols and agreements were not in conformity with best practices. A cost centre template for compensation was designed, from which a mathematical equation was derived for compensation for agricultural products, improved market value model for land and buildings, and expected future returns on crops based on their economic life yields. A software was developed for efficient running of the model. The research identified 14 major crop resources, built-up and non-built-up areas across Ghana. Eight (8) protocols and agreements were developed. A multiple linear regression model was thus developed to address the challenges within the current compensation regime in Ghana. The results of the research formed a compensation package for compulsorily acquired land in Ghana (COMPACAL-G). The research is also useful for preliminary assessment of compensation at project conception stage for capital budgeting.

DEDICATION

Dedicated to my late father George Emmanuel Asenso-Gyamera who conscientiously taught me the value of education.

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I'll praise my Maker while I have breath
And when my voice is lost in death.
Praise shall employ my nobler powers,
My days of praise shall ne'er be past,
While life, and thought, and being last,
Or immortality endures. MHB 428, Psalm 146

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CHAPTER 1

INTRODUCTION

1.1 Background

In Ghana, more than 80% of the land is owned by customary tenure while land owned by the state is less than 20% (Adu Gyamfi, 2012). The population of Ghana has grown from 8.5 million in 1970 to 25 million in 2010, an increase of over 194% at an average growth rate of 4.7% annually (Obeng-Odoom, 2010).

In the wake of urbanisation and increasing demand for social infrastructure, the government has to provide public facilities and infrastructure that ensure safety and security, health and welfare, social and economic enhancement, and protection and restoration of the natural environment.

An early step in the process of providing infrastructure and public facilities is the acquisition of sufficient land. In some cases, several locations could be suitable for a facility such as a new government office, and the government may be able to purchase land at one of the locations through the land market. In other cases, specific land parcels may be required for large-scale projects such as route of a new road, rail line, airport, dam, harbour or mining. Such large parcels of land may not be available on sale at the time it is required.

"In order to obtain land whenever it is needed, governments have the power of compulsory acquisition. Government can compel owners to sell their land in order for it to be used for specific purposes. This power of government to compulsorily acquire private land is popularly referred to as "Power of Eminent Domain'' (Anon., 2008a). The constitution of Ghana guarantees the rights of individuals to own property, hence prompt, adequate and fair compensation must be paid if government wants to exercise the "Power of Eminent Domain'' to access land for public good.

Compensation is the amount of money and/or incentives or reimbursement required to put the dispossessed landowner in the same position as if his property had not been acquired. Under compulsory acquisition, landowners are deprived of their rights of ownership guaranteed under the constitution and must therefore be adequately compensated. Protecting landowners promotes land tenure security. The compulsory acquisition process therefore requires the right balance between the public need for land on the one hand, and the protection of rights of landowners on

the other hand (Anon., 2008a). Problems arise when compulsory acquisition and compensation are not done well, and may lead to:

(i) Litigation: appeals against unfair compensation processes may delay critical government projects and result in budgetary overruns;

(ii) Corruption: lack of a transparent process gives room for public officers to influence the amount of compensation; and

(iii) Tenure insecurity: Security of tenure is important in the land market, so if the process of compulsory acquisition and compensation is not done well, people lose confidence, even in the guarantees of protection granted by the constitution. People may be discouraged to invest in land.

Laws on compulsory acquisition and compensation are incoherent and inconsistent with the requirements of the constitution and international human rights laws, and there are loopholes in the laws and policies. Presently, there are 166 laws and subsidiary legislations that relate to land administration in Ghana. However, the most relevant to compulsory acquisition and compensation are: Land Administration Act, 1962 (Act 123), State Lands Act, 1962 (Act 125); and the Minerals and Mining Act, 2006 (Act 703). The Minerals and Mining Act, 2006 (Act 703) has, however, been amended as Minerals and Mining Act, 2015 (Act 900).

King and Sumbo (2015) reported that in some instances of compulsory acquisition, due process was not even followed, let alone payment of adequate, fair and prompt compensation. The document also contended that the 1992 constitution does not also define prompt, fair and adequate compensation. Individuals everywhere fear and abhor compulsory acquisition due to issues relating to compensation payment. Experiences show that if not properly handled, compulsory acquisition and compensation can cause alarming political and social disorders (Ghansah, 2010; Johnson, 2010).

Compulsory land acquisition and compensation, unless supported by clear institutional protocols, which are transparent and predictable, may result in unintended and undesirable conflicts (Wilbard, 2010). Anim-Odame (2011) stated “The greatest challenge confronting the Government of Ghana in the use of its power of compulsory acquisition to expropriate private interest in real estate is the inability to pay fair and adequate compensation promptly.

Meanwhile, the operative constitution in the country reinforces commensurate compensation based on the principle of equivalent reinstatement".

The acquisition and management of state lands have left in their trail several unresolved problems. Among them are the acquisition of lands far in excess of actual requirement, unpaid compensation in respect of some of the acquisitions, lack of intergenerational equity in the utilisation of paid compensation, change of use against the purpose of acquisition and optimising the use and economic returns of state lands (Larbi, 2008).

1.2 Statement of the Problem

Compulsory acquisition is the involuntary transfer of property of a private owner to the government. The state possesses the power to acquire private property for public use. The exercise of this "Power of Eminent Domain" must be done according to law. This means that, "compulsory acquisition power" extinguishes all proprietary titles, interests and other rights vested in the owners of the land, the laws of Ghana make provision for prompt, fair and adequate compensation payments to recompense the owners of the land (Adu-Gyamfi, 2012; Anon., 2008b).

In Ghana, the Land Valuation Division (LVD) of the Lands Commission (LC) is required to make an assessment of fair and adequate compensation. In practice, compensation tends to be based largely on the market value of the affected land, that is, the sum of money that the land might have been expected to realise if sold in the open market by a willing seller (Larbi *et al.*, 2004). However, as stated by King and Sumbo (2015), the definition of fair, adequate and prompt compensation is not well defined by the 1992 constitution, and the values from the LVD are always small (Mireku-Gyimah, 1997). Typically, there are differences in compensation determined by LVD and their counterparts in the private sector. There may have been some fundamental reasons for private sector valuers to be quoting higher amounts than the LVD (Anim-Odame, 2011). The process is perceived not to be transparent. Raschid-Sally *et al.* (2008) stated that the people directly affected by the Kpong and Akosombo dams in the Eastern Region of Ghana were not well informed about the planning and execution of the compensation processes.

The lack of standards in calculating compensation creates conflicting outcomes and allows corrupt officials to provide favourable compensation to those who are influential or offer bribes. The poor and vulnerable that have less negotiating power are likely to be disadvantaged (Anon.,

2008b). Akrofi and Whittal (2013) recommended that the general policy on compulsory acquisition needs review and payment of compensation requires further investigation. While compensation is based on financial equivalence of only the loss of the land and resources on it, it is argued that is not enough to replace only what the landowner would lose.

This research therefore aimed at addressing the problems in calculating compensation for compulsory land acquisition by government. Specifically, it determines a model and develops a computer programme for the exercise.

1.3 Objectives of Research

The objectives of the research are to:

(i) identify various resources on the land using remote sensing techniques, Global Position System (GPS) and Geographic Information System (GIS);

(ii) determine best practice agreements and protocols on compensation for land acquisition; and

(iii) develop a model for the estimation of fair, adequate and transparent compensation for compulsorily acquired lands.

1.4 Methods Used

The methods used for this research included:

(i) Review of relevant literature on compulsory land acquisition and compensation;

(ii) Use of satellite imagery, drones, aerial photographs and existing maps to identify various

resources on land;

(iii) Use of android mobile phones for field data collection;

(iv) Spatial data collection of land resources using GPS and Real

Time Kinematic (RTK) technologies through actual ground survey;

(v) Application of ArcGIS software to generate thematic layers of various resources

on the land;

(vi) Interviews and focus group discussions through direct interactions and administration of questionnaire;

(vii) Development of Protocols through case study;

(viii) Computation of compensation for various land resources using cost centre approach;

(ix) Development of computer programme, COMPACAL-G, using Visual Basic for estimation of compensation; and

(x) Testing the model using statistical analysis.

1.5 Facilities Used

The following facilities were employed for the research:

(i) Internet and library facilities from the University of Mines and Technology (UMaT);

(ii) Internet and library facilities from the Council for Scientific and Industrial Research Building and Road Research Institute (CSIR-BRRI);

(iii) Survey instruments (RTK, GPS) from CSIR-BRRI;

(iv) ArcGIS, STATA and Visual Basic from CSIR-BRRI.;

(v) Mobile phones, Open Data Kit (ODK) App; and

(vi) Drones (Phantom 4) from CSIR-BRRI).

1.6 Organisation of Research

This thesis is made up of six chapters. Chapter 1, the introductory chapter, gives a general overview of the study. Chapter 2 provides review of relevant literature about the study. Chapter 3 provides relevant information on the study area. Chapter 4 addresses both the materials and methods used to achieve the objectives of the study. The results are discussed in Chapter 5. Chapter 6 is on the conclusions from the study and recommendations.

CHAPTER 2

LITERATURE REVIEW

2.1 Concepts of Compulsory Acquisition

The term 'compulsory acquisition' is used to denote the various terminologies applied internationally including 'eminent domain', 'expropriation', 'compulsory purchase', 'land acquisition', and 'takings' among others (Ty *et al.*, 2013). It is a power possessed in one form or another by governments of all modern nations. This power is often necessary not just for meeting the social and economic development needs of local, state or national governments, but also for the protection of the natural environment against the excesses of private businesses (Akujuru and Ruddock, 2015).

Urbanisation has emerged as a major trend in the world economy and it is one of the most powerful irreversible forces of the world (Westman, 2007). As world population continues to climb and a greater concentration of the world's population continue to centralise, Rosenberg (2005) highlighted the density dilemma facing governments as 90% of the earth's population lives on approximately 10% of the land. For the first time on record, the number of people living in urban areas has exceeded the world's rural population (Satterthwaite *et al*., 2010). The United Nations (UN) projects that the world's urban population will grow by another 3 billion people by the year 2050, putting unprecedented demands on air, water, land and essential public services (Satterthwaite *et al.*, 2012; McDonald *et al*., 2011; Mc Granahan *et al.*, 2007; and Satterthwaite *et al*., 2012). The increase in population has in turn increased the need for land to develop infrastructure and buildings.

Underlying these transformations are complex processes that have gradually re-defined the ways in which land, labour and related resources *(e.g*., water, fishing, and mining rights) are governed for the purposes of commercial and industrial development (Seto *et al.*, 2012a and Roy, 2011). The first is a macro-economic shift away from primary production (in agriculture and resource extraction) towards manufacturing and services (Sassen, 2013; Seto *et al.*, 2012b and Satterthwaite *et al.*, 2012). The second is a process of global economic re-structuring whereby urban and peri-urban areas have emerged as important sites of production, processing

and exchange (Kim, 2011; Seto *et al.,* 2011 and Lin, 2001). The third, which is the focus of this research, is the acquisition and conversion of land for non-agricultural purposes. Driving this process, many governments and municipalities have used "eminent domain" land acquisition policy as a means of procuring land for commercial, educational, health, transport, agricultural and industrial development (Mahalingham, 2011; Chen, 2009; Roy, 2010 and Kim, 2011).

Allen (2000) discussed the importance of the State's ability to compulsorily acquire land for public good. Several authors have justified the need for governments to resort to compulsory acquisition of interests in land in developing economies (Ogedengbe, 2007; Onwuegbuzie and Leech, 2007; Kakulu, 2008 and Otegbulu, 2009). Palmer *et al*. (2009) stated that though there was variation between countries, the constitutions of many countries provided for both the protection of property rights and the power of the government to acquire land without the willing consent of the owner.

Public purpose or interest may be viewed in a broad or narrow sense by governments, depending on the socio-economic and legal environment of the particular country. The constitutions of some countries enumerate the activities and goals that comprise public interest, whilst others leave this for later determination.

Compulsory acquisition is inherently disruptive. Land acquisition indirectly produces effects related to wealth redistribution as farmers receive different levels of compensation (Ty *et al*., 2013). Even when compensation is generous and procedures are generally fair and efficient, the displacement of people from established homes, businesses and communities will still entail significant human costs. Where the process is designed or implemented poorly, the economic, social and political costs may be enormous.

The Food and Agricultural Organisation (FAO) outlines the principles for legislation on compulsory acquisition to include:

(i) Protection of due process and fair procedure: Rules that place reasonable constraints on the power of the government to compulsorily acquire land strengthen the confidence of people in the justice system, empower people to protect their land rights, and increase the perception of tenure security. Rules should provide for appropriate advance consultation, participatory planning and accessible mechanisms for appeals, and should limit the discretion of officials.

(ii) Good governance: Agencies that compulsorily acquire land should be accountable and exercise good faith in implementation of the legislation. Laws that are not observed by local officials undermine the legitimacy of compulsory acquisition. Good governance reduces the abuse of power and opportunities for corruption.

(iii) Equivalent compensation: Claimants should be paid compensation, which is no more or no less than the loss resulting from the compulsory acquisition of their land. Laws should ensure that affected owners and occupants receive equivalent compensation, whether in money or alternative land. Regulations should set out clear and consistent valuation bases for achieving this (Anon., 2012).

In a critical review of land acquisition and valuation processes across the world, Arul vikram and Murali (2015) made the following observations:

"Some countries have broadly defined provisions for compulsory acquisition while those of other countries are more specific. Constitutional frameworks that have broadly defined provisions concentrate on basic principles and often simply assert the power to compulsorily acquire land as the single exception to fully protected private property rights". For example, the constitution of the United States of America mandates that: "No person shall be deprived of property without due process of law nor shall private property be taken for public use without just compensation".

Similarly, Rwanda's constitution states: "Private property, whether individual or collective, shall be inviolable. No infringement shall take place except for the reason of public utility, in the cases and manner established by the law, and in return for fair and prior compensation." Such constitutions leave the details of compulsory acquisition to other legislation and, in some instances, to the interpretation of the courts. Other constitutional frameworks specify in detail the mechanisms by which the government can compulsorily acquire land. They tend to include a specific list of the purposes for which land may be acquired. For example, Ghana's constitution includes provisions detailing exactly what kinds of projects allow the government to use its power of compulsory acquisition and specifies that displaced inhabitants should be resettled on suitable alternative land. Chile's constitution identifies the purposes for which land may be compulsorily acquired, the right of property holders to contest the action in court, a framework for the calculation of compensation, the mechanisms by which the state must pay people who

are deprived of their property, and the timing and sequence of possession. Most countries supplement the constitutional basis for compulsory acquisition, whether broadly or specifically defined, with extensive laws and regulations.

National or sub-national laws usually describe in detail the purposes for which compulsory acquisition can be used, the agencies and officials with the power to compulsorily acquire land, the procedures to be followed, the methods for determining compensation, the rights of affected owners or occupants and how grievances are to be addressed. The regulations that accompany these laws may be particularly important as they often provide the acquiring agency with instructions on how to carry out compulsory acquisition during all phases of the process. The laws governing compulsory acquisition are part property law and part administrative law, which dictate governance procedures. Principles of administrative justice and good governance often require that such powers are bound by legal rules, which allow for hearings and appeals and are subject to judicial review.

2.2 The Concept of Compensation

Compensation in the context of land acquisition typically implies a process of reimbursing people for the loss of assets, incomes, security and wellbeing. For landowners, land acquisition involves the expropriation of individual land holdings, often in exchange for some form of financial compensation (Johnson and Chakravarty, 2013). Alias and Dand (2001) indicated the goal of compensation as an attempt to reinstate the affected persons to their former status prior to the acquisition, if not better. Zimmermann (2008) showed two forms of compensation – financial compensation and resettlement. Financial compensation is the payment of monetary equivalent of the property lost, as well as other associated losses to the affected persons (Shapiro *et al*., 2012). Resettlement as a form of compensation is the physical transfer of individuals or groups from their usual place of residence to another location by an external body. It must be preceded by the provision of housing, basic services and infrastructure, livelihood opportunities and security of tenure to displaced households in the new location (Maartje and Banerjee, 2013).

To achieve these goals of compensation, the FAO indicates certain principles that need to be fulfilled as follows (Anon., 2012):

(i) the principle of equivalence;

(ii) the principle of balance of interests;

(iii) the principle of flexibility;

(iv) the principle of equal application to *de facto* and *de jure* interests; and

(v) the principle of fairness and transparency.

The objectives set out in this research have adequately addressed these principles through the building of a Cost Centre (CC) for the variables that must be compensated for in a fair and transparent manner. An application of a customized App for effective electronic field data collection and the deployment of efficient spatial data collection tools to make information easily accessible for purposes of calculating compensation. The development of protocols and agreements ensure an inclusive and transparent process.

2.3 Valuation

The FAO guidelines for valuation and compensations recommend the following (Anon, 2008b):

(i) People should be compensated in such a way that they are not worse off than they were before the compulsory acquisition process started;

(ii) Regulations should be specific enough to provide clear valuation guidelines, but flexible enough to allow room to determine equivalent compensation in all situations;

(iii) Legislation should define a date for the valuation;

(iv) Valuation should be based on both *de facto* and *de jure* rights:
Compensation should be calculated on the basis of what would have occurred had the land not been acquired;

(v) The valuation should not reflect changes in the value of the land arising solely from the project itself;

(vi) If market value forms the basis of compensation, laws must clearly state how market value will be assessed and determined;

(vii) Valuation must take care for the loss of any land, and also for all improvements to the land

and crops, trees, and other natural resources;

(viii) Where communities lose access to sustainable resources such as forests, waterways or

grazing lands, they should be provided with replacements in kind or compensated for per capita yearly use;

(ix) Valuation must take into consideration disturbances and disruption, including removal, expenses and other costs, which result from the compulsory acquisition process;

(x) Valuation must consider the costs of any disturbance, disruption, or damage caused by the project on their remaining land;

(xi) Vulnerable groups should be provided with training or financial support if the acquisition results in the loss of their livelihoods;

(xii) The acquiring agency should take steps to ensure that there are sufficient number of independent valuers and advocates to help people to understand the valuation and assess their compensation claims;

(xiii) People should receive full payment of the agreed compensation sum in a timely manner after valuation is considered acceptable to claimants; and

(xiii) Possession should not be taken unless at least a substantial percentage of the agreed valuation is paid as compensation.

The process of valuation for compensation in compulsory acquisition of land takes place within distinct legal, cultural, socio-economic, political and historical environments, which influence the delivery of the process by key actors in it. The basic principles are perceived to be quite similar even though the practice may vary in different nations or regions. Determination of compensation has been the most controversial point when it comes to compulsory acquisition power. There are no clear laws regulating the regime of compulsory acquisition with respect to compensation. The ambiguity revolves around what constitutes just, fair or adequate compensation and the criteria used when government acquires properties such as lands for developmental purposes (Kakuku *et al*., 2009).

Other contending issues associated with the determination of compensation are as follows (Chaudhry, 2012; Ghatak and Mookherjee, 2011):

(i) Determining the value of land: The main question arises what amount is adequate for compensation, and what factors should be incorporated for determining the value of

land.

(ii) Amount of compensation: In many cases it is observed that payment of compensation amount for land resources is far below the actual investments made by landowners or farmers.

(iii) The manner of giving compensation: One-time payment of compensation is the current practice in most countries especially in developing countries. Now, the one-time payment is an issue, which should be thoroughly evaluated, with a search for alternative methods. The compensation and its mode of payment should not be one-time event and it must ensure the regular income of land-loser. Resettlement and Rehabilitation (R&R) should be taken care at the time of land acquisition.

(iv) Other benefits sharing (Ghatak and Mookherjee, 2011): Compensation can be decomposed into two parts - cash compensation and other benefits. Other benefits along with the cash compensation might be a possible solution—for example, allotting a part of the developed land or equity shares in commercial venture or offering jobs to the land-losers and displaced persons or the transfer development rights (Chaudhry, 2012). It may ensure proper rehabilitation and resettlement along with compensating for the land loss.

(v) Time frame for payment: The compensation should be paid within a time limit.

This research addressed the slow data collection process that results in delays in compensation payment. Apart from the transparent Cost Centre developed, the GIS database, the customized electronic Open Data Kit (ODK) App and the programme developed from the model, calculating compensation is made faster, more scientific, accurate and transparent. As a result, payments could be faster to ensure tensions and hardships on vulnerable groups are mitigated. The research also proposed other benefits apart from cash compensation especially for vulnerable groups to ensure sustained livelihood.

2.4 Forms of Compensation

2.4.1 Cash Compensation

Cash compensation can provide opportunities for opening family businesses and may even attempt to reduce agriculture-dependence. Amount of compensation is determined at current market price considering quality of land, location, access, etc. Cash compensation

disproportionately benefits some interest groups but not small and marginal farmers, or the landless workers (Chaudhry, 2012).

In line with the Sustainable Development Goals (SDG 1, 2, 8, 10, 15 and 16), it is incumbent on governments through state institutions to ensure the protection of such vulnerable groups. Institutions must put in adequate measures to ensure sustainable livelihoods after compulsory acquisitions.

2.4.2 Land for Land

The principle of land-for-land should be focused on compensation policies, especially for the tribal area. All the developed countries like the USA, UK, Denmark, *etc*. follow this principle. This principle is known as the 'land consolidation'. In this method, land is given to the land-losers and they can carry on agricultural activities, which definitely ensure food security for the country. Land is also an inheritable asset, which provide income for generations, and also ensures sustainability. Though the comparable area of land is provided as compensation, yet there may be the possibility that the land available to be provided as compensation is not of the same quality or productivity. It may require a lot of investment and hard work to make such a land of equitable productivity. Merely giving the alternative land without infrastructure and other facilities may not be useful to the farmer to whom it is given as compensation (Chaudhry, 2012).

2.4.3 Jobs for land

Apart from cash compensation for land, according to the requirement if any, appropriate jobs can be offered to the skilled or semi-skilled land-losers as an alternative choice of compensation. It should be mentioned that it is not only the landowner who actually suffers loss because of the land acquisition, but there are many other landless people who lose their means of livelihood attached to the land which is acquired.

2.4.4 Land Rent

Annual rent payment is another way of compensation to land users. However, rent fixing is another major challenge the market has not adequately addressed.

2.4.5 Provision of Subsidised Loans

The acquiring authority must take responsibility of assisting by way of subsidised loans to bring farmers to a similar position prior to acquisition. If alternative land is available to the farmer,

this can be done by way of provision of farm inputs like seedlings, fertilizer, extension services and farm maintenance. Such loans must be paid back when the farm begins to yield returns.

2.4.6 Provision of Equity

Where the acquiring authority intends to embark upon a business venture, dispossessed landowners may be given the opportunity to use part of their compensation package as equity in the business. In this way, victims of compulsory acquisition may be assured of sustainable livelihood.

This research was however restricted to the calculation of cash compensation but proposed alternative benefits for vulnerable groups. This was because one-time cash compensation has often been practiced in Ghana and other developing countries. Other forms of compensation are recommended for further research.

2.5 Resources and Losses to be Compensated

Interests to be compensated when urban land is compulsorily acquired are given under FAO guidelines and include: the land itself; improvements to the land, including crops; the value of any financial advantage other than market value that the person may enjoy by virtue of owning or occupying the land in question; and interest on unpaid compensation from the date of possession. Others are expenses incurred as a direct and reasonable consequence of the acquisition, loss in value to other land owned by the affected owner due to the project.

In some countries, the compensation will be reduced if the retained land increases in value as a result of the project, a condition sometimes referred to as “betterment” and legal or professional costs including the costs of obtaining advice, and of preparing and submitting documents.
Compensation must include; costs of moving, acquiring alternative accommodation, costs associated with re-organisation of farming operations and when only a part of a parcel is acquired. Also, loss in value of a business displaced by the acquisition or if the business is permanently closed because of the acquisition, temporary loss of earnings, personal hardship and other losses or damages suffered must be catered for. (Anon., 2009).

This research attempted to capture all costs and rights of the dispossessed landowner or farmer with the view to ensuring fairness and sustained livelihood for victims. Future benefits that must accrue to landowner were considered as an essential element of the compensation process.

2.6 Planning and Executing Compulsory Acquisition and Compensation

The generic process of compulsory acquisition and compensation is described as follows (Asiamah, 2015):

(i) Preliminary Stage:

This stage entails all activities that are undertaken prior to land acquisition. This mainly involves the planning of the activity and the interaction with the potential affected persons. The planning involves identifying the exact location, size, resources, and rights inherent in the land determined to be suitable for the project. Alternative sites are also explored with the help of the affected persons as well as alternative means of acquiring the land, such as through the open market.

(ii) Application for the use of Compulsory Acquisition:

After going through the activities of the preliminary stages as required by the law, the next stage is for the acquiring authority to apply for the use of the power of compulsory land acquisition. This application is made to a higher body, which may be an administrative, legislative or judicial body. Depending on the jurisdiction, the affected persons may be informed of this step.

(iii) Decision for use of Compulsory Acquisition power:

The higher authority so petitioned for the use of the power of compulsory acquisition determines whether the use of the power of compulsory acquisition is necessary. The standard here is usually to find out whether the overall benefit of the project outweighs the cost to the affected persons (Viitanen *et al.*, 2010).

(iv) Submission of claims and determination of Compensation:

When the acquiring authority has been granted the power to compulsorily acquire the property, it will then ask the affected persons to submit their claims for compensation. The rights of the various affected persons in the land are also determined. The land is then valued by the acquiring authority or another authorised body to determine compensation to be awarded. The acquiring authority then makes an offer to the affected persons. The affected persons may negotiate this.

(v) Payment of Compensation:

Where the compensation is monetary, the money is paid to the affected persons by the acquiring authority.

(vi) Change of ownership and possession:

After the compensation is paid, the acquiring authority then takes ownership and physical possession of the property.

It is clear from the above process that the natural bias rule must be applied (Peach, 2003 and Viitanen *et al.*, 2010a). The rule states, "No man shall be the judge of his own case". Therefore, the acquiring body should not be the one that has the final say with respect to whether the power is used.

The hearing rule also applies to the second stage of the process. The rule known as *audi altera partem*, literally meaning "hear the other party" refers to the need for the affected parties to be given the platform to be heard on the compulsory acquisition of their land. This form of hearing, if fair, will allow the affected parties understand and accept the need for the acquisition. This process is intended to curb the arbitrary tendencies that are associated with compulsory land acquisition and compensation (Asiamah, 2015).

The indicators for equity and justice in the process include prompt payment of fair and adequate compensation. The United Nations (UN) also shows the need for laws and regulation that help in shaping the process of compulsory acquisition and compensation, Anon (2009). The resulting compensation assessment should be clearly specified in the laws governing compulsory acquisition (Viitanen *et al*., 2010a).

