Improving Land Rights: A Model for Determining Compensation Package (Compacal-G) for Compulsorily Acquired Land in Ghana

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Key words: compulsory acquisition, compensation, geo-spatial, statistical model, resources

ABSTRACT

Ghana’s economy accelerated to 8.1 % in 2017, driven by the mining and oil sectors, making it the fastest growing African economy, trailing only Ethiopia. Industry’s growth is expected to improve to 9.7 % in 2019. These growth rates are expected to translate into the improvement and growth of Industry and infrastructure (SDG 9), which requires large tracts of land. The growth of the mining sector also requires large tracts of agricultural lands. However, 80 % of the land in Ghana are customarily owned. This requires government to compulsorily acquire land for public good to improve life on land (SDG 11 & 15). Government must also pay fair and adequate compensation to land losers as required by the Constitution of Ghana. Over the years, these acquisitions have been met with violence, tension and litigations due to unfair, inadequate and non-transparent compensations. When compensations are paid, they are delayed due to data acquisition and processing challenges. This promotes inequity, loss of livelihood and poverty. This study set out to identify compensable agricultural resources by applying modern geo-spatial technologies to create a geo-database of major resources in the sixteen regions in Ghana. A Cost Centre and “linear regression model” was generated by adequately costing all the elements for developing the resources. The process was inclusive of major stakeholders and was scientifically done in accordance with best practice. The computerised model package, COMPACAL-G was developed to ensure fair, adequate and transparent compensation that promotes equity (SDG 10), ensures sustainable livelihood for vulnerable farmers and mitigates poverty (SDG 1). COMPACAL-G ensures faster data acquisition, processing, assessment of fair, transparent and prompt compensation calculation, which the present system fails to address. COMPACAL-G can be used to undertake desk top preliminary assessment of possible compensation figures prior to acquisitions. This enables compensation to be adequately factored into project costs at the inception stage.

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1. INTRODUCTION

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. 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'' (FAO, 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 required to put the dispossessed landowner in the same position as if his property had not been acquired. Compulsory acquisition therefore requires the determination of the right balance between the public need for land on the one hand, and the provision of land tenure security and the protection of rights on the other hand (FAO, 2008a). Problems arise when compulsory acquisition and compensation is 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: confidence in tenure security is lost and investment in land becomes unattractive to the business community.

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. 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, 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. The process does not promote equity. 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 (FAO, 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 what the landowner would lose, especially vulnerable but hard working farmers. Specifically, the study aimed at deriving a model for crop compensation when agricultural lands belonging to the vulnerable in society are lost.
The objectives of the study were to:

(i) identify various crop resources on the land using remote sensing, GPS and GIS Technologies; and
(ii) develop a model for the estimation of fair and transparent compensation package for compulsorily acquired lands (COMPACAL-G).

2 MATERIALS AND METHODS

2.1 Study Area

Ghana is a country in West Africa, south of the Sahara. It consists of sixteen region. Lake Volta, the largest artificial lake on the planet dissects the country as seen in figure. The horizontal width of Ghana is approximately 329.21 km and the vertical Length is 557.7 km (Anon). 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), (Figure 3.1). 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 *et al*., 2003; Aryeetey, 2007 and 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, 2016).

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, cocoa, 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, 2016 and Anon, 2010a).

2.2 Materials and Methods

2.2.1 Materials

The following materials were used to obtain data on agricultural resources for the study area:

(i) Satellite imagery, drone, aerial photographs and existing maps to identify various resources on land (ii) Global Position System (GPS) (iii) Drone

The following were the software used in the study: (i) ArcGIS (ii) Visual Basic
(iii) STATA (statistical software (iv) Microsoft MySQL

2.2 Methods

2.2.1 Conceptual framework of the Study

Figure 2.1 shows the conceptual framework of the study. Primary and secondary data were collected and stored unto a workstation. Land resources database were 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.