Mostert (2003) emphasised the dissemination of and access to timely, important and accurate information to all affected persons and their representatives so as to provide a platform for their participation in the decision-making and collaboration with the acquiring authority. Information regarding the process should therefore be open to all members of the affected community.

The objectives set out in this research clearly addressed the planning and execution of compulsory acquisition and compensation as described by law and also addressed the challenges of arriving at fair and adequate values for compensation. This research used modern Remote Sensing technology that is able to undertake the site selection process at the preliminary stage of decision making. It provides best practice protocols and agreements that could ensure

satisfaction for the victims and promote a culture of sustainable livelihood beyond compulsory acquisition.

2.7 Practice of Compulsory Acquisition and Compensation in Sub-Saharan Africa

German *et al.,* (2013) carried out a study on contemporary processes of large–scale land acquisition in Sub–Saharan Africa. The study showed the relationship between practice and policy associated with customary rights protection of large-scale land acquisitions and case study analyses from Mozambique, Ghana, Zambia and Tanzania. The procedure followed for the land acquisition consisted of comparative assessment of stakeholder experiences across multiple studies. A set of parameters was framed for the policy analysis and they were followed differently in these four countries. For all types of land acquisition, there were provisions for persons displaced. Land revenues were to be shared between the Traditional Councils, Stools and District Assemblies according to a constitutional formula.

Where "public interest" projects (e.g., transport, energy or water supply lines) placed restrictions on existing land use, the public or private entity involved must compensate the title holder an amount corresponding to the value of the harm resulting from the utilisation of the affected area. Any person whose customary right of occupancy or recognised long-standing occupation or customary use of land was revoked had right to full, fair, and prompt compensation. Compensation was deemed to be for the value of un-exhausted improvements, loss of profits, which included transportation, accommodation and disturbance allowance.

In Ghana, in general, compensation for acquired land is determined by the Land Valuation Division (LVD) of the Lands Commission (LC) upon a claim. The various claims for which an expropriated owner may be compensated are:

(i) market value of the land taken;
(ii) replacement value of the land taken;
(iii) cost of disturbance; and
(iv) severance and injurious affection.

In practice, however, market values from LC are less. Cost of disturbance, severance and injurious affection are not seen to be effected or of no effect. Special requirements are imposed when it comes to expropriation for mining purposes.

This study through the building of "Cost Centre", integrated cost related to above variables (disturbance integrated costs or inconvenience), so as to make compensation adequate and fair to victims of acquisition. The land values determined by location and disturbance are cost variables that played critical roles in the calculation.

Currently, compensation figures are computed at the Head office of the Lands Commission and sent to the Regional offices. In certain instances, the Regional offices are not even in a position to explain the calculation to determine final compensation figures. The basis of arriving at the figures is always in contention. Thus, in this research, the formula for arriving at compensation figures are made clear and transparent such that a victim of compulsory acquisition can validate the figures and make meaningful negotiations if necessary.

2.8 Practice of Compensation in other Jurisdictions

In Ethiopia, for rural landholder or holders of common land whose landholding has been provisionally expropriated, compensation is based on lost income. It is calculated based on the average annual income secured during the five years preceding the expropriation of the land. Such payment shall not exceed the amount of displacement compensation. Compensation for permanent improvement to land is calculated based on the value of capital and labour expended on the land.

Factors for determination of compensation in Kenya are as follows:

(i) market value;
(ii) severance;
(iii) injurious affection;
(iv) expenses incidental to the change of residence or place of business caused by the acquisition;
(v) damage genuinely resulting from diminution of the profits of the land between the date of publication in the Gazette of the notice of intention to acquire the land and the date the Commissioner takes possession of the land; and
(vi) the compensation for disturbance is the amount determined according to previous rules in addition to 15% of the market value.

In Tanzania, the compensation for acquisition shall reflect market price of the land and exhausted improvements determined by comparative method, evidenced by actual recent sales or similar property or by use of capitalization of income approach or replacement cost method

when the property is of a special value. Compensation for loss of any interest in land shall include:

(i) value of unexhausted improvement disturbance allowance (calculated by multiplying value of the land by average percentage rate of interest offered by commercial banks on fixed deposits at the time of loss of interest in land);

(ii) transport allowance (actual costs of transporting 12 tons of luggage by rail or road within 20 km from the point of displacement);

(iii) accommodation allowance (market rent for the building multiplied by 36 months); and

(iv) loss of profits (net monthly profit of the business carried out on the land shall be assessed, evidenced by audited accounts and multiplied by 36 months).

If the compensation remains unpaid for more than 6 months from the acquisition of land, the interest corresponding to the average percentage rate of interest offered by commercial banks on fixed deposits shall be payable until compensation is paid.

The Government of Bangladesh is empowered to acquire the land under two conditions: (1) Every citizen has the right to hold, acquire, dispose or otherwise transfer the property, (2) Provide for the acquisition with compensation and fix the amount of compensation to be paid.

Various types of acquisition laws are followed in Bangladesh. In 1976, the Government of Bangladesh established the District Land Allocation Committee (DLAC) and a Central Land Allocation Committee (CLAC). The Requiring Body (RB) and Acquiring Body (AB) under these two committees acquire the land. Under the compulsory Land Acquisition Law, 1982, market value is taken for the valuation purposes. Sometimes there may be increase of 20% from market value (50% in some cases). Under this law, there is no obligation for relocation (Atahar, 2013).

In Finland, compensation is based on the market value of the land and resources on it. Depreciation value is calculated if only part of the land was expropriated; disturbance compensation is paid mostly for occupiers for costs and expenses incurred by moving and provision is made for equitable accommodation or land for the owner. However, there are still challenges with establishing a reasonable amount of compensation.

In New Zealand, additional compensation is paid for loss of future profits, valuation, legal and other professional costs incurred by the landowner. In South Africa, the amount of compensation for land acquisition shall be just and equitable, reflecting an equitable balance between the public interest and the interests of those affected, having regard to:

(i) market value;

(ii) actual financial loss incurred;

(iii) solatium (additional benefits);

(iv) the current use of the property;

(v) the history of the acquisition and use of the property;

(vi) the extent of direct state investment and subsidy in the acquisition and beneficial capital, improvement of the property; and

(vii) the purpose of the expropriation.

Ghimire *et al.* (2017) carried out a study of gaps in land acquisition for infrastructure projects. The study was based on desk study using the experiences of the cases in infrastructure development projects in China, India, Malaysia, Nepal and Norway. In this study, three main issues for identifying the gaps in land acquisition and compensation were:

(i) laws and regulations,

(ii) procedure for land acquisition and compensation, and

(iii) land valuation approaches for compensation.

The major gap identified from the study about the situation in Nepal was the implementation aspects of land acquisition, compensation and land valuation system in reference to good governance principles namely; public participation, access to information, transparent procedure and stakeholder consultation.

The market value is followed for the compensation of land in countries like United Kingdom (UK), Zambia and Kenya (Arul vikram *et al.*, 2015). In UK, one of the results of new road construction is often a reduction in the price of nearby properties. Property owners can be compensated for this loss through the Land Compensation Act. The appropriate level of compensation is currently determined by valuers and is mainly based upon their expertise and skill.

Lake and Lovette (2000) carried out a study to determine what the correct level of compensation should be. It was specifically designed to fulfill the requirements of current legislation and could be integrated into existing compensation procedures. This was achieved through a hedonic pricing (HP) study that related current property prices to a wide range of factors. These variables included the structure, neighbourhood, accessibility and environment of the property, in addition to the impact of nearby roads. These were all created through GIS and large-scale digital data. The study, which was based on over 3500 property sales in Glasgow, Scotland suggested that property prices were depressed by 0.20% for each decibel increase in road noise. This result has enabled a more streamlined compensation procedure to be developed and demonstrated that compensation claims could be estimated at the road-development stage.

Ty *et al.* (2013) carried out a study on the policy and praxis of compensation for land expropriations in China. The land acquisition in China was mainly based on the notion of public interest. The Government paid the compensation, which took three elements into account, namely, (1) resettlement allowance for the displaced peasants, (2) compensation for the land and (3) compensation for lost crops. The amount of compensation payable to these collectives could not be higher than 30 times as much as the value of the land's average output over the previous 3 years.

In the context of institutional problems in the legal and administrative framework in Trinidad and Tobago, the compensation was one of the main problems for the affected landowners and entities in the process. In many cases, the Government had acquired and used private properties before compensating the landowner. In many circumstances, the public were paid years later from the date of settlement and it cost additional interest of 9% per annum. The process may have involved problems of ownership and delays in the compensatory negotiation process (Huggins *et al*., 2013).

It is clear from literature that in establishing a reasonable amount of compensation for compulsory land acquisition, there is the challenge with the scientific calculation of market or economic value and by extension, the compensation values. Given the importance for socio-economic development, it is surprising that the conceptual and empirical literature on compulsory acquisition is focused mainly on developed countries.

Meanwhile, access to land is one of the frequently mentioned constraints to private sector investment in developing countries. Land issues are deeply rooted in histories of countries and

are often sensitive politically, implying that attempts to address them need to be solidly grounded in empirical research, often building on carefully evaluated pilots (Bell, 2007).

Development policy must focus on creating economic opportunities, which increase the demand for transferring land from primary to secondary or tertiary activities, without ignoring income security of landholders (Dinda, 2016).

Thus, in this research, a scientific means of calculating a reasonable amount of compensation for compulsorily acquired lands is to be developed through the COMPACAL-G model to address concerns raised in various literature, including compensation for inconvenience, contingency and loss of future income.

2.9 Methods of Data Collection of Resources on Land for Compulsory Acquisition

Modern scientific tools can be used to resolve the problems confronting compensation in compulsory acquisition of land in Ghana. Information, Communication and Technology (ICT) has become a tool to drive value creation, improve efficiency and delivery of services in the global community. By computer applications, calculating compensation for compulsory land acquisition in Ghana will be made easy, fast and transparent. The following are modern and efficient ways of data collection and processing to improve land acquisition and compensation processes:

2.9.1 Satellite Imagery Technology

Satellite imagery technology is a very useful application for capturing spatial data. Satellite images are remote sensing data that provides information for monitoring in many applications such as land cover classification. It has become a cheap means of obtaining spatial data through online mapping applications like Google Earth (Varshney *et al*., 2015).

Businesses and Agencies are collecting 2-D and 3-D locational and attribute data points at all times using satellite-imaging techniques on the surface of the earth. The value of satellite imagery is its availability and automated processing. Satellite images are useful for analysing land use management, land inventory and land use database. Moody *et al.,* (2017) used satellite image technology for crop identification in South Dakota and also to map corn and soy crops in the state of Mata Grosso, Brazil.

In this research, satellite imagery technology was applied to cover entire study area for resource classification so that rural areas where maps were not readily available could easily be captured. Satellite imagery was used to identify built up areas in terms of housing, urbanisation and physical development.

2.9.2 Unmanned Aircraft Vehicle (UAV)

The increased speed and automation that Unmanned Aircraft Vehicle (UAV) provides permit surveyors to safely take on and complete jobs in less time. UAVs popularly referred to as "Drones" are capable of producing equivalent results as traditional tools without the heavy lifting, walking and exhaustion. It has added advantage of a 3-dimensional, spatial coverage, and the ability to collect, process, store and relay data on their own in real time (Sorenson *et al*., 2017 and Ng and Sharlin, 2011).

Drones have more advantages over ground survey methods (Wang *et al*., 2015). However, its use is restricted to low altitude remote sensing for thematic land classification (Natesan *et al*., 2018). UAVs have become a valuable source for research and education that could be used for inspection, surveillance, mapping and other data acquisition applications (Alkabi, and Abuelgasim, 2017).

The drone technology was applied to map the case study area in this study to achieve objective (i) of this research. Its speed, reliability of data and pictorial presentation of features were some of the benefits recorded.

2.9.3 Global Navigation Satellite System (GNSS), Total Station and RTK

The GNSS refers to a constellation of satellites providing signals from space that transmit positioning and timing data to determine location. By definition, GNSS provides global coverage. The Real Time Kinematic (RTK) positioning is one of the most popular topics in civilian applications. Normally, RTK can be used to collect the land use change in urban areas as well as positioning.

The classical terrestrial methods, such as total station systems, can be used to aid RTK, where there are challenges with bad weather conditions and forest cover. The collected land information can be entered into an existing land information system. The land use of the interested region could be classified into a certain number of groups from Geographic Information System (GIS), Lin (2003). An RTK survey will yield absolute positions in real time with no post-processing at the end of the field day, thereby increasing speed of survey delivery.

Benefits of conducting an RTK survey include sub-10 cm position accuracy calculated in the field during the survey, rather than at the end of a survey or back in the office. RTK surveys, however, require careful preplanning, a large amount of equipment, and few obstructions in the field area.

This research will use these useful modern data acquisition technologies to capture spatial data as a means of validating map data from the remote sensing data. They increased the speed and accuracy of spatial data capture. The process enabled data to be easily transmitted to a server for data processing.

2.9.4 Geographic Information System

Another important step in calculating compensation in land acquisition is the inventory of resources on the land. Conventionally, inventory of resources is taken on the basis of physical visitation to the land. The location is presented on a paper map in graphical form. In the process of representing features, many details or data often get filtered away. Moreover, data retrieval gets challenging, especially where there are large volumes of information to be represented. The map is only a static qualitative document and extremely difficult to attempt quantitative spatial analysis.

GIS is an effective tool for capturing, storing, checking, integrating, manipulating analysing and displaying data that are spatially referenced (Saheed *et al.*, 2006). The combination of spatial and non-spatial data in GIS makes its benefits in the compensation process invaluable. Another challenge in compensation is the determination of land prices. According to Yang *et al*., (2015), GIS is a useful tool for serving Land Price Information (LPI).

With GIS, a list of all affected parcels together with relevant attributes can be extracted from the database to enhance transparency in operations where there are overlapping mandates, and highlights gaps in the whole acquisition process (Kamunyu *et al.*, 2015). Lake and Lovette (2000) created variables for compensation for a road project in a GIS because many of the variables that needed to be calculated were inherently spatial.

GIS can examine the relationship between these variables and the potential to improve the calculation of these variables. It has the ability to query what is at a certain location, for example, the location, ownership, area and resource related to a parcel. However, potentially important variables such as number of tree crops or storeys in a building cannot be easily defined.

This research will make extensive use of GIS to create relevant map layers for resources identified on land in Ghana to achieve the first objective. The GIS served as an effective decision support system for the study.

2.10 Visual Basic Computer Programming

Computer simulation is a powerful alternative approach to solve numerical iteration using a high level language of interest. Simulation is a very useful research tool and is a legitimate, disciplined approach to scientific investigation and its value needs to be recognised and appreciated. Simulation analysis offers a variety of benefits; it can be useful in developing theory and in guiding empirical work. It can provide insight into the operation of complex systems and explore their behaviour. It can examine the consequence of theoretical arguments and assumptions, generate alternative explanations and hypothesis and test the validity of explanations.

Numerical analysis is concerned with the mathematical derivation description and analysis of methods of obtaining numerical solution of mathematical problems with little or no error resulting from approximation. It can also be referred to as that branch of applied mathematics, which studies the methods and algorithms to find (approximate) numerical solutions to various mathematical problems using a finite sequence of arithmetic and logical operation. It is a process of repeating a set of instruction, a specified number of times until a specific result is achieved (Hassan *et al*., 2009).

In front of this textual language of basic programming is a well-thought-out graphic user interface, which allows the programmer to construct windows and all their corresponding components such as buttons, slider bars, and menus, by selecting graphic icons and dragging them onto a graphic representation of a window. The programmer then writes textual source code fragments that are essentially event handlers for the different possible mouse and keyboard events. This code is linked to the graphic representation of the window, so that instead of scrolling through long files of source, a programmer can access relevant code by clicking on a physical location. In other words, the interface provides, first of all, a way of constructing the framework of a user interface by manipulating graphic objects, and, second of all, a way of spatialising access to the textual code that needs to be written.

The application of these data collection and processing tools in compulsory acquisition and compensation ensures transparency and speed of the processes involved in calculating fair compensation.

Visual Basic is the programming language to be used for coding in this research. The visual studio was used to develop the front end or the interface. Visual basic, together with other database management systems will help to build the database structure into physical files optimized for speed and efficiency.

2.11 Mathematical Models for Valuation and Compensation

Mathematical models are usually composed of relationships and variables. “Operators” such as algebraic operators, functions, differential operators *etc.* can describe relationships. Variables are abstractions of system parameters of interest that can be quantified. Several classification criteria can be used for mathematical models according to their structure. If all operators in a mathematical model exhibit linearity, the resulting mathematical model is defined as linear. A model is considered non-linear, otherwise.

A model requires certain inputs. The system relating inputs to outputs depends on other variables such as:

(i) decision variables;

(ii) state variables;

(iii) exogenous variables; and

(iv) random variables.

Decision variables are known as “Independent variables”. Exogenous variables are the constants or parameters.

Valuation methods are mathematical models of how opinion of land and its resources or property values can be formed (Kauko, 2004). Various models have evolved over the years to address the weaknesses in one another.

2.11.1 Market Valuation Models

Market valuation methods or models such as replacement cost approach, market comparison and income capitalisation have featured prominently in the assessment of market value compensation for land expropriation (Alemu, 2012; Famuyiwa and Omirin, 2011 and Sumrada *et al*., 2013).

The outline of what constitutes adequate compensation for land expropriation and analytical insights into such perceptions include market value plus value of specific disturbances suffered in connection with expropriation (Alemu, 2012; Nayak, 2000; Omar and Ismail, 2009). Market value takes into account the bargaining strength of parties in the transaction (Wyat, 2007). Market value models are used to determine the most likely selling price of a property.

Alemu (2012) designed a model as follows:

$$\text{Total Compensation} = MV + \textit{other claim} + \textit{Premium} \qquad 2.1$$

where: MV = the market value

Other claims represent disturbance, severance and injurious affection,

and *Premium* represents other payments above market value.

Kauko (2004) described the Disturbance – Integrated Compensation Model (DICM) as:

$$Tc = MVk + WTACd \qquad 2.2$$

3where: Tc = total compensation

MVk = the market value

WTACd = the contingent value of disturbance entitlements

Ataguba (2014) developed a prototype of a Disturbance-Integrated Compensation Model which enhanced compensation for the proposed Bugesera International Airport in Rwanda, as compared to the assessed market value compensation. Data for the design of the model included spatial information of acquired parcel, market valuation report of properties, interview responses and compensable entitlements. The model is conceived using Analytical framework for the valuation of landed properties.

Whereas there is a theoretical underpinning that disturbance integrated compensation model is drawn from the perception of what constitutes adequate compensation for land acquisition, it is unknown how disturbance entitlements arising from land acquisition can be valued using economic valuation models, let alone their integration with market value of real estate as a formal method of assessing compensation for land acquisition (Ataguba, 2014).

2.11.2 Economic Value Model

Economic Value Model is a combination of fair value and subjective value (Blume and Rubenfield, 1984 and Chang, 2013). Wyat (2007) also described the macroeconomic concepts of valuation. Whereas an Economic valuation theoretically leads to full compensation, it has been criticised (Chang, 2013).

2.11.3 Current Value Model

Chang (2013) stated that the Current Value Model was not a good form of compensation because it could not be higher than market value.

Other forms of valuation models for land acquisition are Replacement cost, Rent, Resettlement and land for jobs as described under forms of compensation in section 2.4 of this report. Scholarly literature on land valuation and compensation models acknowledge the need for the expropriator to pay full and adequate compensation, including market value and disturbances (Alemu, 2012; Alias and Daud, 2006; Norell, 2008; Omar and Ismail, 2009).

However, there are still gaps in how to monetise a collection of objective and subjective disturbance entitlements (Cernea, 1988; Chang, 2013 and Kusiluka *et al.*, 2011). There is also a challenge in integrating market value of real properties for the purpose of achieving equivalent value of land rights and other intangible rights affected by the acquisition. These models value expropriated property for compensation but the outcome of the valuations do not actually reflect the meaning of fair and adequate compensation to the affected party (Viitanen *et al*, 2010b).
It is obvious that these models were targeted at the land and the buildings on them. Little attention was paid to the resources like food and cash crops. The economic value of these resources for sustainable livelihood to many victims of compulsory acquisition and the country cannot be underestimated. Unfortunately, many victims belong to the vulnerable groups in the country, especially in rural communities.

It was important to develop a model that enhances compensation package that takes care of all the entitlements of the land loser to ensure fairness, adequacy and sustained livelihood. The gaps in existing models necessitated the formulation of COMPACAL-G, a computer programme that calculates realistic compensation for compulsorily acquired lands in Ghana.

In this research, the defining equation was formulated in terms of elementary algebra derived from a Cost Centre. The Cost Centre took care of all the variables in building the compensable resource. The model also considers the expected future returns that might be lost as well as sustainable livelihood for vulnerable groups.

CHAPTER 3

STUDY AREA

3.1 Location and Geography

Ghana is located in West Africa on the Gulf of Guinea, with a total land area of 238 538 km^2 that consist of 227 538 km^2 of land and 11 000 km^2 of water (Briney, 2017; Anon., 2018a; Anon., 2015a and Anon., 2009). It lies between latitudes 4° 45' N and 11°N, and longitudes 1° 15' E and 3° 15' W. Geographically, Ghana is closer to the centre of the earth than any other country. Ghana has a 2 420 km land border with Burkina Faso (602 km), Cote d'Ivoire (720 km) and Togo (1 098 km) (Anon., 2018a). The Greenwich Meridian, which passes through eastern England, also runs through the eastern half of Ghana, cutting the coast at the port of Tema (Boateng, 1966).

Ghana consists of sixteen regions, namely Ashanti, Brong-Ahafo, Bono-East, Oti, Savannah, North East, Ahafo, Central, Eastern, Greater Accra, Northern, Upper East, Upper West, Volta, Western North and Western (Figure 3.1). Lake Volta, the largest artificial lake on the planet dissects the country as seen in Figure. 3.1. The horizontal width of Ghana is approximately 329.21 km and the vertical Length is 557.7 km (Anon., 2018c). Within the country, the Northern and Savannah Regions have the largest land area, almost a third of the total land area of Ghana (29.5%) while the Greater Accra occupies the least land area of 1.4%. Nearly 50% of Ghana lies less than 152 m above sea level. The country's highest point, Mount Afadjato, rises 880 m; its lowest point is the Gulf of Guinea at 0 m (Anon., 2018c).

Ghana's coastline stretches 539 km along the Gulf of Guinea in the Atlantic Ocean. A tropical rain forest belt (central and east) broken by heavily forested hills and many streams and rivers, extends northward from the coastline. To the north of this region, the country varies from 91 m to 396 m above sea level and covered by low bush, park-like savannah, and scattered grassy plains. The forested regions of the country extend northward from the south-west coast on the Gulf of Guinea in the Atlantic Ocean 320 km and eastward for a maximum of about 270 km with the southern part of Ghana being a primary location for mining of industrial minerals and timber (Anon., 2018b).

The eastern coastal belt of Ghana is warm and relatively dry, while the southwest corner is hot and humid, and the north, hot and dry. The climate of Ghana is generally warm because its location is only a few degrees north of the Equator. The nature of the climate is mostly tropical and comprises two main seasons: the wet season and the dry season. May through June and August through September are two distinct rainy seasons in the south. The rainy seasons in the northern regions on the other hand tend to merge. Harmattan, a dry northeasterly wind blows in January and February. The average annual rainfall in the coastal zone is 33 inches (83 cm) (Blakeney *et al*., 2012; Anon., 2012a). Annual average temperatures range from 26.1 °C in places near the coast to 28.9 °C in the extreme north (Anon., 2016).

Ghana encompasses plains, waterfalls, low hills and rivers. There are four discrete geographical regions. Low plains stretch across the southern part of the country. The Ashanti uplands, the Akwapim-Togo Ranges, and the Volta Basin are three regions occupying the north of the low plains. The fourth region, which comprises of the high plains, resides at the northern and northwestern sector of the country (Anon., 2018b).

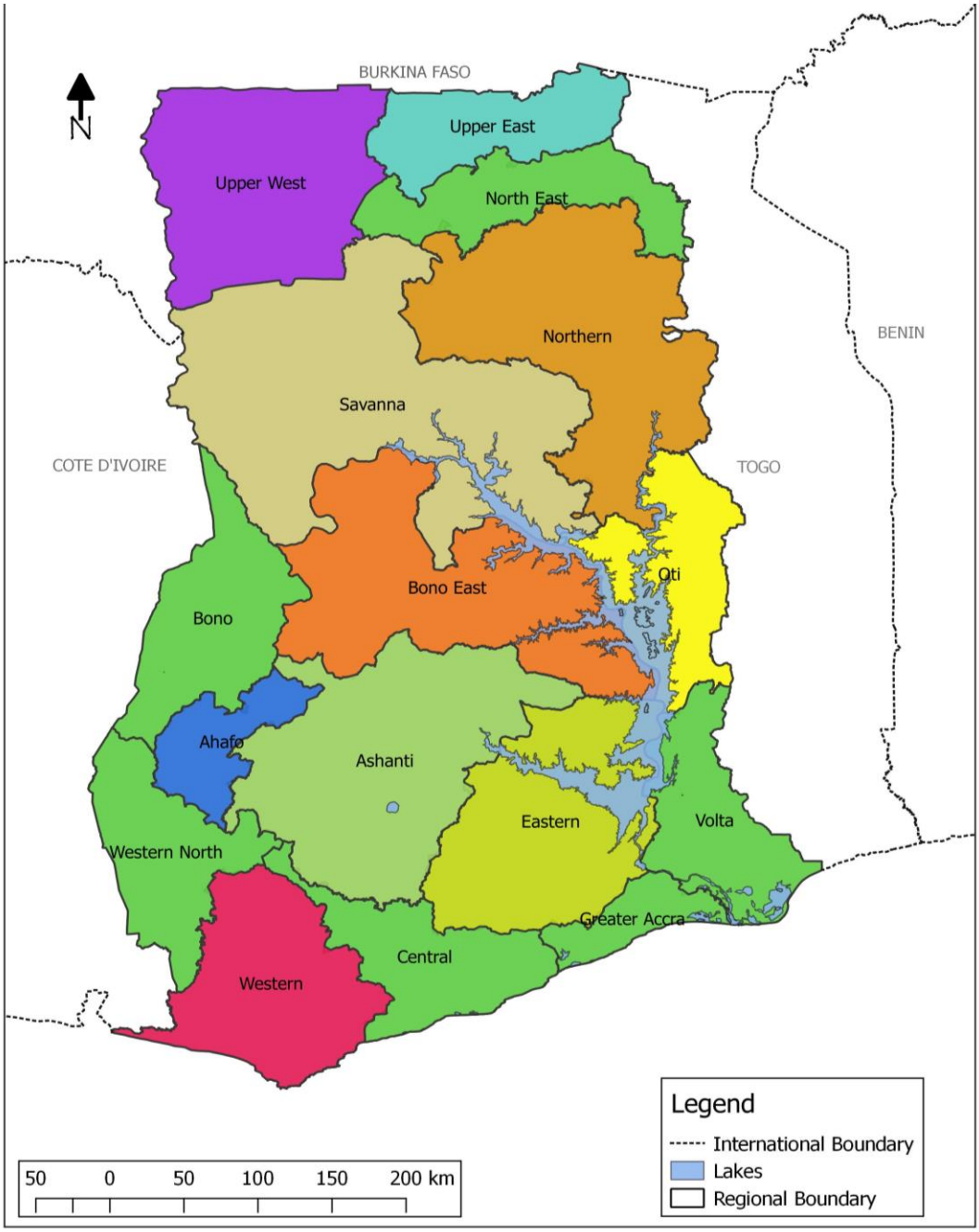

Figure 3.1 Political Map of Ghana showing the Sixteen Regions

3.2 Demographics

Ghana recorded a population of 24 658 823 in 2010. The population was 6 726 815 in 1960 and it increased to 18 912 079 in 2000. Hence, the population increased more than three times between 1960 and 2010, a period of fifty years. There was a record of 30.7% increase from the year 2000 to 2010. The highest increase between censuses over the 50-year period was 53.8% and this occurred between 1984 and 2000. Therefore, the average annual growth rate between 2000 and 2010 was 2.5% (Anon., 2013a).