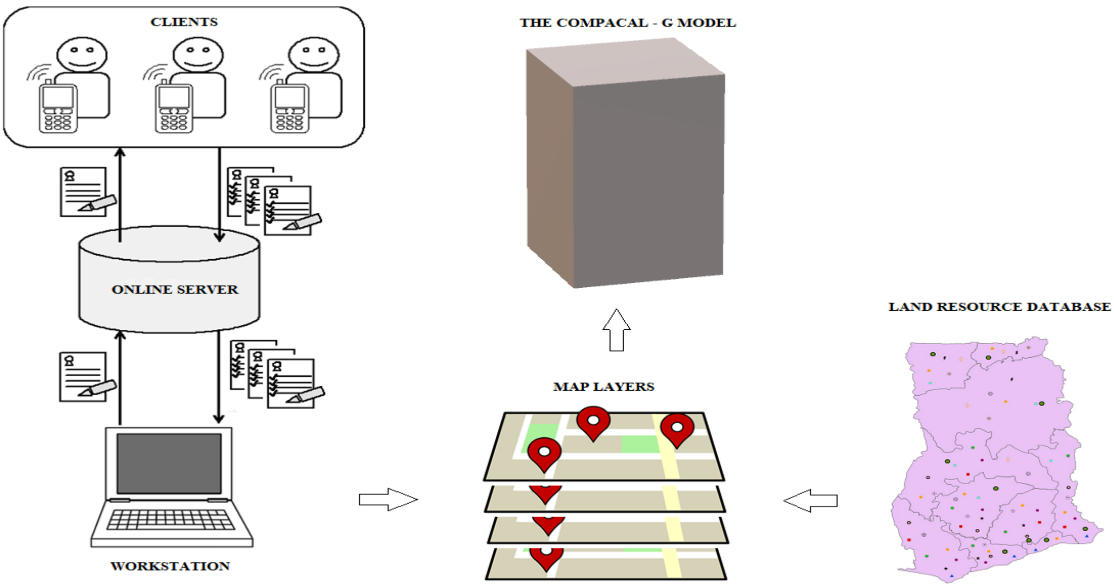


Figure 2.1 Conceptual framework of study

2.2.2 Determination of Resources

Land cover is a fundamental variable in many scientific studies such as resource investigations (Chen *et al*., 2018). The use of classifications 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 agricultural 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. Interviews and focus group discussion was held with stakeholders, including the Lands Commission.

With the satellite imagery data, drone surveys, ground truthing with GPS/ RTK and Open

Data Kit (ODK) Collect applications, 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. The process enabled data to be easily transmitted to a server for data processing. Where digital data was not sufficient, paper maps and ground survey methods were applied to improve the database. Ground survey methods included the use of GPS/RTK. From the land resource database, the major resources were identified for consideration in developing compensation and the COMPACAL-G model. Figure 2.3 shows the flow chart for creating the land resource geo-database.

2.2.3 Cost Centre (CC) Development

This study used quantitative methods to build Cost Centre (CC) for the various activities that go into developing the various resources identified using Visual Basic. 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, elements, activities and inputs on the acquired land, including intangibles and inconveniences are properly priced. Farmers in the cultivation of the various crops were engaged at community levels and market centres. Recognised farmer Associations were also engaged. Data was obtained from Agricultural Research Institutes and Ministry of Food and Agriculture (MOFA). Land values within the CC can experience minor variations based on location. The average agricultural land values was used in the study. The dollar to cedi exchange rate at time of developing the cost centre in July, 2018 was US$1.00 = GH¢4.80. From the CC, a mathematical equation was derived. 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 3.3). 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 expected future income to farmers.

2.2.4 Statistical Modelling

Statistical analysis was carried out to estimate the relationship between the variables in the CC using STATA. 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 analysis was also intended to understand which factors impacted most on compensation calculation and which can be ignored. The analysis established the statistical significance of the model.

2.2.5 MySQL COMPACAL-G Programme

A computer programme was developed to run the COMPACAL-G model. The visual studio was used to develop the front end or the interface. The Visual Studio was connected to the database (MySQL -WAMP) by source code. Visual Basic (VB) was the programming language used for executing all the codes in this application to give an efficient system. Figures 3.2 show MySQL interfaces for compensation calculation database.