The population of Ghana as projected from the 2010 Population and Housing Census by Ghana Statistical Service in 2016 was 28 308 301. Currently, Ghana's population is estimated to be 29 376 623 as of May 2018, based on the latest United Nations estimates (Anon., 2018d). This population is therefore equivalent to 0.39% of the total world population. The population density increased from 29 persons per km^2 in 1960 to 103 persons per km^2 in 2010. However, the current population density in Ghana is 129 per km^2 (Anon., 2018d).

Ghana has a young age structure, with approximately 57% of the population under the age of 25 and the median age is estimated to be 20.5 years. Its total fertility rate fell significantly during the 1980s and 1990s but has stalled at around four children per woman for the last few years, with 3.94 children born to every woman in rural areas and 2.78 to every woman in urban areas. The ratio of the population living in urban areas has more than doubled in the last five decades, expanding from 23% in 1960 to 51% in 2010.

The sex ratio of 102.2 males per 100 females recorded in 1960 declined to 95.2 males per 100 females in 2010. The proportion of the population under age 15 also decreased from 45% in 1960 to 38% in 2010, while the proportion of the population age 65 years and older increased from 3% to 5% over the same period (Anon., 2014a and Tekpli, 2013).

Over the last five decades, life expectancy at birth has increased from 38 years to 60 years among males and from 43 years to 63 years among females (Anon., 2013a; Anon., 2011a and Anon., 2006a). Better health care, nutrition, and hygiene, and reduced fertility have increased Ghana's share of elderly persons. Ghana's proportion of persons aged over 60 years is among the highest in Sub-Saharan Africa (Anon., 2018e). The rate of urbanisation estimated for the period of 2010 to 2015 was 4% per annum, which is recorded as one of the highest among developing countries (Anon., 2011b).

The Ghanaian population is made up of several ethnic groups, with the Akans constituting the largest group (48%), followed by the Mole-Dagbani (17%), Ewe (14%), Ga-Dangme (7%), and others (14%). From the 2014 population estimates, the Ashanti, Eastern, and Greater Accra regions out of the sixteen (16) regions of the country together constituted about 50% of the country's population. Upper East was the least populated region, accounting for 2% of the total population of Ghana (Anon., 2012b). Internally, poverty and other developmental disparities continue to drive Ghanaians from the north to the south, particularly to its urban centres.

3.3 Economy

The structure of the Ghanaian economy has seen significant changes over the past two decades. The agriculture sector, previously the largest contributor to the Ghanaian economy, has been overtaken by the service and industry sectors. By 2014, the service sector was the fastest growing sector of the economy, contributing 52% of the gross domestic product (GDP), followed by the industry sector at 27% and the agriculture sector at 22%. In 2014, the service sector recorded its highest growth of 6%, followed by the agricultural sector with 5% growth and the industry sector with 1% growth (Anon., 2015a).

Ghana is a middle-income country, which experienced impressive economic growth from 2005 to 2012. This growth has slowed significantly since 2013 in light of macro-economic challenges, such as high budget deficit and inflation, but is still expected to remain positive, due to the country's stable democratic institutions and rich natural resources. The 2014 real annual GDP grew by 4% compared with 7% growth recorded in 2013 (Anon., 2015b). About half of the economically active population is engaged in agriculture. A high proportion of the employed population of Ghana works in the informal sector, the majority being self-employed (Anon., 2014a).

Ghana is an average natural resource enriched country possessing industrial minerals, hydrocarbons and precious metals. It is an emerging designated digital economy with mixed economy hybridisation and emerging market with 8.7% GDP growth in 2012 (Anon., 2018c). The leading export commodities of Ghana are cocoa, gold and timber.

Recently, the economy has diversified to the export of non-traditional commodities such as pineapples, bananas, yams and cashew nuts. The tourism industry also contributes substantially to the country's economic growth. The industry has been the third largest foreign exchange earner after merchandise exports and remittances from abroad and has become one of the most important and fastest growing sectors of the Ghanaian economy (Anon., 2007).

Per capita GDP reached US$ 1 858 in 2013, and the Human Development Index (HDI) improved as access to health care and education increased, making Ghana one of the few 'medium human development' countries in the region. Ghana halved extreme poverty from 36.5% to 18.2% between 1991 and 2006, achieving one of the best records in Sub-Saharan Africa. Furthermore, Ghana has met the Millennium Development Goal 1 (MDG1) of halving poverty and hunger before 2015 (Anon., 2013b).

Though poverty has declined in Ghana, it remains pervasive in the northern regions, which is susceptible to droughts and floods and has less access to transportation infrastructure, markets, fertile farming land, and industrial centres. Over the past decade, the government of Ghana has embarked on various economic and poverty reduction programmes designed to improve the living conditions of its inhabitants. The Livelihood Empowerment against Poverty (LEAP) programme was introduced in 2007 and in 2008, the poor began to receive cash support on a monthly basis. Nevertheless, over a quarter of the population still remains below the poverty line of US$ 1.25 per day (Anon., 2018f).

After a severe collapse in the 1970s, the Ghanaian economy began a recovery in the 1980s that continued through to the 2000s and slowly regained some of its lost potential. Buoyed by high commodity prices for nearly a decade and the advent of oil production in 2010, the economy grew, on the back of related investments in mining and oil. The growth was from an average of 6.5% in the 2000s to 15% in 2011 (non-oil GDP growth in 2011 was about 8%) before slowing down to about 7% in 2013. This rate was comparatively higher than the sub-Saharan African average growth rate of 4.2% (Anon., 2015b).

The country, however, has an economic plan target known as the "Ghana Vision 2020". The plan envisions Ghana as the first African country to become a developed country between 2020 and 2029 and a newly industrialised country between 2030 and 2039. Ghana's economy also has ties to the Chinese yuan renminbi as Chinese investments continue to rise (Anon., 2018f).

The Ghanaian economy is moving away from agriculture in terms of GDP (about 22% of Ghana's total GDP) but still employs more than half of the Ghanaian workforce. From the 2012 report of the Worldwide Governance Indicators, the country counts on an improving environment for democratic governance, coupled with a gradual improvement in the effectiveness of public institutions and persistent economic growth.

3.4 Agriculture

Ghana produces a variety of crops in various climatic zones which range from dry savannah to wet forest and which run in east-west bands across Ghana (Clark, 1994). Ghana's agriculture has been subsistence since independence and basically depends on the weather. Agriculture has been the backbone of the Ghanaian economy since independence in 1957 (Wayo Seini and Nyanteng, 2003; Aryeetey, 2007; McKay and Aryeetey, 2004), until 2014. According to

Ministry of Food and Agriculture in Ghana, out of a Total Land Area (TLA) of 23 853 800 hectares, Agricultural Land Area (ALA) represents 56.9% (Anon., 2016a).

Agriculture is predominantly on a smallholder basis in Ghana and the main system of farming is traditional, with hoe and cutlass as the main farming tools. About 90% of farm holdings are less than 2 hectares in size, although there are some large farms and plantations, particularly for rubber, oil palm and coconut and to a lesser extent, rice, maize and pineapples (Amissah, 2018). Out of the total agricultural land area, only 7 846 551 hectares (57.6%) are under cultivation leaving 5 781 628 hectares (42.4%) uncultivated. Also, only 30 269 (0.2%) of the agricultural land area is under irrigation (Anon., 2016b and Anon., 2010a).

The sector has grown significantly since 2007, benefiting from high international prices, particularly for its main exports such as cocoa (Anon., 2014b). Despite this growth, agriculture remains largely rain-fed and subsistence-based, with rudimentary technology used to produce 80% of total output (Anon., 2018g).

The country's main agricultural commodities include cocoa, cassava, yam, banana and maize, as well as other cereals and fruits as seen in Figure 3.2. Oil palm, rubber, cotton and coconut are also important cash crops. Production of food crops by smallholders has increased in recent years but is still characterized by low productivity. Ghana is a net importer of agricultural products, importing mainly consumer-ready commodities. Ghana's principal agricultural exports are cocoa, timber, horticultural products and fish/sea foods, whereas the principal agricultural imports are wheat, rice, chicken (frozen), milk and fish (Anon., 2018d).

The Agricultural sector is also expected to play a critical role in the achievement of the fundamental objective of the Sustainable Development Goals 1 and 2; to end poverty in all its forms everywhere, end hunger, achieve food security and improved nutrition and promote sustainable agriculture (Anon., 2014c). Figure 3.2 is a map of a moderate resolution image land cover types in Ghana showing agricultural products.

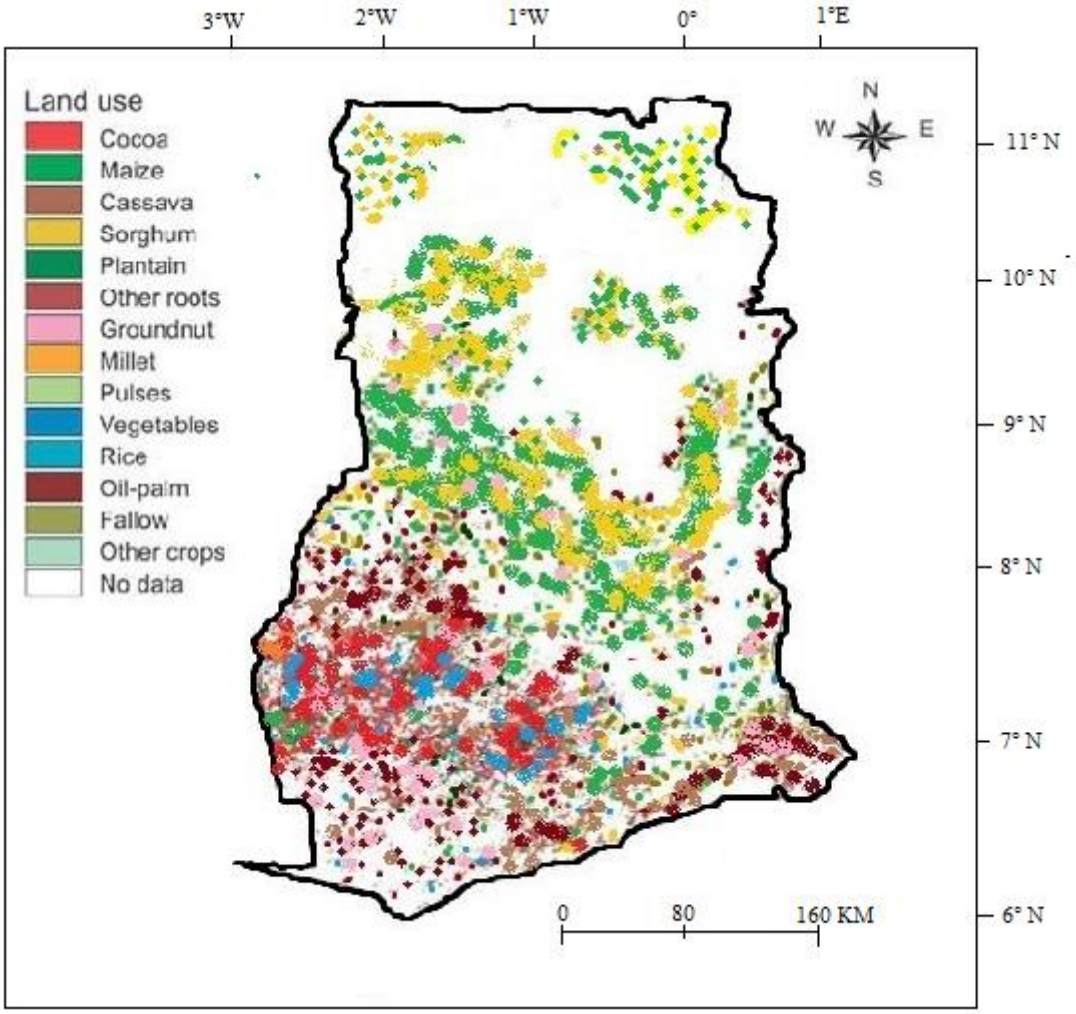

Figure 3.2: Map of Major Agricultural Products in Ghana

Source: Anon. (2018i): NASA- Moderate Resolution- Imaging- Land Cover type

3.5 Geology

Ghana is situated mostly within the West African craton, which stabilised during the early Proterozoic period some two billion years ago (Grenholm, 2014). Large areas were folded, faulted, metamorphosed, and subjected to igneous activity, erosion and sedimentary processes, giving rise to a structure of gold belts in a series of tectonic processes.

The country is divided into five geological domains or provinces namely; western unit, south eastern unit, the flat lying central unit, the coastal basins and tertiary to recent deposits. These divisions are based on age, tectonics and lithologic characteristics (Kesse, 1985). The main mineral deposits in the country comprise gold, diamonds, bauxite, manganese and iron ore (of medium quality). There are also deposits of tin, titanium and impure graphite. Sporadic occurrences of lead, copper, molybdenum, tungsten, niobium, barytes and asbestos are known.

The presence of uranium, cassiterite, platinum, molybdenite and tantalite has been reported. Large deposits of some industrial minerals are also known (Anon., 2003).

Deposits are variable and structurally complex, featuring gold that occurs in both quartz-filled shear zones and in altered rocks adjacent to shear zones. The metamorphosed volcanic belts in which they are found average between 15 km and 40 km in width and cover approximately one-sixth of Ghana's surface area. The bulk of Ghanaian gold is derived from Birimian rocks. The second category is Tarkwaian gold. Auriferous quartz-pebble conglomerates deposits occur within the Tarkwaian super-crustal rocks of Ghana. The matrix is fine-grained quartz and black sands (mainly hematite, and to a lesser extent, ilmenite, magnetite and rutile), and over 90% of the pebbles are vein-quartz, and the balance, quartzite and phyllite. In short, Ghana is covered by the paleoprotoerozoic rocks of the Birimian super group and the overlying clastic sedimentary Tarkwaian group (Ralph, 2013; Adjei *et al*., 2012 and Hayford *et al*., 2008).

Geologists today place gold deposits into one of two general categories. The first of these is Birimian gold. The Birimian supracrustal rocks of West Africa, which extend from Ghana westwards to Senegal and Mauritania, and northwards into Burkina Faso, are richly endowed with Proterozoic greenstone-type gold lode deposits (Dzigbodi-Adjimah and Bansah, 1995).

As a result of a series of erosional events, however, significant portions of rocks have been re-deposited as placer formations in a number of streams and channels. Placer gold deposits, which are also referred to as 'alluvial gold' are found in majority of rivers. Large deposits of placer gold also occur along the terraces, flood plains, channels and river beds of the Offin, Pra, Ankobra, Birim and Tano rivers, where large Birimian and Tarkwaian gold deposits have experienced several episodes of erosion and subsequent deposition. Small-scale gold mining is for the most part confined to these areas, since most operators lack the requisite mechanised equipment to mine hard rock deposits of the Birimian and Tarkwian belts (Kesse, 1985 and Yendaw, 2011).

3.6 Mining

Ghana is endowed with substantial mineral resources and has a well-established mining sector, which has grown considerably in recent years (Anon., 2010b). The mineral production potential of Ghana is largely due to the country's favourable geology (Hinde, 2010). Mining thus tends to be one of the spatially more concentrated economic activities in Ghana as seen in Figure 3.3. In 1960, over 96% of mining employment was located in Western, Eastern and Ashanti regions.

By 1970, the proportion was 94%. Currently, one half of all mining employment is in the Western regions and one third is in Ashanti.

Ghana is the second largest gold producer in Africa after South Africa, the third largest African producer of aluminium metal, manganese ore and a significant producer of bauxite and diamond (Coakley, 1999). The mining sector sustained an average contribution of 5.5% to Gross Domestic Product (GDP) and 42% of total merchandise export during 2000 to 2008 (Anon., 2010b). In 2016, however, the industry was faced with challenges of unstable gold prices and energy crisis, leading to under performance, and downsizing operations in Ghana (Kingson, 2018).

The country has a long tradition of gold mining with an estimated 2 488 metric tonnes (80 million ounces) of gold produced between the first documentation of gold mining in 1493 and 1997 (Kesse, 1985; Amponsah-Tawiah and Dartey-Baah, 2011). The Ghanaian small-scale mining industry is over 2 000 years old (Hilson, 2001 and Hayford *et al*., 2008). Residues of alluvial gold extraction and winning activities have been located since the sixth century, and there is a wealthof evidence demonstrating that precious metals recuperated from regional artisan activities were attracting Arab traders to the country as early as the 7th and 8th centuries AD. The rich gold deposits of the Western Sahara were principally responsible for the wealth and strength of large ancient Ghanaian empires and cultures (Botchway, 1995).

Across Africa, in countries with rich mineral reserves and barren economies, thousands of the unemployed dig for fortunes operating illegally and unregulated (Harkinson, 2003). These miners earn a living at great threat to their lives. Ghana's small scale/artisanal sector employs about 300 000 people most of whom are stark illiterates and employ very primitive methods in mining at the expense of their lives and the environment. The opposite can be said for the large-scale mining sector, which uses highly mechanised equipment and thus employ very few but highly skilled individuals. Therefore, the small scale/artisan miners and the large-scale miners are the two main players in the industry.

The major gold producing companies in Ghana are: Goldfields Ghana Ltd (Tarkwa and Damang mines); Anglo Gold Ashanti (Obuasi and Iduapriem mines); Kinross Mines (Bibiani), Golden Star Resources (Bogosu/Prestea and Akyempim mines), recently Redback Mining Ltd (Chirano mine) and Newmont Ghana Gold Ltd (Ahafo and Akyem mines). Ghana Bauxite Co. Ltd. (GBC) operates the country's only bauxite mine at Awaso, just as Ghana Manganese Company

Limited Nsuta-Wassa's open pit mine remains the only significant producer of manganese ore in the country. Ghana Consolidated Diamonds (Akwatia mine) is also the only operating diamond mine in Ghana.

The structure of the mining industry appears pyramidal. At the apex of the pyramid are a few large companies from Canada, Australia, and South Africa and in recent time the United States. There are, however, lesser investors from the United Kingdom, Norway and China. In terms of nationality of ownership, 85% of the industry is owned by foreigners and the rest by the state of Ghana and several small scale Ghanaian operators largely due to the legal restriction of small scale mining to nationals (Akabzaa and Darimani, 2001).

Between 1986 and 2006, the Mineral and Mining Law, 1986 (PNDCL.153) was the basic mining legislation in Ghana. While it was regarded as a trailblazer in terms of mining legislation in Sub-Saharan Africa, changes in the international mining scene necessitated its revision. After a protracted review from the early 2000s, the current Minerals and Mining Act, 2015 (Act 900) became the governing legislation for Ghana's minerals and mining sector.

Mining has played a major role in the establishment of communications networks and urbanisation. Railways built in the early part of this century to link Obuasi and Tarkwa to the coast also opened up new mines. The historical importance of mining in the economic development of Ghana is considerable and well documented, with the country's colonial name Gold Coast, reflecting the importance of the mining sector, particularly, the gold trade to the country (Arah, 2015 and Akabzaa, 2000).

The main environmental problems identified with mining and processing in Ghana are water pollution, land degradation, air pollution and other socio-economic problems such as land-use conflicts and loss of livelihood for farming communities. Mining and processing lead to land alienation in Ghana. It was estimated in 1990 that 1 166 sq. km of land (0.5% of the country's total area) had been alienated by industrial mining. The total disturbance to land due to the direct effects of mining was approximately 60 km^2, assuming that each of the new mines was fully developed (Arah, 2015).

The mining industry remains a priority area for Foreign Direct Investment (FDI) in most developing countries with mineral resources (Weber-Fahr, 2002). The mining sector of Ghana received priority attention unrivalled by any other sector in the country under the Economic

Recovery Programme (ERP) in 1983. Apart from the general macro-economic policy reforms for the country, there were specific sector policy reforms that sought to boost investor interest in the mining sector. For instance, between 1984 and 1995, there were significant institutional development and policy changes that offered generous incentives to investors to reflect the new paradigm.

The establishment of the Minerals Commission in 1984, the promulgation of the minerals and mining code in 1986, the promulgation of the small-scale mining law in 1989 and the establishment of the Environmental Protection Agency in 1994 were all to boost the mining industry in Ghana. In addition to the regulatory framework developed via the laws and institutions, generous incentives were provided to foreign investors to boost foreign direct investment in mining. For example, corporate income tax on mineral production of private companies in Ghana decreased from 50-55% in 1975 to 45% in 1986 and 35% in 1994 (Campbell, 2003; Akabzaa and Darimani, 2001). Between 1983 and 1998, the mining industry brought approximately US$ 4 billion in FDI to Ghana, representing more than 60% of all such investment in the country. The mining sector is credited with bringing in a significant amount of foreign exchange earnings, employment generation, mineral royalties, employee income, taxes payments *etc*. It is noteworthy that mining's contribution to GDP increased from 1.3% in 1991 to an average of about 5.2% between the years 2001-2004 (Anon., 2006b).

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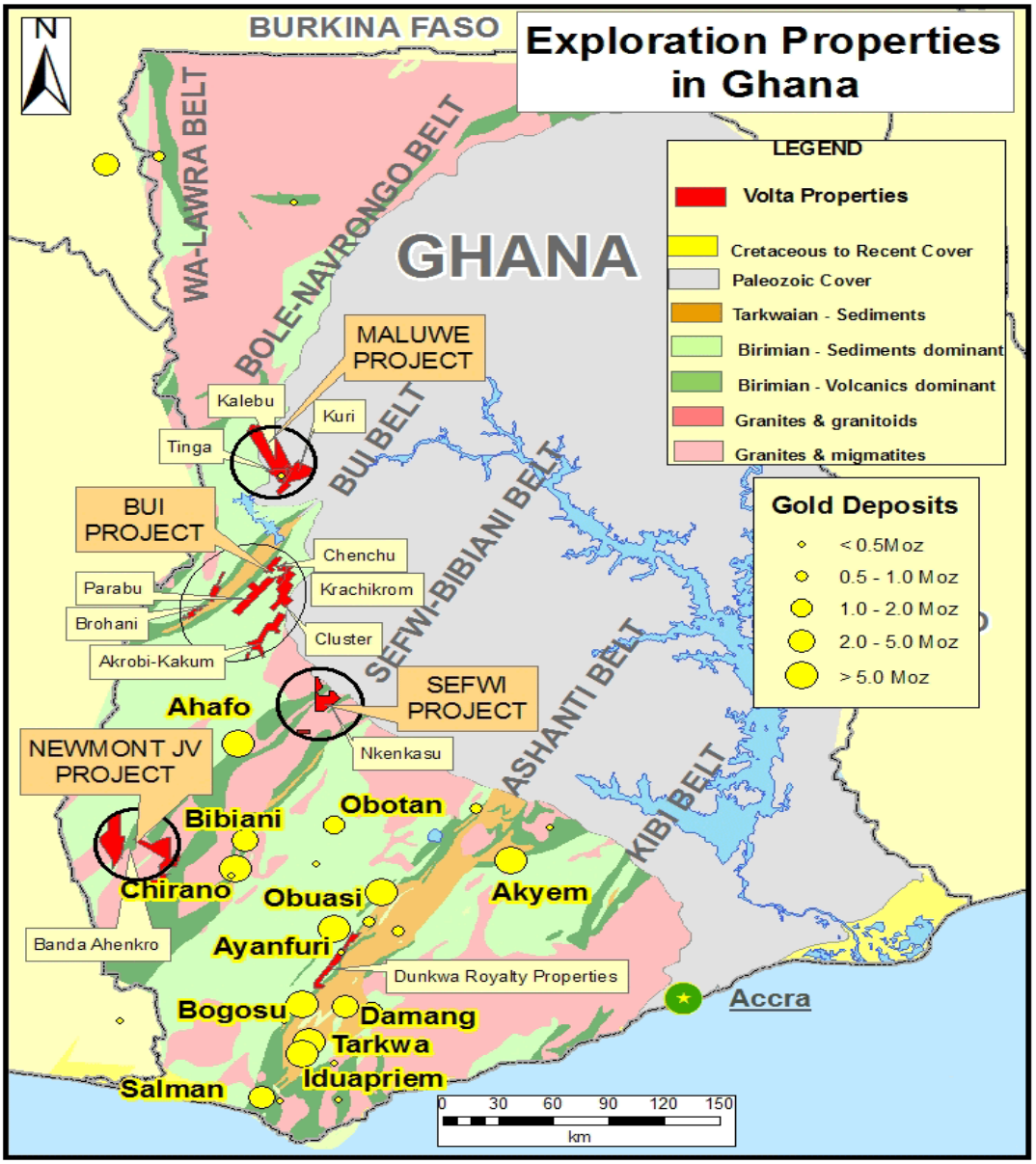

Figure 3.3 Mining Areas and Geological Map of Ghana

Source: Anon. (2018h): Ghana Maps

CHAPTER 4

MATERIALS AND METHODS

4.1 Materials

Materials used for the research were as follows:

4.1.1 Hardware

The following hardware were used:

(i) Global Position System (GPS) Receivers;

(ii) Phantom 4 drone;

(iii) Android mobile phone;

(iv) Garmin handheld GPS;

(v) Workstation with
Processor: Core i3 with at least 2.7 GHZ
Hard disk: Minimum 100 GB
RAM: 4 GB or more; and
Operating system Windows 10.

4.1.2 Software

The following software were used:

(i) ArcGIS;

(ii) Visual basic;

(iii) Microsoft MySQL;

(iv) Stata; and

(v) Open Data Kit APP

4.1.3 Other data

(i) Remote sensing imageries for spatial data;

(ii) Data from websites and agencies; and

(iii) Topographical maps

4.2 Conceptual Framework of Research

Figure 4.1 shows the conceptual framework of the research. Primary and secondary data were collected and stored unto a workstation. Land resources database was generated by means of ArcGIS. Data integration was undertaken, and a GIS database created. A Cost Centre (CC) was built for the various land resources and the compensation model developed. A programme was developed for easy and efficient management of the database for the COMPACAL-G model.

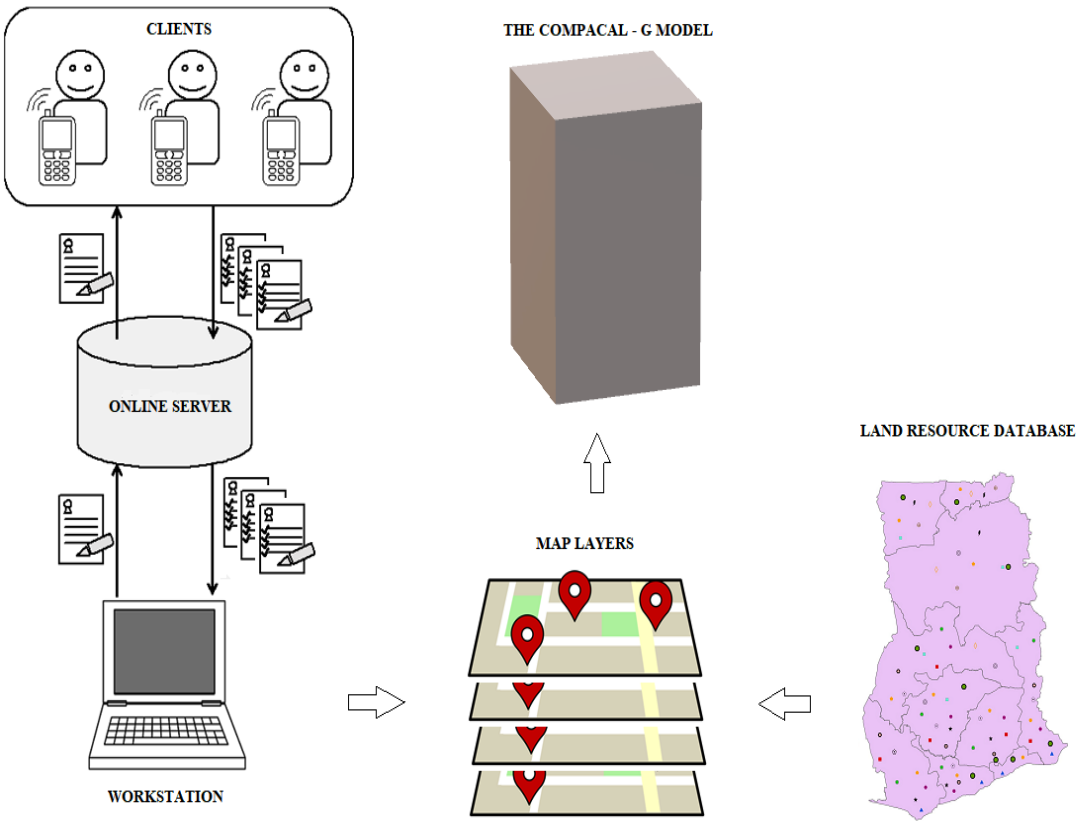

Figure 4.1 Conceptual Framework of Research

Figure 4.2 shows the COMPACAL-G implementation framework. The framework starts with the identification of the project for which acquisition of land is needed. A preliminary investigation is required for site selection suitability analysis. At this stage, secondary data is useful to take a preliminary decision. This stage also enables an acquiring authority to understand the kind of resources to be compensated for. With COMPACAL-G land resource database, it is possible to obtain preliminary estimates at this stage of decision-making. When the site selection is done, the primary data collection can proceed together with desktop studies.

In this research, identifying resources defines objective 1. The second objective is achieved from assessing and adopting the right protocols and agreements towards implementing

compulsory acquisition and compensation determination. The implementation process must begin with the necessary protocols by the acquiring and implementing authorities.

When a decision is finally taken for the acquisition to take place, the legal framework is initiated in consultation with state institutions. The Lands Commission is required to undertake stakeholders' consultation, carry out assessment and projected compensation. This stage of the process still requires protocols and agreements with key stakeholders to arrive at a consensus. This stage which defines Objective 2 in this research is very important and must be handled with utmost professionalism.

The third stage of the implementation is the compensation calculation, which satisfies Objective 3. However, the second and third stages form a continuum, in that the protocols and agreements must continue by way of consultation with stakeholders. This is to ensure that dispossessed owners are reasonably satisfied with the process and package regarding their compensation

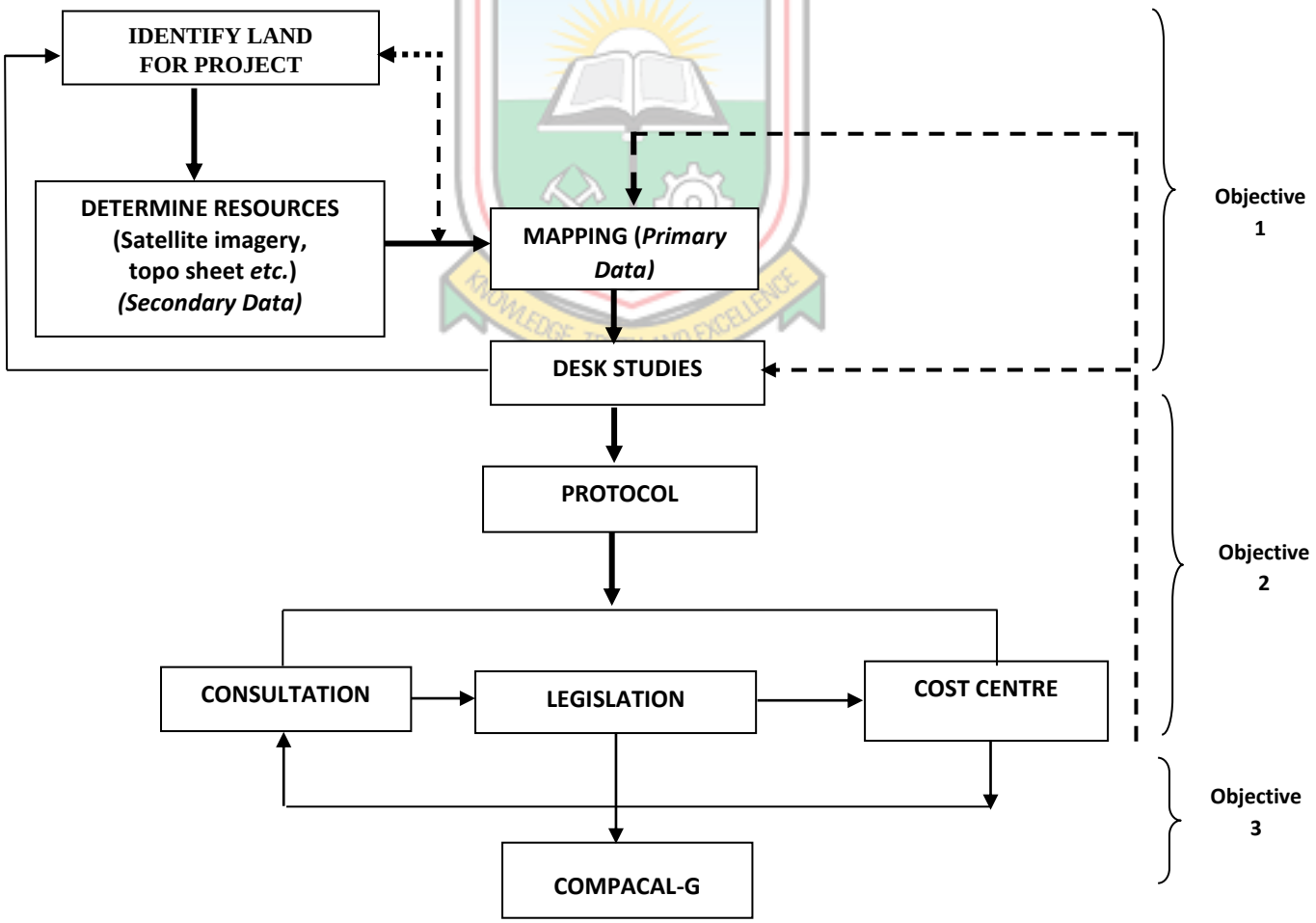

Figure 4.2 COMPACAL-G Implementation Framework

4.3 Determination of Land Resource

4.3.1 Data Collection for Land Resource Geo-data Base

Land cover is a fundamental variable in many scientific studies such as resource investigations (Chen *et al*., 2018). The use of classification is an efficient way to extract land cover information from remote sensing images (Fritz *et al*., 2009). Remote sensing and other survey applications were employed to determine compensable land resources. By means of satellite images, pixel-based classification approach was used to extract land cover information from different remote sensing images.

Data on crops cultivated in Ghana was also gathered from several websites including the sixteen (16) regional webpages of the Ministry of Food and Agriculture (MOFA). Data was also obtained from reliable institutions and organisations such as Ministry of Food and Agriculture, CSIR-Crops Research Institute (CSIR-CRI), CSIR- Savanna Agricultural Institute (CSIR-SARI), CSIR-Oil Palm Research Institute (CSIR-OPRI), Cocoa Research Institute of Ghana (CRIG), Rubber Plantation Ghana Limited (RPGL), Association of Eastern Region Rubber Out growers (AERRO) and other farmer organisations.

Information on the current state and future projection of cotton production in the country were obtained respectively from Asinyo *et al*. (2015) and Anon. (2017). Data was also generated from satellite imagery and land cover field samples that were collected as part of the production of the 2015 land cover map of Ghana (Hackman *et al*., 2017). Ground truthing was carried out for validation purposes. With ArcGIS, a Geo-database was created. Steps in creating the geo-database are as shown in Figure 4.3.

With the satellite imagery data and ground truthing, semi-automatic image analysis was carried out. This was supported with data from MOFA, Research Institutes and other relevant agencies. By means of GIS, classification was carried out, land cover and land use maps were generated. With these maps, thematic layers were generated in the GIS environment. Attribute data on land resources and other ancillary data were integrated with the thematic layer map and a Land Resource Geo-database was created.

Where digital data was not sufficient, paper maps and ground survey methods were applied to improve the database. From the land resource database, the major resources were identified for consideration in developing compensation and the COMPACAL-G model.

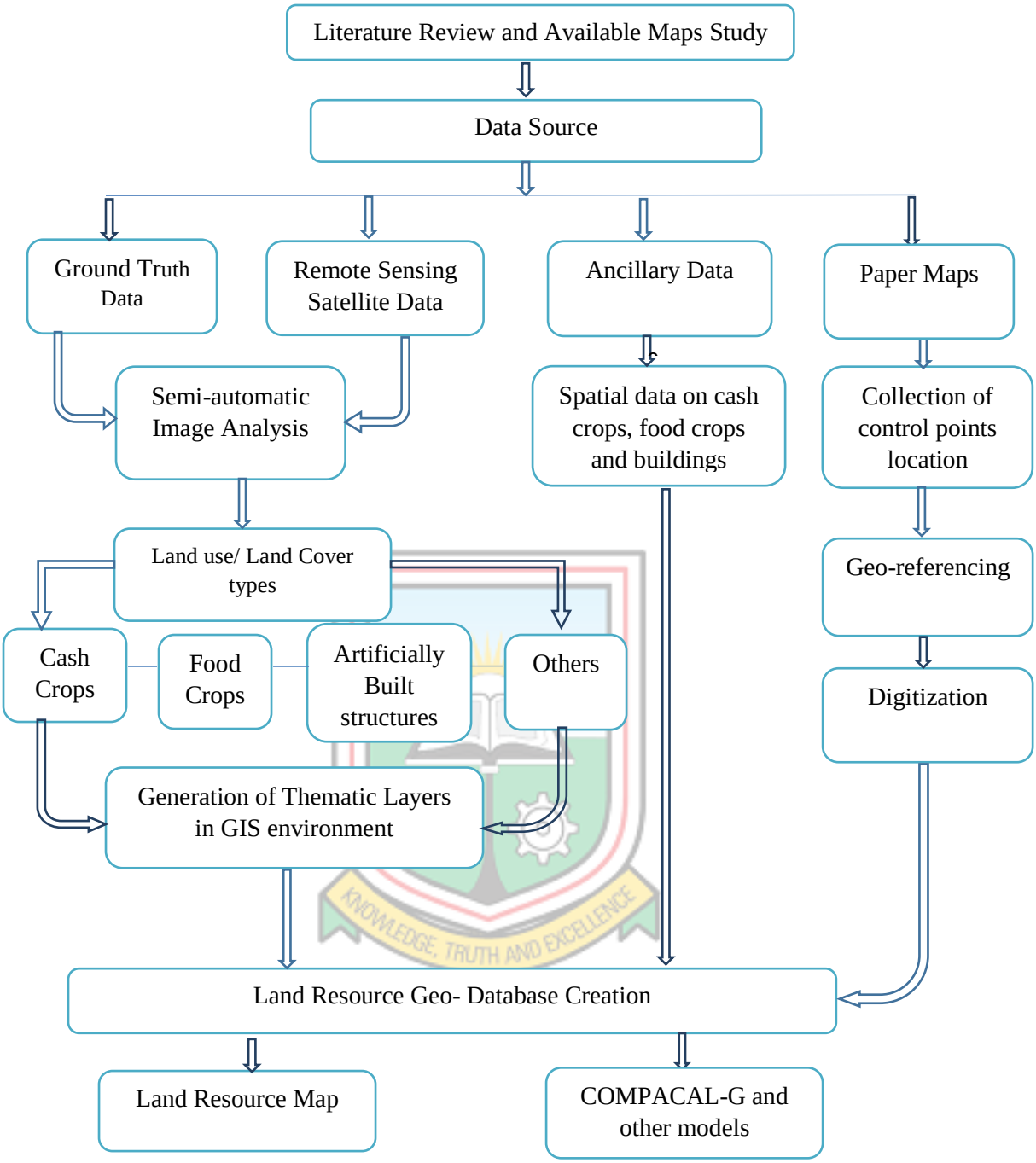

Figure 4.3 Flow Chart for Determination of Land Resource Database

4.3.2 Data Capture with the Open Data Kit

Primary data collection was undertaken using Open Data Kit (ODK) collection tool. The tool was customized into a data collection template for Compulsory Land Acquisition and Compensation. ODK is a suite of tools that allows data collection and submission using Android mobile devices. The ODK saved data collectors from the difficulties associated with storing and managing paper-based data collection (Hartung *et al.*, 2010). ODK was designed as a set of

components that can be used exclusively or in different setups. The three main aims of ODK are:

(i) To make tools adjustable so that they can be effectively made into suitable arrangements for each disposition;

(ii) Make full use of Open interfaces so that solutions are not made into rigid enterprise-level packages that are difficult to understand and maintain; and

(iii) Set up data collection tools at the front line of technology in order to prevent early deterioration of usefulness and also attract talented developers.

The ODK consists of three main components; the client, the online server and the workstation as shown in Figure 4.1. The client component consists of ODK-enabled smartphones that are used to download empty forms from the online server, field data collection, and upload of completed data forms. The installation of the mobile ODK client is necessary to keep the smartphone connected with the other components of the ODK data collection system.

The online servers, also called "Aggregates", served as data storage and aggregation platforms of the ODK data collection workflow. This aggregate was an online Java server that stored, analysed and presented survey data that were collected with the ODK application. It gathered information and gave standard interfaces to extract information such as spreadsheets, queries, and maps, and also combined with other systems by means of real time web requests (Anokwa *et al.*, 2009). Moreover, in areas where internet accessibility was problematic, ODK briefcase served as an alternative data aggregation system within the data collection workflow. In each of these scenarios, form uploads and downloads as well as the gathering of completed data was possible.

The workstation component refers to the computer on which the forms are created. The form for the data collection was built on the computer using Microsoft Excel and saved in xml format. Data was uploaded to the online server after editing. The online server (the aggregate) also had an error checking mechanism as part of its form upload module.

In this research, extra layers of spatial data were assembled through a field-based questionnaire using the ODK (Figure 4.4) – an extensible, open-source collection of tools designed to build information systems for developing regions (Anokwa *et al*., 2009 and Hartung *et al*., 2010).


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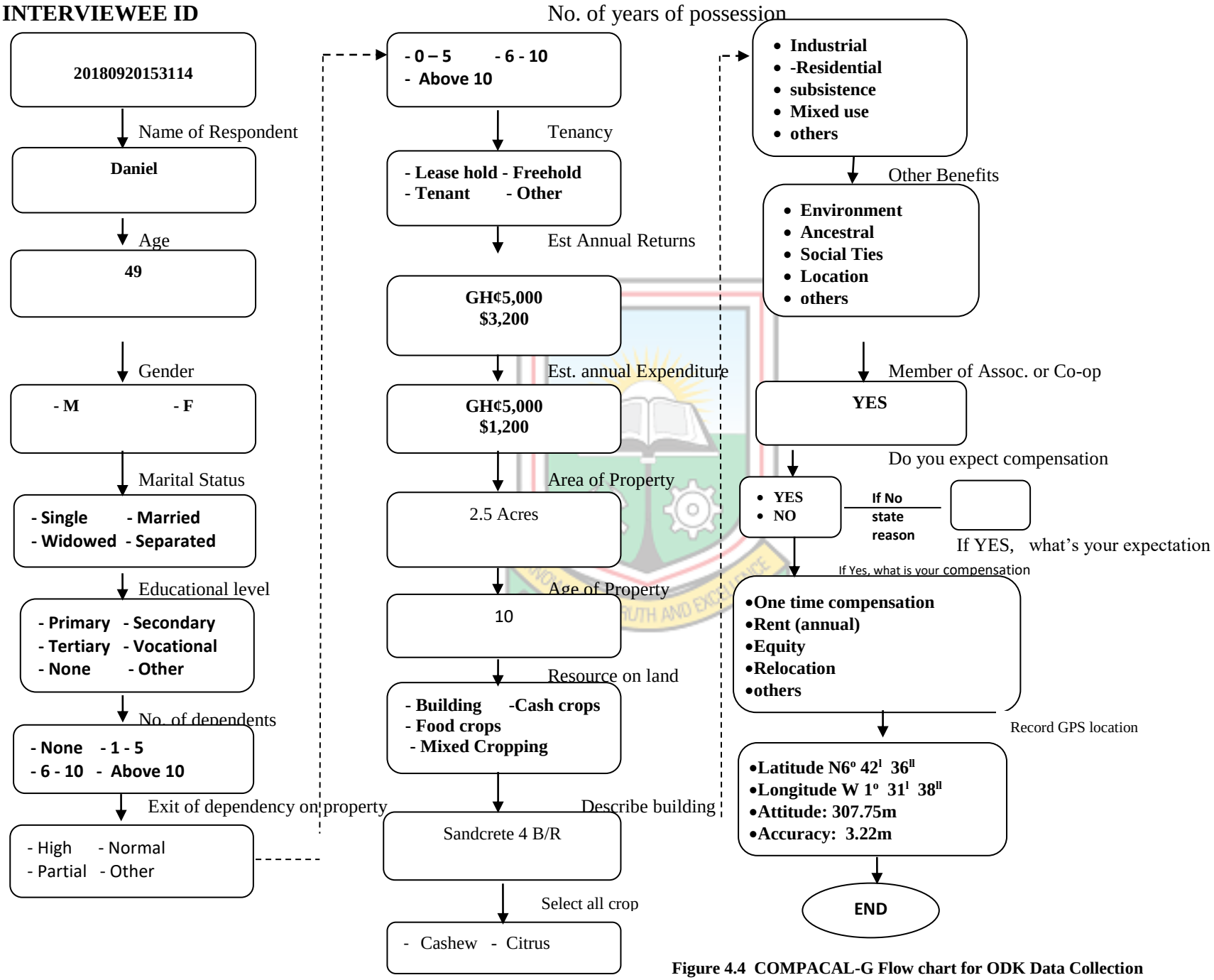

Figure 4.4 COMPACAL-G Flow chart for ODK Data Collection

The ODK data collection workflow went through the following procedures:

(i) Creation of data aggregation system;

(ii) Form building in Microsoft Excel (i.e. XLS Form), error checking and conversion to XML format, and upload to online server (or through ODK briefcase);

(iii) Installation and configuration of mobile client on smartphone;

(iv) Download of empty forms from server; and

(v) Field data collection by enumerators.

The ODK output can be put into five main parts as shown in Figure 4.5. Part one requires the title of the form or project name. Part two is the design of the form to incorporate all relevant data to be captured. Part three divides the form into various menu. Part four provides the blank form ready for field data capture and part five gives the GPS location. The form can be viewed, edited, saved and then sent to the server.

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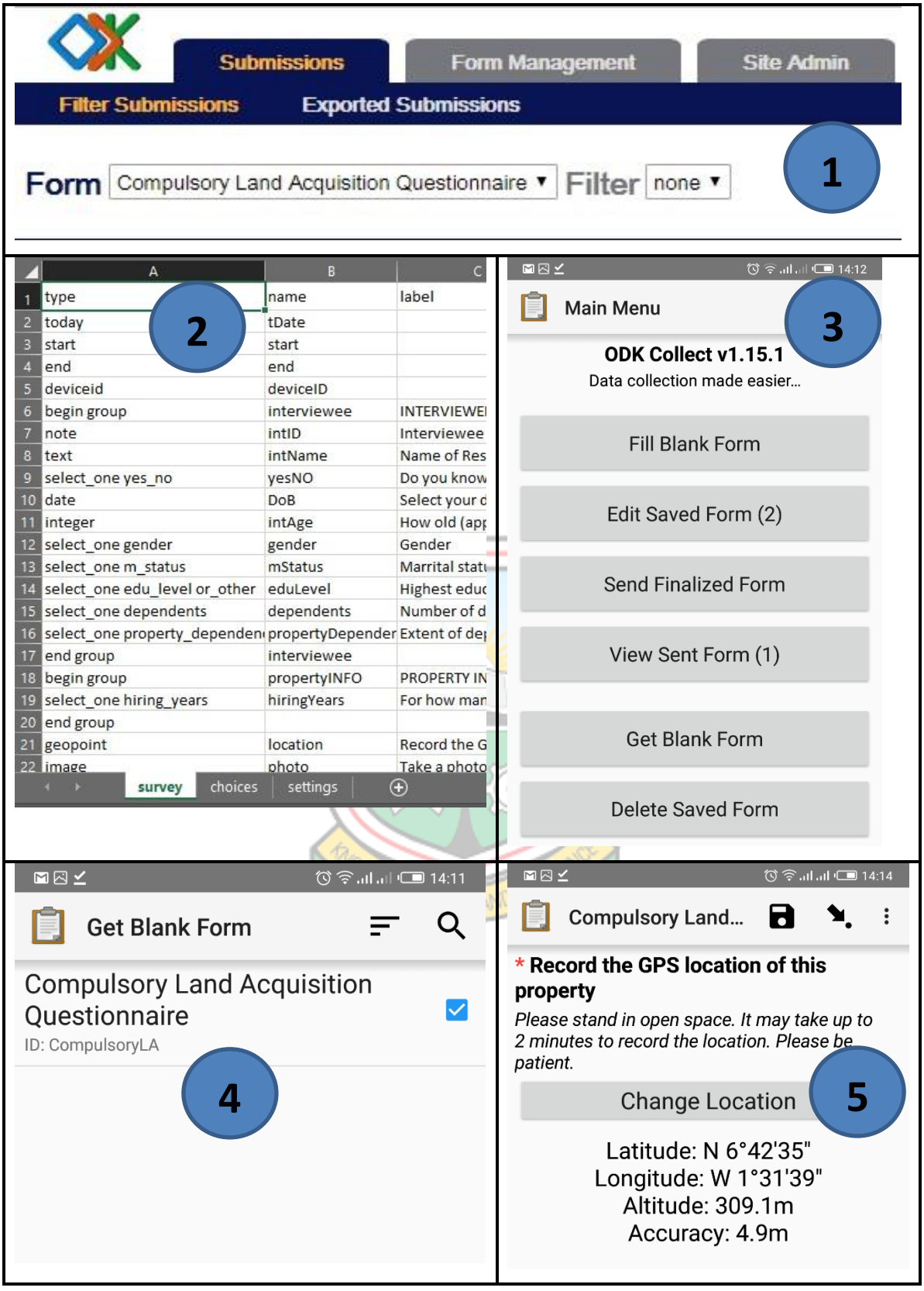


Figure 4.5 Pictorial Representation of the ODK Data Collection Workflow

4.4 Building Cost Centre for Crop Resources

This study used quantitative methods to build cost centre (CC) for the various items that go into developing the various crop resources identified. This cost centre was modified from Mireku-Gyimah (1997). Tables 5.3 shows the cost centre for the various major agricultural resources identified in Ghana. However, the cost centre can experience minor variations based on location. The dollar to cedi exchange rate at time of developing the cost centre in July, 2018 was US$1.00 = GH¢4.80.

A well-developed valuation system for buildings is in place in Ghana. The valuation method based on market value, floor area or Bill of Quantities (BOQ) can address any challenge relating to compensation. This takes into account the location, infrastructure, size, materials and facilities for construction. As a result, serious compensation challenges for buildings can be easily dealt with. The Construction Cost Indices (C.I) developed by CSIR-Building and Road Research Institute for the building industry adequately takes care of price fluctuations in a transparent and fair manner and for "value for money audits"

Land and documentation were major costs for compensation within the cost centre when it came to farming. Improving the land administration system is critical in Compensation determination as well as its disbursement. Though the land market is not fully developed, getting market values for land in areas can be ascertained. It has often depended on the Demand and Supply theory. In this research, the values used for cost centre for crops were based on average rural land values. Though it is easy to determine the going market values for land in any location, Lands Commission figures are still relatively lower

4.5 Determination of Best Practice Agreements and Protocols (COMPACAL-G PROTOCOLS)

Compulsory Acquisition and Compensation require processes that promote transparency, fairness and sustainable livelihood. Agreements and protocols must define the process and ensure societal stability and cohesion.

In this research, a number of methods were used to determine best practice agreements and protocols suitable for Ghana, though they can be generic for other jurisdictions. The methods were also intended to assess the often-negative outcomes of compulsory acquisition and compensation calculation. The methods included the following:

(i) Assessment of Compulsory Acquisition and Compensation in Africa, Europe; Asia and America through literature review;

(ii) Assessment of the various Land Tenure Systems (LTS) across the world through literature review;

(iii) Assessment of previous Compulsory Land Acquisition and Compensations in Ghana through Literature review;

(iv) Review of International Laws and Protocols;

(v) Interviews of affected communities in Greater Accra, Eastern, Ashanti, Central Western, Brong Ahafo and Northern regions;

(vi) Case study of Compulsory Acquisition and Compensation in Ghana; and

(vii) Development of COMPACAL-G Unified Modelling Language (UML) Activity for Ghana.

In all, Protocols and Tenure systems for 25 countries in Africa (with emphasis on Sub-Saharan Africa), Asia, Europe, America and Australia were reviewed. LTS for developing and emerging economies were also reviewed.

The UN-FAO good governance practice protocols on Compulsory Land Acquisition and Compensation and the African Human Rights Charter provided a guide in determining Best Practice Agreements and Protocols within the context of Rule of Law and Democratic Practice as in the case of Ghana.

4.5.1 Case Study Area

A case study area was adopted to determine Best Practice Agreements and Protocols for Ghana. A case study area was selected from the following nine (9) potential sites:

(i) CSIR- Savannah Agricultural Research Institute, Nyankpala site in the Northern Region: The site was acquired for the development of crop resources to improve agriculture in the northern belt of the country. The acquisition was willingly agreed upon by chiefs and people who owned the land. Though it was documented with an executive instrument, it did not follow the rigour of compulsory acquisition.

(ii) Bui Dam site in the Bono East Region;

The Bui Dam site in the Bono-East region was compulsorily acquired for the construction of the Bui Dam hydroelectric project to increase energy supply mix to boost socio-economic development. Obour *et al.* (2016) stated that though there were significant improvements with respect to compensation and resettlement, there was still shortfalls. In the Bui dam acquisition, the major form of compensation was resettlement of farmers and even fishermen. Each household was given 0.8 ha of land, regardless of the area held before. However, they also enjoyed some monetary compensation.

(iii) Aiyinase in the Western Region for MOFA:

Aiyinase in the Western region was acquired for the development of agriculture for the Ministry of Food and Agriculture. It also did not go through the rules of compulsory acquisition, hence compensation regime was not strictly enforced through executive instrument. Not much challenge has been experienced by the beneficiary institution because the area is still a rural community with very little pressure on the land. The presence of CSIR-Crop Research Institute and MOFA provides employment opportunity for the rural community as well.

(iv) Cape Coast University site in the Central Region:

Cape Coast university site was compulsorily acquired. Though compensation was not fully paid, most of the land has been occupied by the university and its overriding significance to the region in terms of education makes it difficult for contestation, though some chiefs have tried in the few last years to go to court to claim compensation.

(v) CSIR-Plant Genetic Research Institute, Bunso site in the Eastern Region:

The Plant Genetic Research Institute site has been identified as compulsorily acquired. However, because documentation and compensation were not concluded, large portions of the land have been repossessed by the allodial owners.

(vi) CSIR- Animal Research Institute, Frafraha site in the Greater Accra Region:

At the Frafraha in the Greater Accra Region, the Animal Research Institute site was compulsorily acquired. Executive instrument was acquired, and compensation was paid. However, 90% of the land has been encroached upon through sale by families and clans. In spite of court actions to halt illegal encroachment, pressure on land coupled with

complex land tenure system and political interference have rendered the acquisition ineffective.

(vii) CSIR- Crop Research Institute, Pokuase site in the Greater Accra Region;

The Pokuase site like the Aiyinase site was compulsorily acquired for crop and animal production and for research. However, the competing needs for land in such a location in the capital of Ghana has created lots of tensions even from state institutions like the Municipal Assembly, Chiefs, community leaders, the Ministry of Works and Housing and MOFA. The contention is that the location is no longer appropriate for its original use as agricultural research fields. Government, however, is having difficulty deciding on the re-location due to long term effect on research.

(viii) Kwame Nkrumah University of Science and Technology (KNUST) site in Kumasi:

The KNUST site was acquired with concurrence from the Asantehene, overlord of the Ashanti kingdom at that time. There is no evidence of payment of compensation. Its strategic significance in Ghana's education system and with the chancellor being the overlord of the Asante kingdom who oversees all the land in the kingdom, isolated challenges have been recorded.

(ix) Fumesua Science Village in the Ashanti Region:

The Fumesua Science Village in the Ashanti region was selected due to its representative nature as typical of compulsory acquisition and compensation. It is located in the middle of the Ashanti Region and at the boundary between Kumasi and Ejisu, (Figure 4.6). Once considered village settings at the time of acquisition, population growth coupled with urbanisation turned the area slowly but gradually into a peri-urban settlement in the 1970s and early 1980s. The rush for land in the area further increased when in the late 1990s government decided to build an inland port in the area. However, after the dualisation of the Kumasi – Ejisu highway between 2000 and 2004, and with extension of electricity, the area saw rapid development in terms of human settlement, hotels and industries leading to pressure on land and consequently rising land values. The acquisition and compensation regime however fell short of some basic principles of compulsory acquisition and compensation, giving rise to tensions and litigation between beneficiary institutions and original land owners.

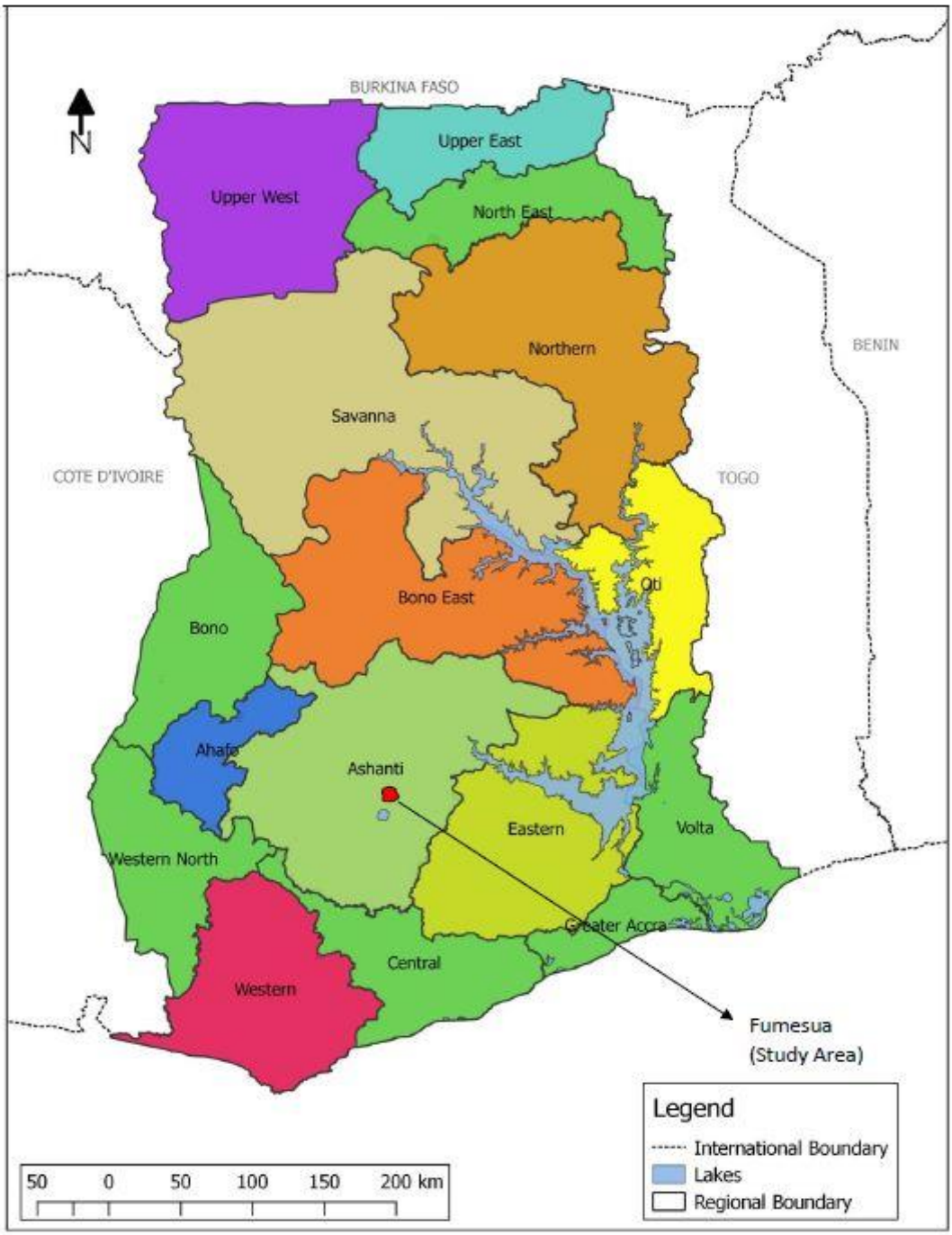


Figure: 4.6 Case Study Area for Determination of Best Practice Agreements and Protocols

4.5.2 Assessment of Case Study

The methods employed in the case study were as follows:

(i) Focus Group Discussion (FGD);

(ii) Direct Interviews;

(iii) Identification of Resources through remote sensing and other survey techniques;

(iv) Identification of landowners;

(v) Review of legislations for acquisition and compensation;

(vi) Review of Protocols for Acquisition; and

(vii) Review of Protocols for compensation calculation and payments.

The FGD brought together officials of Lands Commission, Chiefs, Stool heads, Victims of Compulsory Acquisition, a lawyer, a valuer and Beneficiary Institutions (Figure 4.7a and 4.7b). Officials of Lands Commission were from the Survey and Mapping Division, Land Valuation Division and Public and Vested Lands Division. The acquisition involved six chiefs, one queen mother and a family. The main beneficiary institution was the Council for Scientific and Industrial Research (CSIR) represented by CSIR- Building and Road Research Institute (CSIR-BRRI), CSIR- Crops Research Institute (CSIR-CRI) and CSIR- Forestry Research Institute of Ghana (CSIR- FORIG). Direct interviews were also conducted separately with Lands Commission, Professionals like Valuers and Land Surveyors, beneficiary institutions, families and chiefs. Two prominent chiefs with professional experience in land matters (in the public sector) co-chaired the group discussions that lasted a year with monthly meetings from August, 2017. At various stages, the group was broken up into smaller groups to come out with specific recommendation for consideration. The meetings were sponsored by CSIR.

Figure 4.7a FGD on Best Practice Agreements and Protocols

Figure 4.7b FGD comparing Spatial Data from Drone and Original Acquisition Map

4.5.3 Survey and Mapping of Site

To map the case study area, satellite imagery was first obtained for the area covering the acquisition. The original acquisition "hard paper" plans were obtained from CSIR and validated from the archives of the Lands Commission Head Office in Accra. By means of GPS and a Continuous Operating Reference (COR) station at CSIR-BRRI, ground controls were established. A phantom 4 Drone was flown over the site in 3 hours to map out the original acquired land and all resources on it. Ground truthing was carried out for validation purposes. The ODK was also deployed at the site for non-spatial data. The Survey and Mapping Division of Lands Commission also carried out an independent survey to corroborate maps produced from this study.

Landowners and communities were identified by means of documents at CSIR and the current occupants of the various stools. The documents reviewed to assess protocols for the acquisition and compensation included minutes of meetings, letters, publications, petitions, court cases and compensation payments.

4.5.4 Assessment of Implementation Strategies

The FGD made assessment of the challenges in the acquisition and compensation with regards to the following:

(i) public participation/consultations;

(ii) compensation calculations;

(iii) payment of compensation;

(iv) legislations on acquisition;

(v) conflict resolution mechanisms;

(vi) tensions between communities and CSIR;

(vii) encroachment;

(viii) litigations;

(ix) tenure insecurity issues;

(x) land use plans of the various communities; and

(xi) any other issues relating to the acquisition and compensation.

Questionnaire was administered to the FGD members for the assessment.

The above parameters and outcomes relating to acquisition were ranked from 1 to 5; with 1 being the least acceptable to respondents of Compulsory acquisition and 5 being the most acceptable to respondents. For the protocols and agreements (i – v), the following interpretation was given:

1: Strongly unacceptable

2: Not good, needs revision

3: Satisfactory, but needs improvement

4: Acceptable

5: Highly Acceptable

For the social outcomes of compulsory acquisition and compensation (vi – ix), the following ranking was given:

1: Very low

2: Low

3: Could be better

4: High (Unacceptable)

5: Very high (Highly unacceptable)

Interviews were conducted with stakeholders beside the FGD. Questionnaires were also administered in the study area to the chiefs and opinion leaders.

Table 4.1 highlights the strategies for interviews and administration of questionnaire. Questionnaires were administered using face-to-face and telephone in some instances for clarification. The purposes of the study were explained to respondents.

Table 4.1 Strategies for Interviews and Administration of questionnaire

STRATEGIES	RESEARCH INSTRUMENT
Case study	Observations, documentary analysis, Semi structured and open-ended discussion
Interview	Semi-structured & Open-ended questionnaires
Focus Groups & Nominal Group Technique	Unstructured and structured questionnaires, discussions

Source: Saunders *et al*., (2009)

4.6 Development of COMPACAL-G Model

4.6.1 Calculation of Compensation for Crop Resources

Calculating compensation first of all required right determination of the direct cost input in the various resources on the land as well as the right market value of the land. Compensation can only be considered fair if all the various items and inputs on the acquired land, including intangibles and inconveniences are properly priced. The determination of the applicable rates was done through data collection from research institutes, farmer organisations and farmers. A cost centre (CC) was so developed through the following methods:

(i) Direct farmer interactions;

(ii) Farmer Associations engagement;

(iii) Assessment of Ministry of Food and Agriculture data base;

(iv) Data from Research and Resource Related Institutions; and

(v) Focus Group Discussion

Farmers engaged in the cultivation of the various crops were engaged at community levels and market centres to determine cost centres. Recognised farmer Associations like Association of Eastern Region Rubber Outgrowers (AERRO) and Oil Palm Outgrowers and Cocoa farmers were all engaged. Data was obtained from Research institutes like Cocoa Research Institute of Ghana (CRIG), CSIR-Oil Palm Research Institute (Kade), CSIR- Savannah Agriculture Research Institute (Nyankpala), CSIR-Crops Research Institute (Kumasi) and Ministry of Food and Agriculture. Also, Rubber Plantation Ghana Limited (RPGL) in Kade also provided useful information on rubber, cocoa and oil palm development.

The economic life span of each crop was obtained from research institutes and farmers. The data was used to compute the maximum economic life span yield of the various resources (Table 5.4). Data on the revenue from the major crops were also obtained from research institutes and corroborated by farmers interviewed. The data on crop yield was used to compute loss of future income to farmers affected by compulsory acquisition. Data for Cost Centre for buildings were obtained from CSIR-Building and Road Research Institute and Ghana Real Estate Developers Association (GREDA) and land prices were determined by prevailing open market values.

4.6.2 Development of Compensation Model

The model for calculating compensation for land resources in terms of crops was carried out first through the development of the Cost Centre. All relevant activities required to develop the various crop resources were catered for. With an excel spreadsheet, the cost of all the activities was computed together with contingencies and inconvenience factored into the cost based on international best practice. Contingencies and inconvenience were taken into consideration using best practices in other jurisdictions with similar legal regime on compulsory acquisition and compensation. Through the cost centre, a fair, transparent and adequate compensation was calculated to restore what a farmer could have lost by developing the resource to the point of maturity.

4.6.3 Mathematical Modelling for COMPACAL-G

The Cost Centre was used to compute the first package for compensation (reimbursable cost) for the crop resources on the land. The cost centre gives the cost input of all activities related to the development of the crop resources. As a result, the farmer or landowner is fully reimbursed for all financial input. The defining mathematical equation from the cost centre is therefore formulated in terms of elementary algebra given as:

$$T_1 = X_1Cc_1 + X_2Cc_2 + \cdots + X_nCc_n + (\sum_1^n X)C_G + (\sum_1^n X)C_I \quad 4.1$$

$$T_1 = X_1Cc_1 + X_2Cc_2 + \ldots + X_nCc_n + (\sum_{i=1}^n X_i)(C_G + C_i) \quad 4.2$$

where

$$Cc_1, Cc_2 \ldots Cc_n = Cost\ per\ hectare\ of\ reimbersable\ crop\ resource$$

$$X_1, X_2 \ldots\ldots X_n = No\ of\ hectares\ of\ reimbersable\ crop\ resource$$

$$C_G = Contigency\ cost\ per\ hectare$$

$$C_I = Inconvenience\ cost\ per\ hectare$$

For the "building" resource, the market value model is used by the preparation of Bill of Quantity (BOQ) and other valuation techniques. Market value of landed properties and building valuation methods have been successful so far in addressing issues of fairness, adequacy and transparency. Controversies in cost can be dealt with by on-site measurements and cost computations. For buildings and land, the compensation is computed as:

$$T_2 = \sum_{i=1}^n M_{vi} + (\sum_{i=1}^n X_i)\, C_i \quad 4.3$$

where

$$M_{vi} = Market\ Value$$

$$C_I = Inconvenience\ or\ Disturbance$$

The second package has to do with the loss of future income for crop resources. This must be adequately taken care of especially for cash crops that take longer than one (1) year to mature. This conforms to best practice as is done in New Zealand, UK and USA. This is selectively applied to economic crops according to their economic life span.

$$T_3 = X_1F_{v1}(P/Ai, n) + X_2F_{v2}(P/Ai, n) + \ldots + X_nF_{vn}(P/Ai, n) \quad 4.4$$

where

$F_{vi,}\ F_{v2\ldots}F_{vn} = Future\ Value\ of\ Crop\ per\ hectare$

n = number of remaining economic life

i = interest rate

The Net Present Value (NPV) of Future Projected Income [$F_{vn}(P/Ai,n)$] is given by :

$$NPV = Xc\sum_{t=0}^{n}\frac{R_t}{(1+i)^t} \qquad 4.5$$

Where

$R_t = net\ cash\ in\ flow - outflow\ per\ hectare\ per\ year$(Annual yield)

$X_C = no\ of\ hectares\ of\ crop$

i = rate of return on investment

It must be emphasised that, the enumeration method for crops compensation practiced in Ghana by Lands Commission does not take sufficient care of future income. This puts farmers at a big disadvantage, creates tension, insecurity and loss of livelihood.

Moreover, the use of "Depreciated value" for buildings and land in some instances, further worsens the plight of the dispossessed owner. In rural areas where the market is not well developed, replacement cost can be a useful tool. However, in urban and peri-urban settings where the market is developed, the market dynamics must be allowed to dictate the market value.

4.7 Statistical Analysis of Cost Centre Data

Statistical analysis in quantitative data is important in making sense of, and to draw inferences from the data. Statistical analysis was therefore carried out from the quantitative data in the study to estimate the relationship between the variables in the compensation model. Regression and correlation analysis were therefore carried out with data from cost centre.

4.7.1 Regression Analysis

Regression analysis was the statistical method used to examine the relationship between the dependent variable, "compensation" and the independent variables, *i.e.* farm operation costs. The regression analysis is shown in Table 5.5. For the COMPACAL-G to satisfy a Multiple Linear Regression model, it must satisfy the following assumptions:

(i) Linearity: the relationship between the dependent (predictor) and the independent variables must be linear;
(ii) Multivariate normality: the residuals are normally distributed;
(iii) No Multi-collinearity: independent variables are not highly correlated with each other; and
(iv) Homoschedasticity: the variance of error terms is similar across the values of the independent variables.

The analyses were necessary to evaluate the relationship between dependent and independent variables and also to determine their statistical significance.

4.7.2 Correlation Analysis

Correlation is used to test relationships between quantitative variables. The study of how variables correlate is called correlation analysis. In this study, an analysis was carried out to determine the correlation among the independent variables that come together to determine compensation for crop resources.

The correlation coefficient in a model is a statistical measure that calculates the strength of the relationship between the relative movements of two variables. The values range between -1.0 and +1.0. A calculated number greater than +1.0 or less than -1.0 means that there was an error in the correlation measurement. A correlation of -1.0 shows a perfect negative correlation, while a correlation of +1.0 shows a perfect positive correlation. A correlation of 0.0 shows no relationship between the movements of the two variables.

Pearson correlation (*r*) measures strength and direction of the linear relationship between two variables. It cannot capture nonlinear relationships between two variables and cannot differentiate between dependent and independent variables.

The strength of the relationship varies in degree based on the value of the correlation coefficient. For example, a value of 0.2 shows there is a positive relationship between the two

variables, but it is weak and likely insignificant. Experts do not consider correlations significant until the value surpasses at least 0.8. However, a correlation coefficient with an absolute value of 0.9 or greater would represent a very strong relationship.

4.8. Compensation for Expected Future Income

During compulsory acquisition, vulnerable groups especially in the agriculture sector have higher tendency to lose their livelihood. Without relevant support, they are likely to lose interest in farming and may not have the relevant skills to invest in alternative ventures. This can lead to lack of interest in farming and promote food insecurity as well. The acquiring institutions and the state must have adequate plans to ensure sustainable livelihoods for such vulnerable groups. Just reimbursing farmers for what they already invested is not compensatory enough. It must be emphasised that some of the resources are long term investments after their maturity. Farmers therefore have rights to ensure their long-term returns are also catered for. COMPACAL-G makes adequate provision for present and future losses by computing the expected future returns on crop resources. The expected future returns is discounted into a present value and paid to the farmer. This principle is equally popular in estimating expected future returns on capital projects.

The provision of alternative livelihoods as outlined in the Literature Review, education and sensitization as well as skills development are important in the compensation paradigm to ensure sustainable livelihoods for vulnerable groups.

4.9 Development of COMPACAL- G Programme

Compensation payments delay due to the slow manner of data capture and processing. The use of ICT will invariably minimize delays. A programme for compensation calculation was developed to manage the records related to the compensation, *i.e.* organise, save, query, search, retrieve and print information relevant for compensation determination. Such information included name of owner, area of land, location and resource(s) on the land. The system was developed to provide the following benefits to the COMPACAL-G model:

(i) to handle and manage the desktop activities involved in compensation in an efficient, easy and reliable manner;

(ii) use of less personnel;

(iii) friendly and attractive user interface; and

(iv) safety and security of database through the use of Administrator login system.

The visual studio used in this application is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs, websites, web apps, web services and mobile apps. It can produce both native and managed coding.

In this research, while the Visual Basic was used as the interface and front end, Microsoft SQL (MySQL) was used as the back end to store the database, which served as the engine that stored the information. The database structure was organised into physical files optimised for speed.

The Compensation Calculation System (COMPACAL-G MySQL Programme)) is a database application system used to determine the amount of compensation for resources on land compulsorily acquired. Two (2) software were used in building the system:

(i) Visual Studio; and

(ii) MySQL(WAMP).

4.9.1 Visual Studio

The Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs, as well as websites, web apps, web services and mobile apps. It can produce both native code and managed code.

For this application, the visual studio was used to develop the front end or the interface (Figure 4.8). The Visual Studio is connected to the MySQL (WAMP) by Source Code (Figure 4.9) to enable the system to function effectively. Visual Basic (VB**)** was the programming language used for executing all the codes in this application.

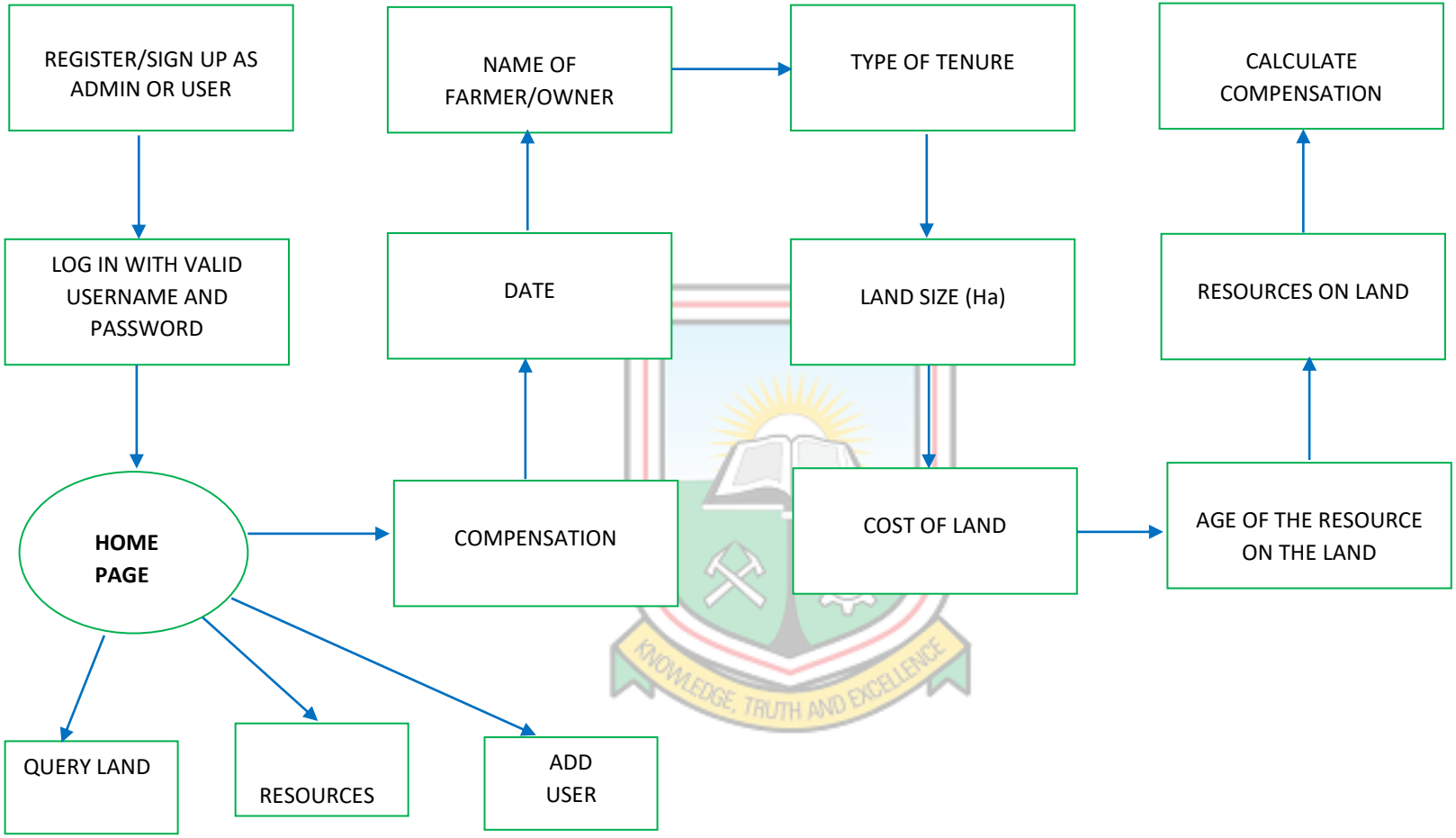


Figure 4.8 Flowchart for MySQL System

```
x1 = Val(TextBox69.Text)
a = Val(TextBox45.Text)
x2 = Val(TextBox68.Text)
b = Val(TextBox46.Text)
x3 = Val(TextBox67.Text)
c = Val(TextBox47.Text)
x4 = Val(TextBox66.Text)
d = Val(TextBox9.Text)
x5 = Val(TextBox1.Text)
f = Val(TextBox65.Text)
x6 = Val(TextBox14.Text)
g = Val(TextBox19.Text)
x7 = Val(TextBox13.Text)
h = Val(TextBox18.Text)
x8 = Val(TextBox12.Text)
i = Val(TextBox17.Text)
x9 = Val(TextBox11.Text)
j = Val(TextBox16.Text)
x10 = Val(TextBox15.Text)
k = Val(TextBox10.Text)
x11 = Val(TextBox21.Text)
l = Val(TextBox20.Text)
x12 = Val(TextBox23.Text)
m = Val(TextBox22.Text)




total = x1 * (a) + x2 * (b) + x3 * (c) + x4 * (d) + x5 * (f) + x6 * (g) + x7 * (h) + x8
MessageBox.Show("Compensation :" & total)
TextBox7.Text = total
```

Figure 4.9 Text Soure Coding for MySQL programming

4.9.2 MySQL WAMP (DATABASE)

The MySQL WAMP is the Relational Database Management System (RDBMS) that stores data in separate tables rather than putting all the data in one big storeroom. The tables are made up of columns and rows. The database structures were organised into physical files optimized for speed. The MySQL (WAMP) was used to build the database which serve as the engine that stores the information in this application. It uses SQL (Structural Query language).

The COMPACAL-G programme was developed to manage the database in compensation calculation in an efficient and reliable way. The “MySQL” database system also helps to organise, save, edit, store, retrieve and query the database. This is done by clicking a button where the information is located on the Data Grid View to popup in their various tools boxes. Figure 4.8 shows the flow chart of “MySQL” database management system.

4.10 COMPACAL-G Test

The COMPACAL-G was tested using the Fumesua Science Village case study area. The test compared compensation calculation from Lands Commission and that from COMPACAL-G. A total land area of about 350 acres yet to be compensated for was examined for assessment. The resources used for estimation purposes were mainly land and crops. The Lands Commission carried out an Assessment using two (2) approaches. The first approach was computed from a Compounded Interest formula using the originally computed Compensation value at time of acquisition in 1972. The Second approach used a formula described also as Market value. This market value was, however, based on "Depreciated Values". The COMPACAL-G model, however, depended on prevailing or open market land values, contingency and disturbance integrated costs in the study area.

CHAPTER 5

RESULTS AND DISCUSSION

5.1 Determination of Compensable Resources

5.1.1 Agricultural Products

Figure 5.1 shows a map of the major agricultural compensable resources on land in Ghana in the event of compulsory acquisition. Fourteen major crops were identified. Crops that were mostly cultivated at the subsistence level for domestic household consumption were grouped together as food crops. They included cassava, maize, yam, plantain, cocoyam, rice, *etc*.

Major cash crops included cocoa, rubber, oil palm, cotton, shea butter, coffee, cashew, tobacco and kola nut. Citrus like oranges, pineapples, pawpaw *etc.* were cultivated on a relatively smaller scale than coconut and mango, which were cultivated in relatively larger plantations. Some crops were not captured at all due to their relatively small-scale production.

Table 5.1 shows the regional distribution of the crop resources across the country. From the table, food crops were cultivated in all regions of the country, while tobacco was the least cultivated, in only two regions. Every region had cash crop cultivation. Farming was a common practice in every region. This shows that the Ghanaian economy is heavily dependent on agriculture and citizens' dependency on land for livelihood was quite high. Every home in the rural area owned a farm with agricultural produce to feed the family as well as generate income for the up keep of their families. There is therefore high emotional and economic attachment to these lands and the resources on them. Compulsory acquisition must therefore be thoroughly thought through so as not to deprive communities of their livelihood.

5.1.2 Buildings

The other major compensable resource was buildings. Remote sensing and other data showed buildings in varied material forms, shapes and sizes. It was important to employ field validation method to describe the predominant building types. The study showed the various building material types:

(i) sandcrete;

(ii) burnt bricks;

(iii) timber;

(iv) steel;

(v) adobe earth;

(vi) bamboo;

(vii) hydra-form; and

(viii) stabilised earth.

The buildings were categorised as residential, industrial and farm huts. Over 90% of buildings in urban areas were in sandcrete, especially in the southern part of the country. Adobe earth and stabilised earth buildings were identified as the majority in rural North and parts of the South. Timber, stabilised earth, hydra-form, burnt bricks, bamboo and steel were found both in rural and urban communities in varying shapes, sizes and use.

5.1.3 Land

Land is the main target for compulsory acquisition and must be compensated for. The land tenure system, however, differs in various customary ways according to the custom and traditions of the community, tribe or clan. As most of the lands are customarily owned, the mode of transfer, usage and ownership can be complex. Economic value of land differs significantly from the urban, peri-urban and rural settings. There are still significant variations even within localities depending on level of urbanisation, infrastructure and even class of citizens.

The compensation value of land is in most cases based on market value. It is done by assessing the prevailing market rate for the land. The values in predominantly rural communities where land is mostly required for subsistence farming ranged between US$ 250.00 and US$ 1 000.00 per hectare. Where local indigenes are involved in the transaction, monies may be paid even in kind. Values, however, go up where large scale commercial agriculture or industry are in the transaction. Transaction cost may also differ for a non-indigene. In rural communities, the value of the land is also influenced by the land use.

Figure 5.2 is the map showing built up areas in Ghana. It has the statistics shown in Table 5.2. The built-up areas are concentrated mostly in the Regional and District capitals. Greater Accra Region has the highest concentration of buildings, followed by Ashanti, Eastern, Western and Bono Regions. The northern parts of Ghana have the least concentration of built up areas

(Figure 5.2). The built-up area of the country constitutes about 2.8% of the entire 238 000 sq. km.

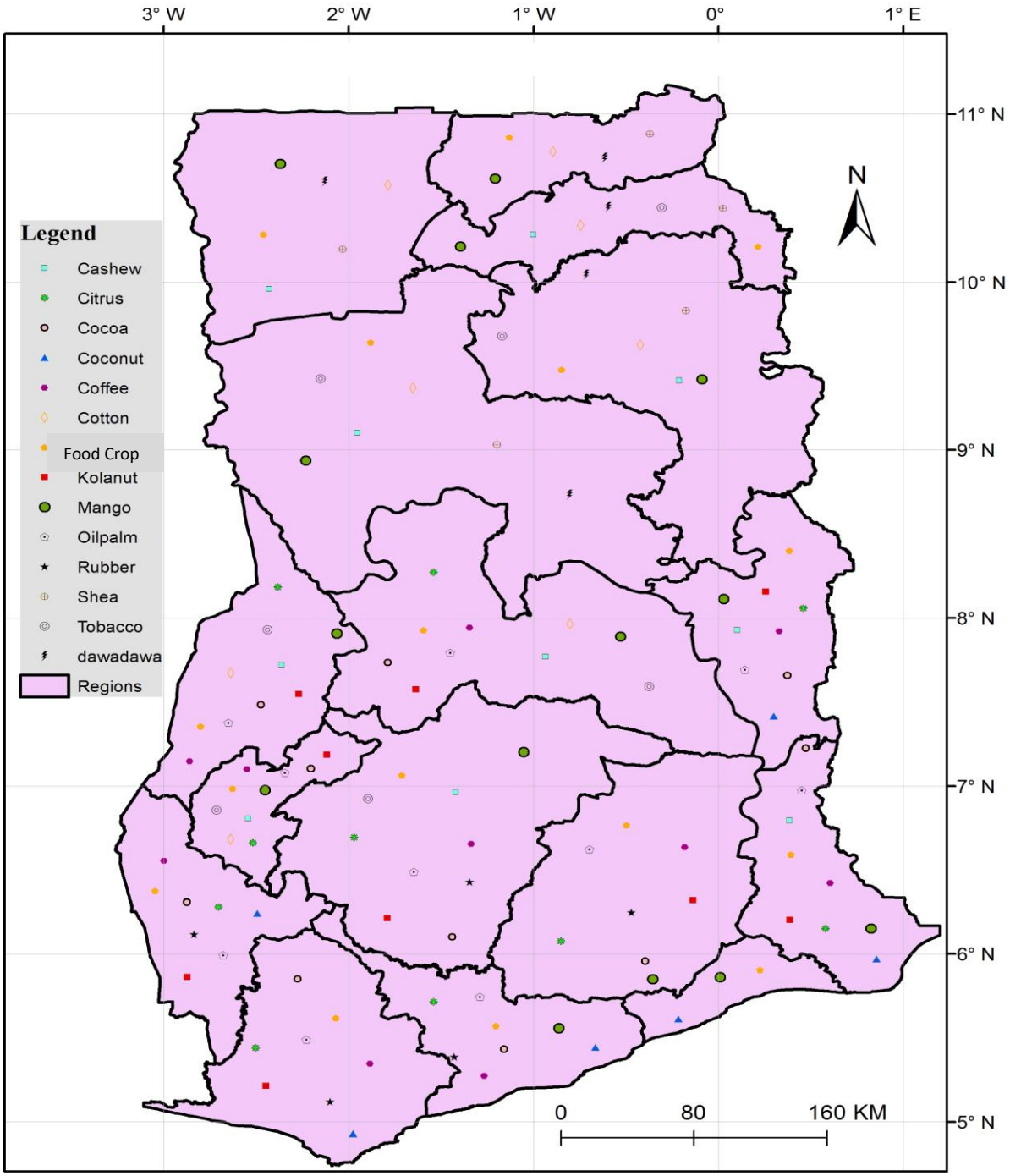


Figure 5.1 Map of Ghana showing Regional Distribution of crop resources

Table 5.1 Regional Distribution of Crops in Ghana

Region	Cashew	Citrus	Cocoa	Coconut	Coffee	Cotton	Food Crops	Kolanut	Mango	Oilpalm	Rubber	Shea	Tobacco	Dawadawa
Ashanti	√	√	√		√		√	√	√	√	√		√	
Ahafo	√	√	√		√	√	√	√	√	√			√	
Bono	√	√	√		√	√	√	√	√	√			√	
Bono East	√	√	√		√	√	√	√	√	√			√	
Central	√	√	√	√		√	√	√	√	√	√			
Eastern		√	√		√		√	√	√	√	√			
Greater Accra				√			√		√					
Northern					√	√	√		√			√		√
North East	√	√		√			√		√	√	√		√	
Oti	√	√	√	√	√		√	√	√	√				
Savannah	√				√	√	√		√			√		√
Upper East						√	√		√			√		√
Upper West	√					√	√		√			√		√
Volta	√	√	√	√	√		√	√	√	√				
Western		√	√	√	√		√	√		√	√			
Western North		√	√	√	√		√	√		√	√			

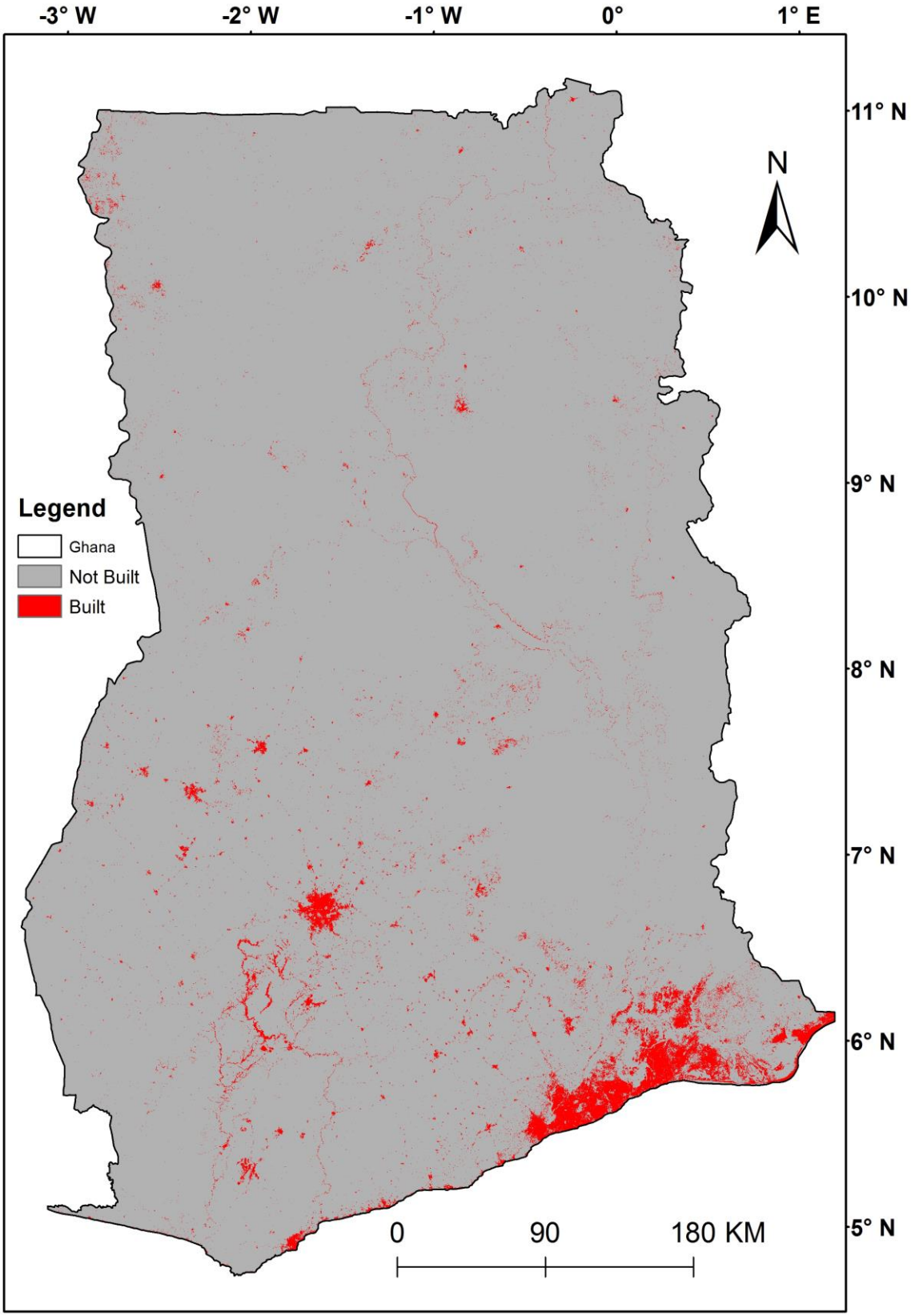


Figure 5.2 Map of Built Up and Non-Built Up Areas of Ghana

Table 5.2 Statistics of map of Built Up and Non-Built Up Areas in Ghana

Class	Pixels (30 m)	Area (sq. km)
Not Built up	267 678 011	231 937
Built up	7 335 244	6 601

5.2 Best Practice Agreements and Protocols

Figure 5.3 shows map of case study area for Best practice agreements and protocols. It shows resources at the time of compulsory acquisition. Figure 5.4 also shows the drone survey capture of current state of the case study area, used for assessing and developing Best Practice Agreements and Protocols most suited for Ghana. The site shows resources such as buildings, land and crops.

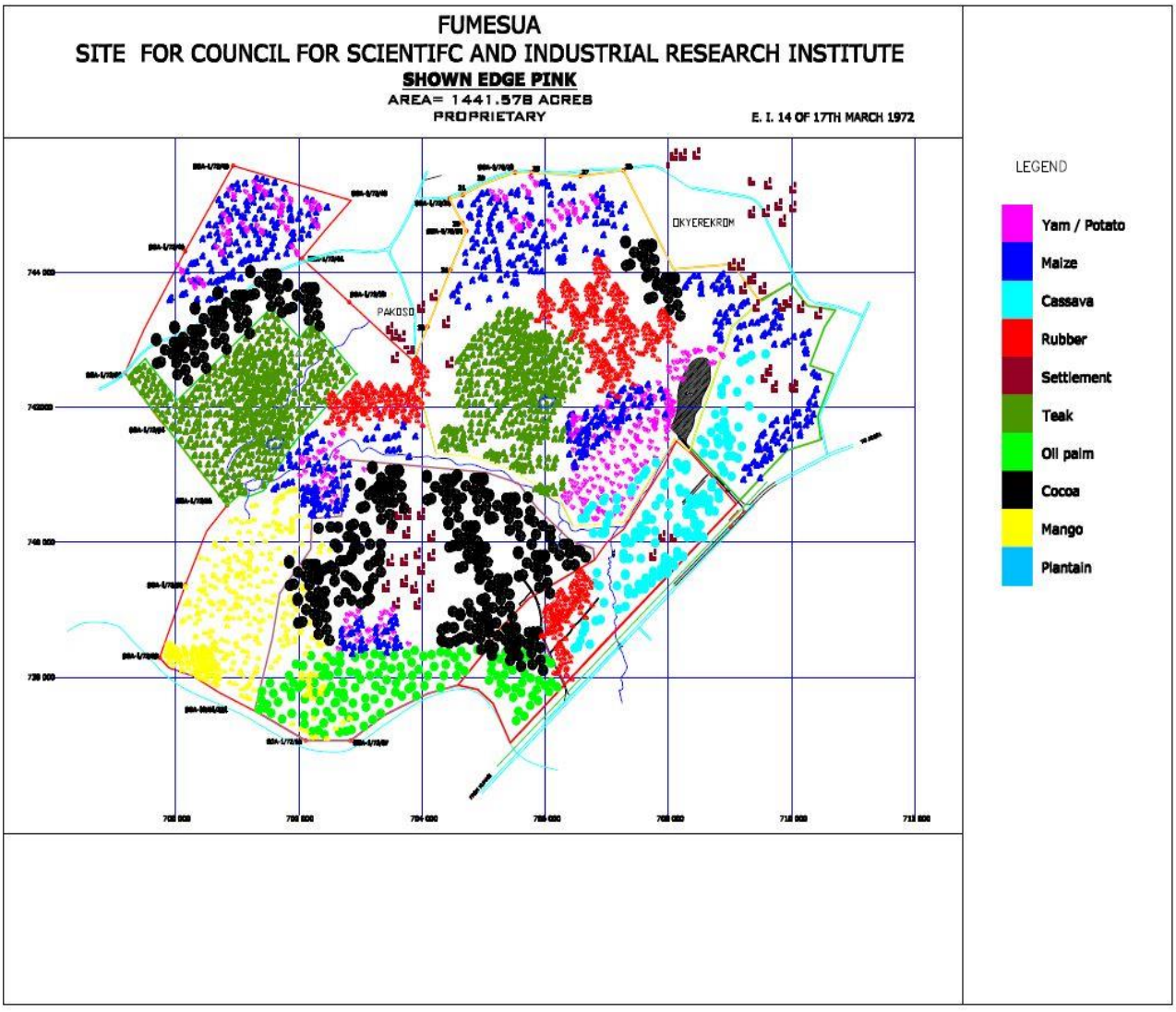


Figure 5.3 Map showing resources on land at time of acquisition

Figure 5.4 Drone Capture of Fumesua Science Village

5.2.1 Assessment of acquisition and compensation implementation in the case study

The assessment of the processes in the acquisition and compensation revealed the following:

(i) Acquisition was done in 1972 by the state;

(ii) Per original acquisition plan, total land acquired was 1 441.578 acres (583.4 ha), though 1 497 acres (605.8 ha) was gazetted (Appendix A);

(iii) Resources compensated were crops, buildings and land;

(iv) Total communities involved were seven (7) and one (1) private person;

(v) Twenty-five percent (25%) compensation payment was made in January 1976 in respect of land, buildings and crops for communities;

(vi) No compensation was paid to the private person;

(vii) Extent of encroachment by end October 2018 was 50% (750 acres);

(vii) Court Litigation (2no);

(viii) Tension between Communities and CSIR since 1978 resulting in violent classes sometimes;

(ix) Destruction of private property and research fields;

(x) Conflict resolution processes were antagonistic; and

(xi) 2 legislations were applied in acquisition. They were Land Administration Act, 1962

(Act 123) and State Lands Act, 1962 (Act 125). However, State Lands Act, 1962 (Act 125) was applied for implementation.

The research also revealed in the case study that compulsory acquisition, compensation calculation and payment have not been in conformity with best practice protocols and agreements. Interviews, documents and FGD revealed the following challenges in Ghana's protocols as executed by the Lands Commission in the study area:

(i) Public Participation and consultations were weak;

(ii) Methods of calculation were not transparent;

(iii) Methods of calculating compensation were not accepted as fair and adequate;

(iv) There were undue delays in paying compensation due to slow methods of data acquisition, data validation and processing (4 years in study area). In the case of the study area, only 25% was paid to community leaders and balance has not been paid after 47 years. No payment has been made to the private person;

(v) Farmlands were not based on market values;

(vi) Contingency and Disturbance integrated costs were not considered;

(vii) Loss of livelihood programmes were not considered for victims; and

(viii) Fluctuation clauses were not available for adjusting values of crop resources even after 4-year delayed payment (between 1972 and 1976).

The research through interviews, FGD and literature review developed protocols that ensure best practice for the implementation of Compulsory Acquisition and Compensation payment in Ghana (COMPACAL-G protocols). The protocols were developed to promote:

(i) transparency in calculating compensation;

(ii) fairness /equity in the compensation;

(iii) inclusiveness of the public/ victims of compulsory acquisition and compensation payment;

(iv) mitigation of delayed payments;

(v) sustainable livelihoods; and

(vi) reduced tension between communities and institutions

5.3 Cost Centre for Crop Resources

Tables 5.3a and 5.3b represent the cost centre for 10 of the 14 major crop resources that had enough data for analysis. It covers almost all activities related to developing the crops to maturity. Table 5.4 shows the maximum economic life span yield per hectare of each resource.

Table 5.3a Cost Centre (CC) for Land Resources in US$ (Modified from Mireku-Gyimah, 1997)

No	Farm Operation Cost up to Maturity of Plant per hectare	Cocoa	Oil Palm	Rubber	Yam	Banana	Plantain	cassava	Maize	Vegetables	Citrus
A	Land Acquisition Land Owner's Charge	781.25	781.25	781.25	260.43	520.83	520.83	260.43	520.83	260.43	520.83
B	Land demarcation, plan preparation and documentation	1200.00	1200.00	1200.00	1200.00	1200.00	1200.00	1200.00	1200.00	600.00	1200.00
C	**Land Preparation for farming**										
	Bush clearing: 15 days x US$ 10.42/day	156.30	156.30	156.30	156.30	156.30	156.30	156.30	156.30	156.30	156.30
	Tree felling (chain saw) 2 days @$130/day	260.00	260.00	260.00	260.00	260.00	260.00	260.00	260.00	260.00	260.00
	Burning: 3 days @ US$ 17.36	52.08	52.08	52.08	52.08	52.08	52.08	52.08	52.08	52.08	52.08
	Clearing and re-burning: 5 days x US$21.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
D.	**Sticks/Sucker**										
Seeds/Corns/											
	Nursed cocoa seedlings (1 125 @$ 0.40/seedling)	450.00	-	-	-	-	-		-	-	-
	Nursed oil palm seedlings(150@ $0.10/seedling)	-	150.00	-	-	-	-		-	-	-
	Rubber seedlings: 1 125 stumps @$0.15	-	-	168.75	-	-	-		-	-	-
	Yam (750 @ $0.42 /corn)	-	-	-	315.00	-	-		-	-	-
	Banana suckers (750 @ $0.42)	-	-	-	-	315.00	-		-	-	-
	Plantain sucker (750 @ $0.63)	-	-	-	-	-	472.50		-	-	-
	Cassava sticks (75 head loads @ $2.00-/headload	-	-	-	-	-	-	150.00		-	-
	Maize (7.5 kg @$10/ kg)	-	-	-	-	-	-		75.00	-	-
	Vegetables (nursed seedlings)	-	-	-	-	-	-		-	150.00	-
	Citrus (150 @ $1.0/seedlings)	-	-	-	-	-	-		-	-	150.00

Table 5.3b Cost Centre

No	Farm Operation Cost Up to Maturity of Plant per acre (0.41 ha)	Cocoa	Oil Palm	Rubber	Yam	Banana	Plantain	Cassava	Maize	Vegetables	Citrus
D	**Planting**										
	Bed raining 10 days @ $10.00/day	-	-	-	100.00	-	-	-	-	-	-
	Mounds raining 20 days @ $10.00/day	-	-	-	200.00	-	-	-	-	-	-
	planting 20 day @ $10.00/day	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00
E	**Farm maintenance**										
	Cash crops										
	(10/20 x weeding @ $40.00/weeding)	500.00	500.00	1000.00	-	-	-	-	-	-	-
	Food crops										
	(5/10 x weeding @ 200/weeding)	-	-	-	500.00	500.00	500.00	500.00	500.00	500.00	500.00
	Pesticides, fertilizer)	500.00	375.00	375.00	125.00	125.00	125.00	125.00	125.00	125.00	125.00
	Extension services	500.00	500.00	500.00	-	-	-		-	-	-
	Sub-total	**4 704.63**	**4 279.63**	**4 798.38**	**3 473.81**	**3 434.21**	**3 591.71**	**3 008.81**	**3 194.21**	**2 408.81**	**3 269.21**
	CONTINGENCY (10% of sub-total A)	470.46	427.96	479.84	347.38	343.42	359.17	300.88	319.42	240.88	326.92
	Sub-total B	**5 175.09**	**4 707.59**	**5 278.22**	**3 821.19**	**3 777.63**	**3 950.88**	**3 309.69**	**3 513.63**	**2 649.69**	**3 596.13**
	INCONVENIENCE (20% of Subtotal B)	1 035.02	941.52	1 055.64	764.24	755.53	790.18	661.94	702.73	529.94	719.23
GRAND TOTAL (Reimbursable cost for Crop Production)		**6 210.11**	**5 649.11**	**6 333.86**	**4 585.43**	**4 533.16**	**3 971.60**	**1 588.64**	**4 216.36**	**3 179.63**	**4 315.36**

Exchange rate: 1 US $ = GH¢4.80 (July 2018)

From the cost centre, rubber attracts the highest development cost per hectare while vegetables attract the least cost (Tables 5.3a and 5.3b). Cash crops have higher cost values than food crops and fruits or citrus. Compensation for reimbursable costs are therefore higher for cash crops.

Table 5.4 shows cocoa has the highest economic life span, followed by rubber and oil palm. Food crops mostly have shorter economic lifespan. Data from CSIR-Oil Palm Research Institute showed that oil palm over a 34-year span yields close to the 54-year yield of cocoa if the appropriate technologies are applied. However, a quarter of that yield is realised without appropriate scientific methods of cultivation. With appropriate scientific technologies, farmers derive maximum yield and improved life span of crops.

Table 5.4 Maximum Economic Lifespan and Economic yield of crop resources

Crop Resource	Economic yield/ha/year (US$)	Maximum Economic lifespan in years
Cocoa	2 375.00	54
oil palm	1 916.67	34
rubber	1 237.50	34
yam	2 238.55	1
banana	1 041.67	22
plantain	1 250.00	22
cassava	2 128.65	1
maize	2 724.48	1
vegetables	1 694.80	1
citrus	520.00	22

Exchange rate 1 US$ = GH¢4.80 (July 2018)

Site selection for projects must therefore take into consideration the kind of resources and their economic life span that are likely to be compensated for, if the cost of the project is a priority. Employing remote sensing technologies can be used to undertake the preliminary assessment for site selection.

The Cost Centre Method (CCM) of calculating compensation ensures total reinstatement of financial losses, inconvenience as well as contingencies that cannot be easily quantified. It affords a transparent method that can easily be assessed, verified and validated. The CCM therefore affords the opportunity to address the inadequacies in the current practice of calculating compensation in Ghana using the enumeration method.

The element of ensuring sustainable livelihoods for victims of compulsory acquisition is important in the compensation factor. This must however be considered from the economic life of the resources on the land. Ensuring sustainable livelihood for victims promotes their self-worth and capacity as well as confidence in the state.

5.4 The COMPACAL-G Protocols

The current protocols of compulsory acquisition and compensation in Ghana do not promote transparency, inclusion and good governance practices as enshrined in The Africa Charter and UN Conventions on Compulsory Land Acquisition and Compensation; hence the protracted conflicts and encroachment of most government lands in the country. The legislative regime is seen as weak and easily corruptible. Data collection systems and documentation are slow and fraught with mistakes. These give room for future manipulations and disputes. Where alternative livelihood programmes were recommended, they were either inappropriate or inadequate and citizens become worse off with time.

Compensation payments to communities were not adequately completed, giving room for future agitations and litigations as evidenced in case study in this research. Other losses such as emotional, cultural and religious attachments were not considered in compensation packages. Stakeholders have often misunderstood the principle of Equivalent Replacement by UN-FAO.
The acquisition and compensation processes require best practices. Each step requires protocols that ensure transparency and fairness. Figure 5.5 shows the COMPACAL-G paradigm for smooth implementation of the process.

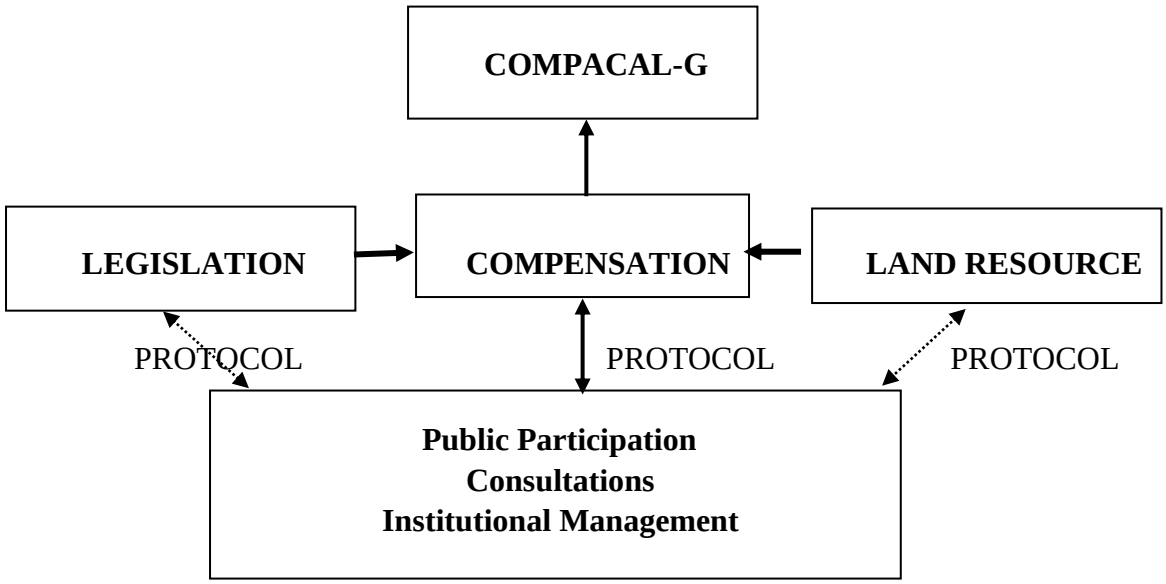


Figure 5.5 COMPACAL-G Paradigm

Figure 5.6 is the Unified Modelling Language (UML) for the COMPACAL-G implementation process. It is a modification of existing process to achieve Best Practice (Asiamah, 2015). The process starts with the acquiring body applying to the State through the Minister responsible for Lands. The acquiring body with approval of the minister engages the Lands Commission. The application is formalised and the Power of Eminent Domain is activated by the state. The necessary protocols are followed through for compensation payment and documentation.

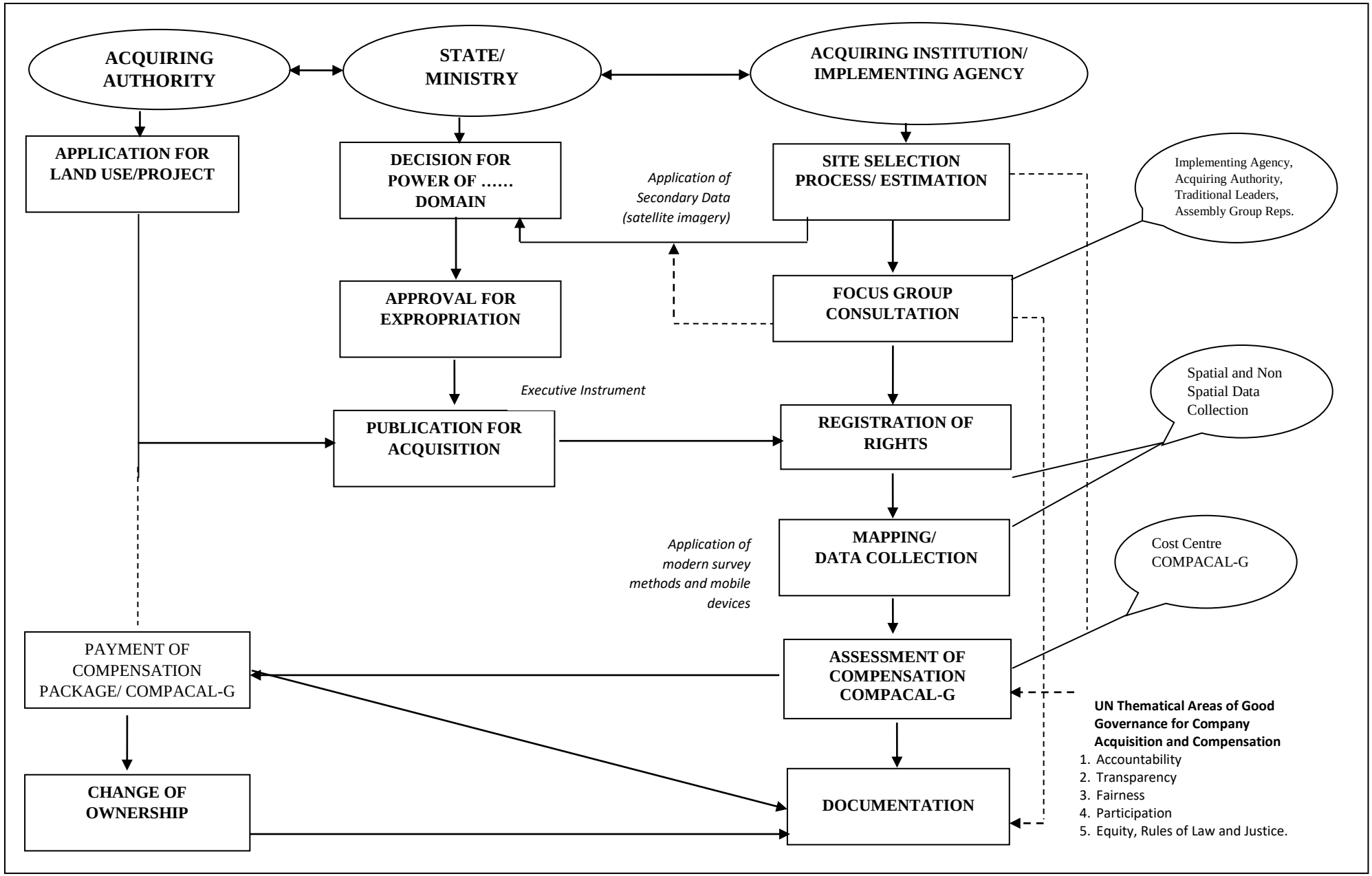


Figure 5.6 Unified Modelling Language (UML) for COMPACAL-G

5.5 Statistical Interpretation of Results

5.5.1 Regression Analysis

Table 5.5 shows the results of the regression analysis. The "F value" and "Prob (F)" statistics test the overall significance of the regression model. The smaller the value of Prob (F), the more significant the parameter and the less likely that the actual parameter value is zero. Because Prob (F) was 0.0004, it indicates there is only 4 chances in 10 000 that all of the regression parameter are zero. This low value implies that at least some of the regression parameters are non-zero and that the regression equation does have some validity in fitting the data (*i.e*., the independent variables are not purely random with respect to the dependent variable). R-squared (the coefficient of determination) is a statistical measure of how close the data are to the fitted regression line.

R-squared = Explained variation / Total variation.

R-squared is always between 0 and 100%. Zero percent (0%) indicates that the model explains none of the variability of the response data around its mean. 100% indicates that the model explains all the variability of the response data around its mean. In general, the higher the "R-squared", the better the model fits the data. From Table 5.5, R-squared is 0.9979. This represents 99.79 % and means that the model explains all the variability of the response data around its mean.

The "adjusted R-squared" is a modified version of R-squared that has been adjusted for the number of predictors in the model. The Adjusted R-squared increases only if the new term improves the model more than would be expected by chance. It decreases when a predictor improves the model less than expected by chance. The adjusted R-squared value of 0.9937 indicates how useful the variables are to the model.

5.5.2 Statistical Significance of the COMPACAL-G Multiple Linear Regression Model (equation 4.2)

The probability value (p-value) for each term tests the null hypothesis that the coefficient is equal to zero (no effect). A low p-value (< 0.05) indicates that the null hypothesis can be rejected. In other words, a predictor that has a low p-value is likely to be a meaningful addition to the regression model because changes in the predictor's (independent) value are related to changes in the response (dependent) variable. Conversely, a larger p-value suggests that changes in the predictor are not associated with changes in the response.

Since the p-values for the various predicted variables are small (< 0.05 in Table 5.5), the predicted or independent variables contribute significantly in computing compensation, therefore the result is statistically significant. The COMPACAL-G model therefore indicates that for every additional predictor variable, the compensation value, T increases.

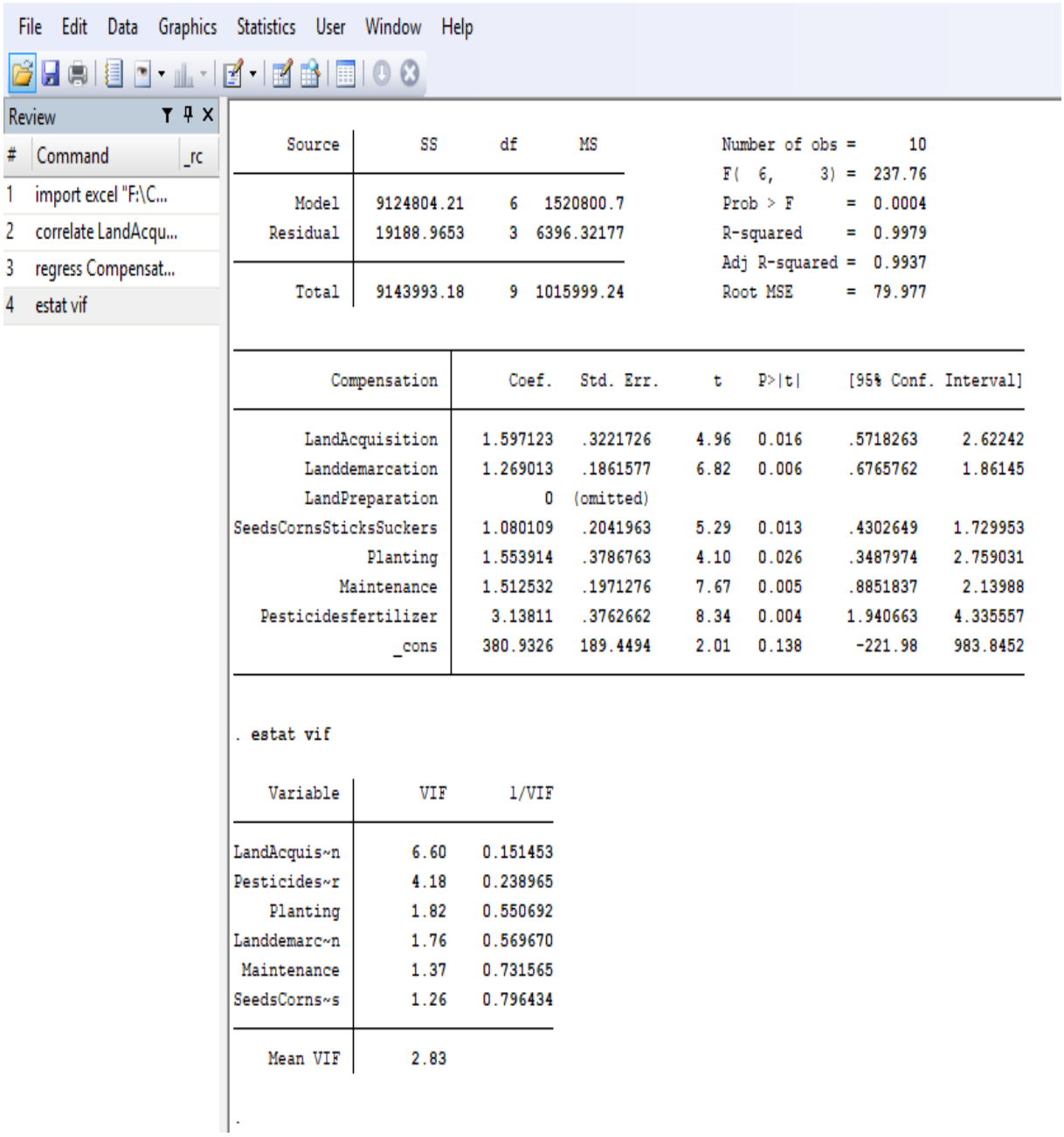
5.5.3 Correlation Analysis

Table 5.6 shows the correlation among the independent variables (activities in the Cost Centre). The correlation analysis shows that among the independent variables, the coefficient of correlation, 'r', is less than 0.5 in most cases, except for pesticides and extension services. Where more than one variable exhibit collinearity, some variables may be dropped. Extension services was dropped. This in statistical terms means correlation is mostly weak to moderate among the independent or predicted variables, hence they are not interdependent. This largely satisfies the assumption that there should be "no multi-collinearity" between independent variables. This also means that when computing for compensation, pesticides could replace extension services.

5.5.4 Variance Inflation Factor

From table 5.6, the mean value of the variance inflation factor (VIF) after dropping extension services was 2.83, which is less than 10. When VIF is 10 or more, it means the correlation coefficient among the independent variables is high and may cause multi-collinearity. With VIF being 2.83 (lower than 10), it means the independent variables can individually help to predict the dependent variable.

Table 5.5 Regression Analysis of Cost Centre using Stata software



Source	SS	df	MS	Number of obs =	10
				F(6, 3) =	237.76
Model	9124804.21	6	1520800.7	Prob > F =	0.0004
Residual	19188.9653	3	6396.32177	R-squared =	0.9979
				Adj R-squared =	0.9937
Total	9143993.18	9	1015999.24	Root MSE =	79.977

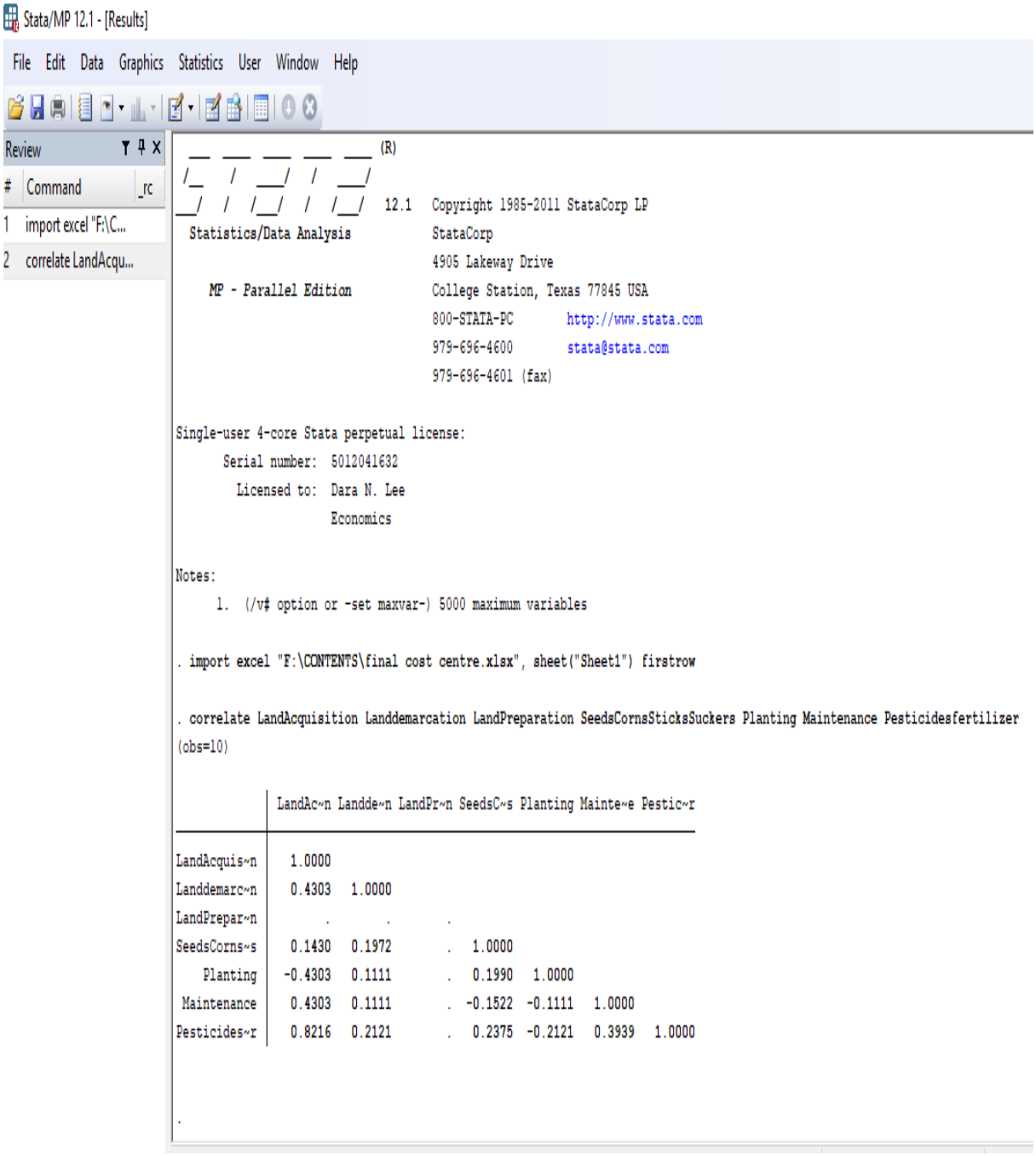
Compensation	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LandAcquisition	1.597123	.3221726	4.96	0.016	.5718263	2.62242
Landdemarcation	1.269013	.1861577	6.82	0.006	.6765762	1.86145
LandPreparation	0	(omitted)				
SeedsCornsSticksSuckers	1.080109	.2041963	5.29	0.013	.4302649	1.729953
Planting	1.553914	.3786763	4.10	0.026	.3487974	2.759031
Maintenance	1.512532	.1971276	7.67	0.005	.8851837	2.13988
Pesticidesfertilizer	3.13811	.3762662	8.34	0.004	1.940663	4.335557
_cons	380.9326	189.4494	2.01	0.138	-221.98	983.8452

. estat vif

Variable	VIF	1/VIF
LandAcquis~n	6.60	0.151453
Pesticides~r	4.18	0.238965
Planting	1.82	0.550692
Landdemarc~n	1.76	0.569670
Maintenance	1.37	0.731565
SeedsCorns~s	1.26	0.796434
Mean VIF	2.83	

.

Table 5.6 Correlation Analysis of Cost Centre using Stata Software



5. 6 COMPACAL-G Programme Output

Figure 5.7 is the output from the the programme developed for COMPACAL-G to generate an efficient database. Access by an administrator is required to enter the system. A user requires a password and username to log in. The homepage takes user to various menu where the database can be assessed for various actions including Compensation calculations. The system ensures security by restricting access.

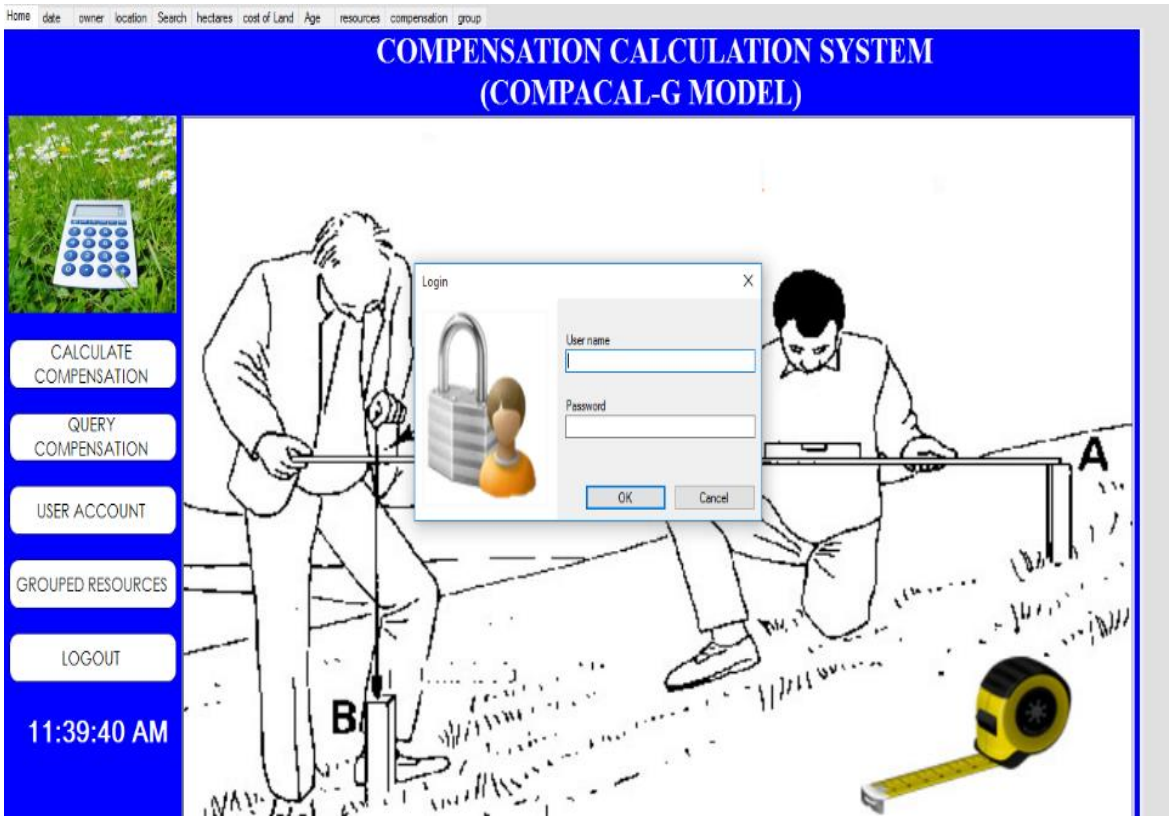


Figure 5.7 COMPACAL-G programme log in system

When access is gained to the system, the date and day are automatically recorded (Figure 5.8). This is part of the quality assurance to monitor duration of processing and payment of compensation when lands are compulsorily acquired.

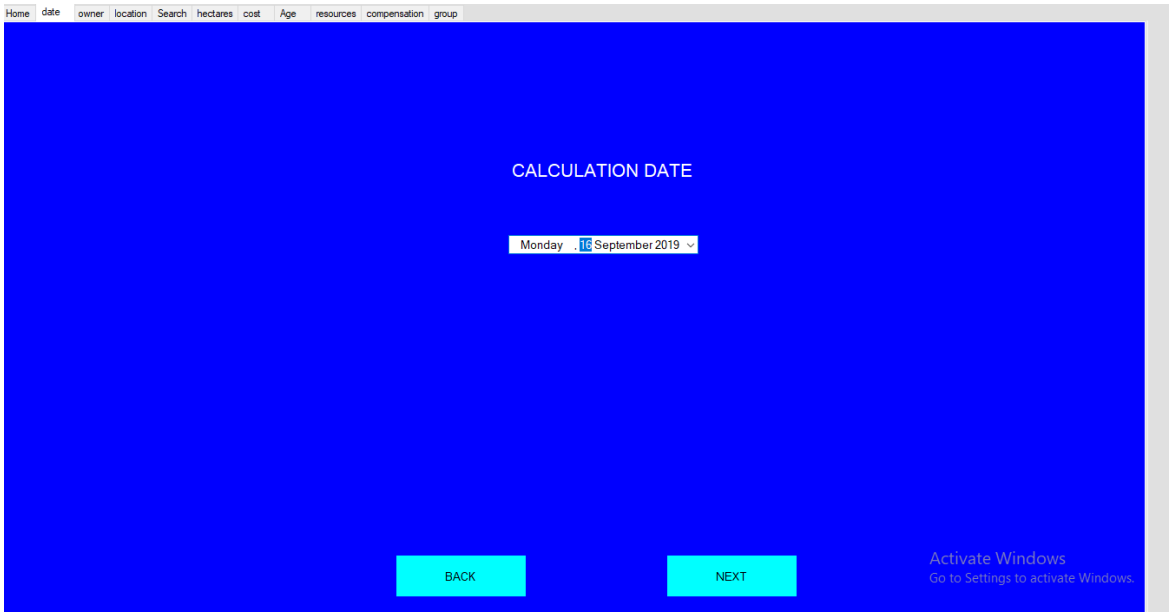


Figure 5.8 MySQL system showing date of commencement of compensation Processing.

Ownership and location identification are very important in the compensation process. The system therefore makes provision for identification of owner (Figure 5.9), location and size through the Open Data Kit App data collection system, which provides bio-data details and photographs of land owner .

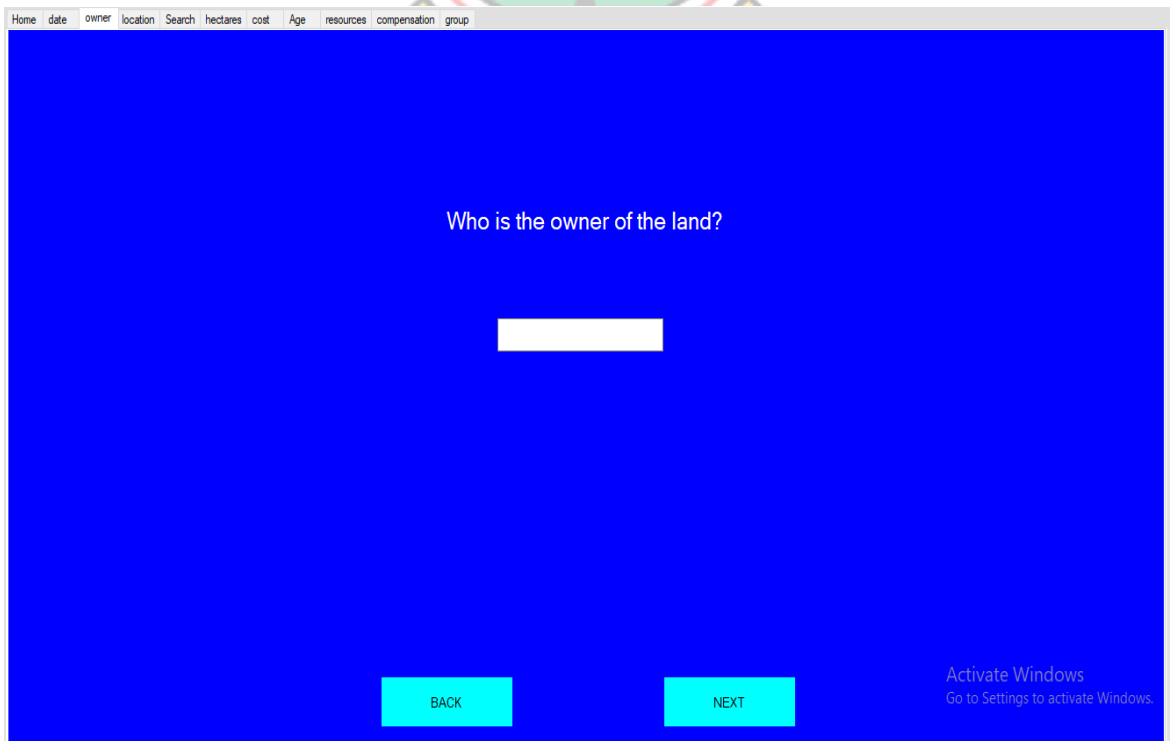


Figure 5.9 MySQL interface for ownership record

COMPACAL-G system allows for selection of all resources and size of land (Figure 5.10)

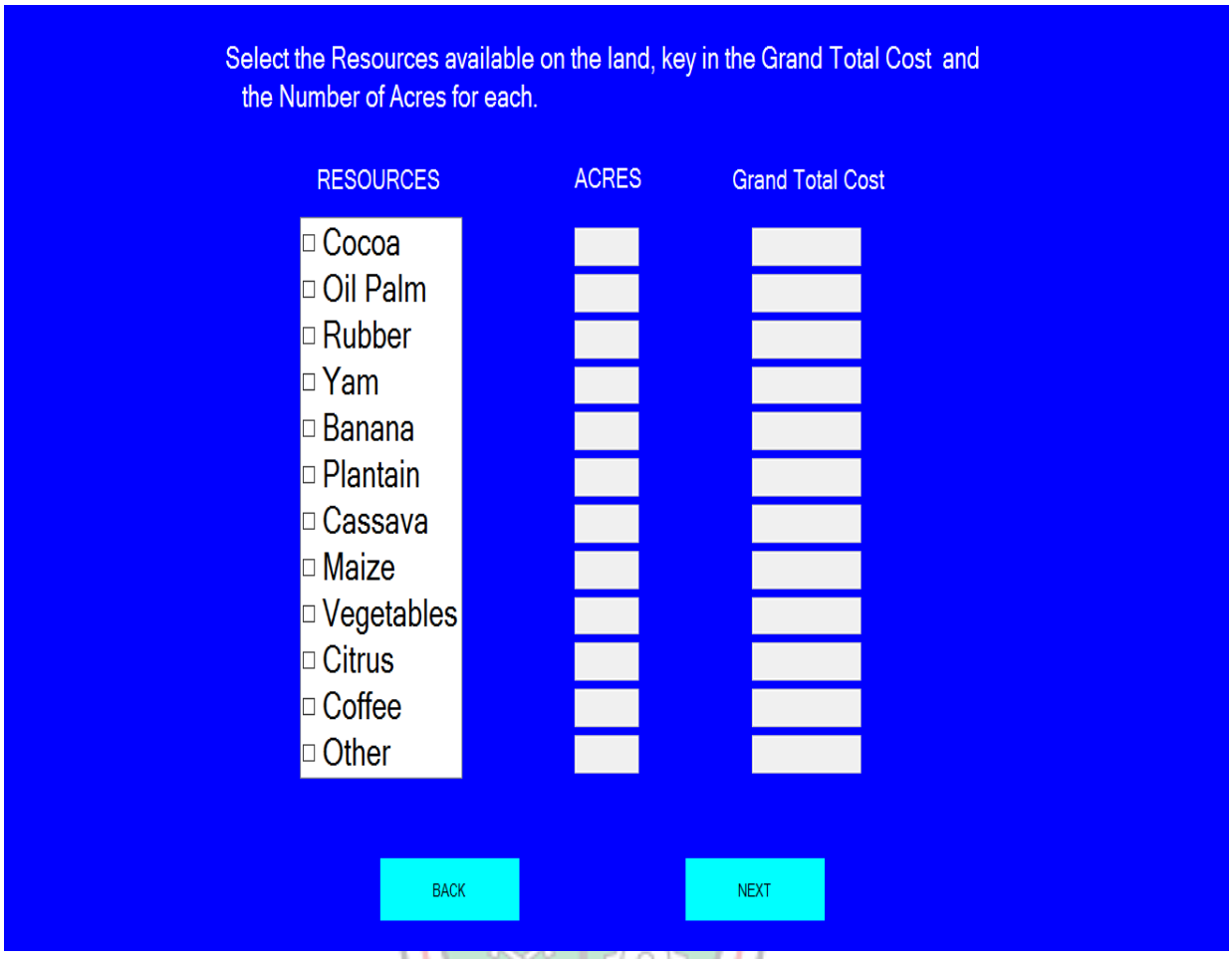


Figure 5.10 MySQL Interface for Resource Selection for Compensation Calculation

With data uploaded into MySQL programme, a compensation database is generated (Figure 5.11). The data can be queried and analysed. Certain functions are restricted for use by only the administrator to ensure security of system and its content.

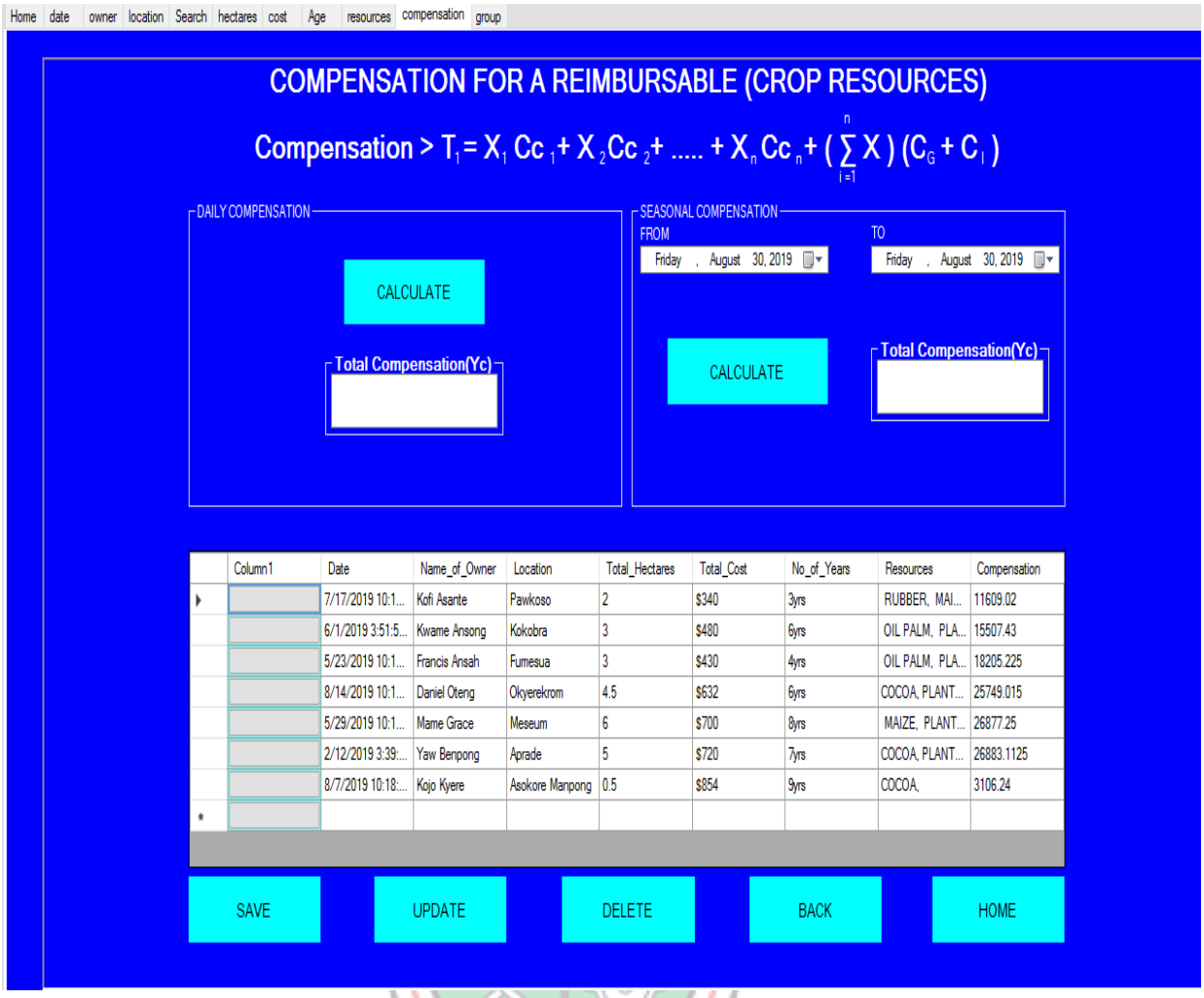


Figure 5.11 Compensation calculation database with MySQL

A

5.7 COMPACAL-G Test

The COMPACAL-G test showed differences in compensation values at the various communities at the Fumesua Science Village as computed by Lands Commission (LC) and COMPACAL-G model (Table 5.7). During the FGD, Lands Commission was requested to calculate the remaining compensation for victims of compulsory acquisition at the Fumesua Science Village. From the study, 25% compensation was paid and 50% of land encroached by 2017. The remaining compensation was therefore determined to be 25% which was 325 acres (131.52 ha) of land. Land Commission used two different approaches, the Compounded Interest formula and the Depreciated Market Value. The first was rejected.

Table 5.7 Comparison between LC and COMPACAL-G Figures in Communities in Study Area

Location	LC (US$)/acre (0.41ha)	COMPACAL-G (US$)/acre(0.41ha)
Fumesua	16 000 - 21 000	30 000 – 40 000
Okyerekrom	16 000 - 21 000	30 000 – 38 000
Aperade	16 000 – 21 000	40 000 - 45 000
Parkoso	16 000 – 21 000	28 000 – 35 000
Kokobra	16 000 – 21 000	30 000 – 36 000
Asokore Mampong	16 000 – 21 000	37 500 – 50 000
Meseum	16 000 – 21 000	40 000 – 45 000
Okyere Stool (Ama Atta)	16 000 – 21 000	40 000 – 45 000

.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

6.1.1 Compensable Resources

Fourteen (14) major compensable cash and food crops, land and buildings were identified across the country as compensable resources. This was achieved through the use of modern technologies such as:

(i) Geographic Information System (GIS)
(ii) Remote Sensing (Drone, Satellite Imagery technology)
(iii) GPS/RTK
(iv) ICT
(v) Android Mobile Phone

The tangible resources included the following:

(i) food crops (maize, cassava, yam, rice, plantain *etc.*);

(ii) cash crops (cocoa, coffee, rubber, oil palm, cashew *etc.*);

(iii) citrus (orange, pineapple, mango, coconut *etc.*);

(iv) buildings of varying sizes, materials and use; and

(v) lands with varying degree of cost depending on location, land use and pressure on demand.

The crops take various times to attain maturity. Whereas food crops take between three (3) months to three (3) years, cash crops can take between three (3) to six (6) years to attain maturity. They also have various economic lifespan. Most food crops do not last beyond one season; however, cash crops like cocoa can have between forty (40) to sixty (60) years economic life.

There are also critical intangibles that must be compensated. These are:

(i) Contingency: This arises from indirect expenditures not regularly captured or documented. By international best practice, it is taken as ten percent (10%) of direct cost; and

(ii) Disturbance Integrated Cost (or Inconvenience): Compulsory acquisition normally inflicts some amount of social costs to victims. These include environmental, socio-cultural, access to herbs (natural medicine), dislocation and psychological orientation.

The following items were the major cost build up for calculating fair and transparent compensation:

1. Land and Buildings:
   (i) Cost of land;
   (ii) Cost of land documentation; and
   (iii) Cost of landed property (buildings, farm huts etc).

2. Farms:
   (i) Cost of land preparation for farming;
   (ii) Cost of acquiring and planting seeds, seedlings, sticks;
   (iii) Cost of farm maintenance; and
   (iv) Cost of extension service.

3. Intangibles:
   (i) Contingency; and
   (ii) Cost for disturbance (social, emotional, cultural, religious)

4. Future Income:

Where there is the need to compensate for future income, provision has been made to restore the farmer over the crop economic life period.

6.1.2 Best Practice Agreements and Protocols (COMPACAL-G PROTOCOLS)

The research identified eight (8) Best Practice Protocols suitable for Ghana and which conform to International Conventions on Human Rights on Property Ownership and Good Governance Practices. These protocols can ensure security of tenure, provide sustainable livelihoods and adequate safety nets for vulnerable groups, mitigate social tensions and promote development in a free society.

The COMPACAL-G protocols developed in this research are as follows:

(i) Public Participation and Inclusion (PPI);

(ii) Development of Alternative livelihood and Empowerment Programmes (DALEP);

(iii) Recognition of Mutual Respect (RoMG);

(iv) Sensitisation and Education (S & E);

(vi) Use of Cost Centre Method (UoCCM) for calculating fair and adequate Compensation;

(vi) Use of Alternative Dispute Resolution (ADR) strategies for conflict resolution ;

(vii) Promotion of Prompt Payment of compensation (PoPP); and

(viii) Skills Development for Alternative Livelihood Management (SDfALM).

6.1.3 COMPACAL- G Model

A three-stage approach was developed for the COMPACAL–G model (Equations 4.2, 4.3 and 5.4). The stages take care of crop resources, land and buildings and expected future returns on investments in crop resources. The Cost Centre approach provided the Multiple Linear Regression Model (LRM) for calculating reimbursable for all activities relating to crop development.

$$T_1 = X_1 Cc_1 + X_2 Cc_2 + \ldots + X_n Cc_n + \left(\sum_{i=1}^{n} X_i\right)(C_G + C_i) \quad 4.2$$

$$T_2 = \sum_{i=1}^{n} M_{vi} + \left(\sum_{i=1}^{n} X_i\right) C_i \quad 4.3$$

$$T_3 = X_1 F_{v1}(P/Ai, n) + X_2 F_{v2}(P/Ai, n) + \ldots + X_n F_{vn}(P/Ai, n) \quad 4.4$$

6.1.4 COMPACAL-G Programme

The COMPACAL-G database management system (MySQL) was developed to provide a useful, easy and efficient means for calculating the compensation for land resources. It provides an easy, efficient and secure avenue to store, manage, edit, retrieve and query the database to obtain all relevant information related to the land and resources on it. The programme improves the speed of the implementation process.

6.1.5 COMPACAL-G Test

The tests of the COMPACAL-G compensation figures proved that the Lands Commission values are lower, and therefore not adequate and fair.

6.2 Recommendations

6.2.1 Site Selection Analysis

Site suitability analysis is important in the process of compulsory acquisition. A preliminary selection of alternative sites for a project must be done to first ascertain the collateral damage or losses to property, environment, displacement of population, food security and livelihood. Site selection through modern technology must be employed to minimize negative impacts on population and environment. A continuously updated database of land resources by relevant state institutions can further enhance the process of compulsory acquisition and compensation in Ghana.

Site suitability analysis must also be carried out for a preliminary assessment of the extent of compensation to be paid prior to acquisition. This stage must inform the budgeting of the project for which acquisition is required.

6.2.2 Budgeting for compensation

Compensation payments must be carefully planned, calculated and must be an integral part of project cost. Compensation payments must be done concurrently with site possession and documentation immediately the acquisition is made effective.

6.2.3 Protocols

Protocols must be strictly complied with to ensure inclusiveness for all stakeholders. Consensus is very important in ensuring peace after acquisition. Minutes of meetings, including signatories of participants and to some extent photographs are very important for future references. Every stage of the process must have the necessary protocols followed. Acquiring and implementing authorities must not be in a hurry to by-pass the relevant protocols. Stakeholders must sign all agreements reached.

6.2.4 Legal framework

The legal framework must be strictly adhered to and must leave no room for ambiguity. It must be clear to victims of acquisition. Authorities must always bear in mind the process is an "inter-generational" one. The needs of future generations must be considered. Legislation must be expanded to incorporate what is deemed to be fair, adequate and just compensation. It must also state time frame for compensation payment and sanctions for delayed payments.

6.2.5 Physical Demarcation and Protection of Land

The presence of the acquiring authority must be felt immediately after the compensation package has been concluded. The boundaries must be clearly marked with visible notices at the site. This situation will avoid encroachment.

6.2.6 Improvement in Land Administration

The land administration system must be improved to make information on land easily accessible. This will improve the land tenure system and promote the land market. An improved land management system will safeguard resources and the interest of vulnerable groups. This research could have been improved if a database of land values and land tenure systems in all regions and districts were available.

6.2.7 Development of Cost Indices (CI) for crop resources

The development and publication of cost indices for crops as has been done for the building industry will protect farmers from underpricing when it comes to compensation calculations. The cost indices will take care of market fluctuations and assure farmers of fair and adequate compensation when dispossessed of their lands. The valuation process must be refined to meet international best practice, instead of the annual percentage adjustment of figure by 10 – 12%.

6.2.8 Alternative Livelihood Programme

Alternative livelihood and empowerment programmes (DALEP) with active participation (PPI) of vulnerable groups must be a key part of the compensation package. It may involve one of the following recommendations:

(i) provision of subsidised loans to farmers for start-up businesses;

(ii) alternative livelihood programmes such as skills/vocational training;

(iii) provision of jobs;

(iv) equity in business; and

(v) alternative land.

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APPENDIX 'A'

FUMESUA

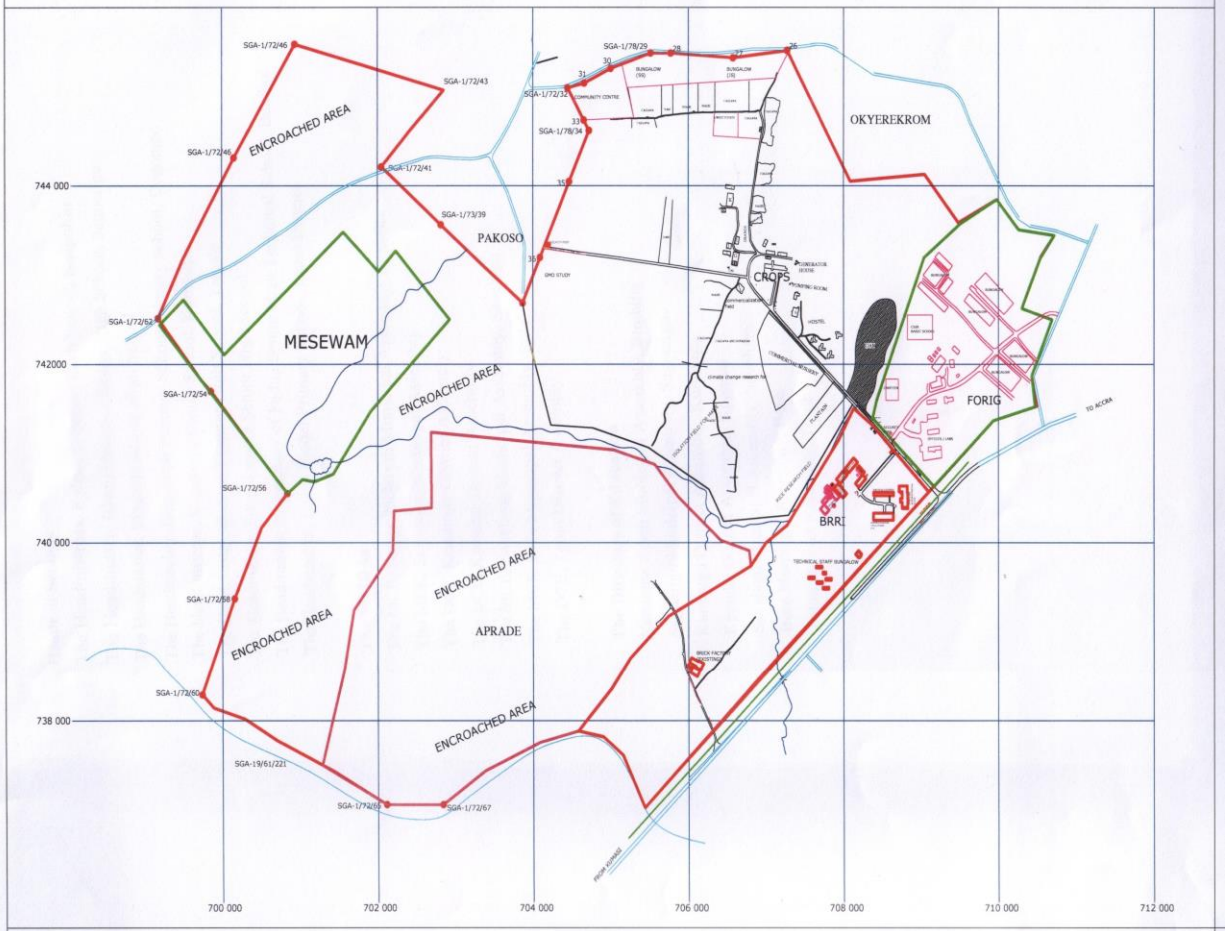
SITE FOR COUNCIL FOR SCIENTIFC AND INDUSTRIAL RESEARCH INSTITUTE

SHOWN EDGE PINK

AREA= 1441.578 ACRES

PROPRIETARY

E. I. 14 OF 17TH MARCH 1972



BASED ON PLAN No Z4637

PLAN No L.D. 7795A/45065

LVB (P) 1160

REVISIONS
J.D.K
25:11:74
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20/01/2015

APPENDIX B

LIST OF ABBREVIATIONS

AERRO	Association of Eastern Region/Rubber Outgrowers
AIR	Animal Research Institute
BRRI	Building and Road Research Institute
Cg	Contingency Cost
CI	Cost Indices
CRI	Crop Research Institute
CRIG	Cocoa Research Institute of Ghana
CC	Cost Centre
COMPACAL-G	Compensation Package for Compulsory Acquisition of Land in Ghana
CSIR	Council for Scientific and Industrial Research
CV	Current Value
EVM	Economic Value Model
FAO	Food and Agriculture Organisation
FGD	Focus Group Discussions
FORIG	Forestry Research Institute Research
GIS	Geographic Information System
GPS	Global Position System
GNSS	Global Navigation Satellite System
GREDA	Ghana Real Estate Developers association
Id	Disturbance Integrated Costs or Inconvenience
KNUST	Kwame Nkrumah University of Science and Technology
LPI	Land Price Information
MKV	Market Value
MV	Market Value
ODK	Open Data Kit
OPRI	Oil Palm Research Institute
RPGL	Rubber Plantation Ghana Limited
RTK	Real Time Kinematic
SARI	Savannah Agricultural Research Institute
TC	Total Compensation
UAV	Unmanned Aircraft Vehicle
UN	United Nations
WTACd	Contingent Value of Disturbance Entitlement

APPENDIX C

```
0 references
Private Sub BunifuFlatButton32_Click(sender As Object, e As EventArgs) Handles BunifuFlatButton32.Click
    Try
        Dim total As String
        Dim a As String
        Dim x1 As String
        Dim b As String
        Dim x2 As String
        Dim c As String
        Dim x3 As String
        Dim d As String
        Dim x4 As String
        Dim f As String
        Dim x5 As String
        Dim g As String
        Dim x6 As String
        Dim h As String
        Dim x7 As String
        Dim i As String
        Dim x8 As String
        Dim j As String
        Dim x9 As String
        Dim k As String
        Dim x10 As String
        Dim l As String
        Dim x11 As String
        Dim m As String
        Dim x12 As String
```

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