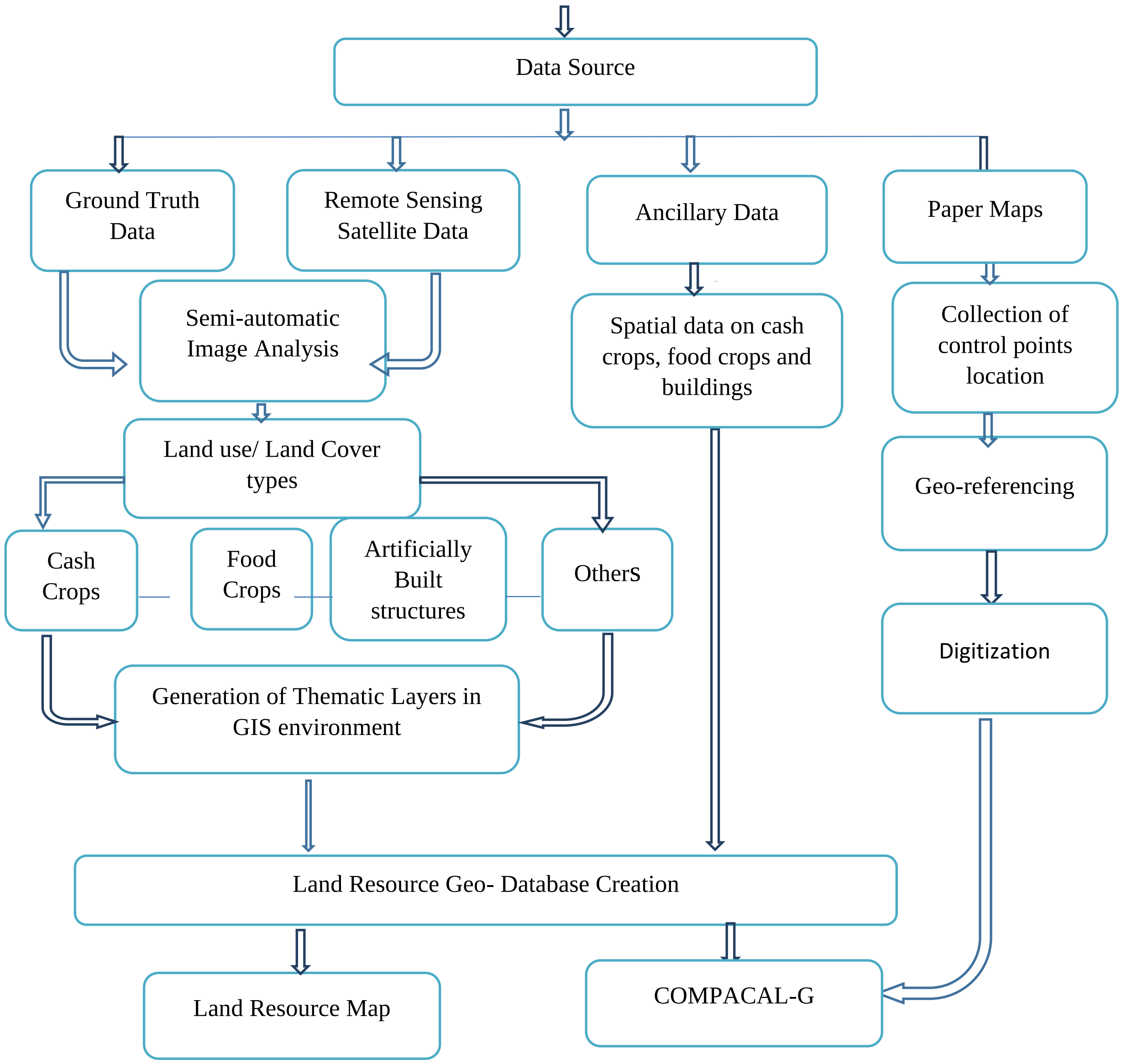


Figure 2.3 Flow Chart for Determination of Land Resource Database

3 RESULTS AND DISCUSSION

3.1 Land Resource Geo-Database

Figure 3.1 and Table 3.1 show the distribution of major crop resources in Ghana. Table 3.2 shows the Cost Centre (CC)

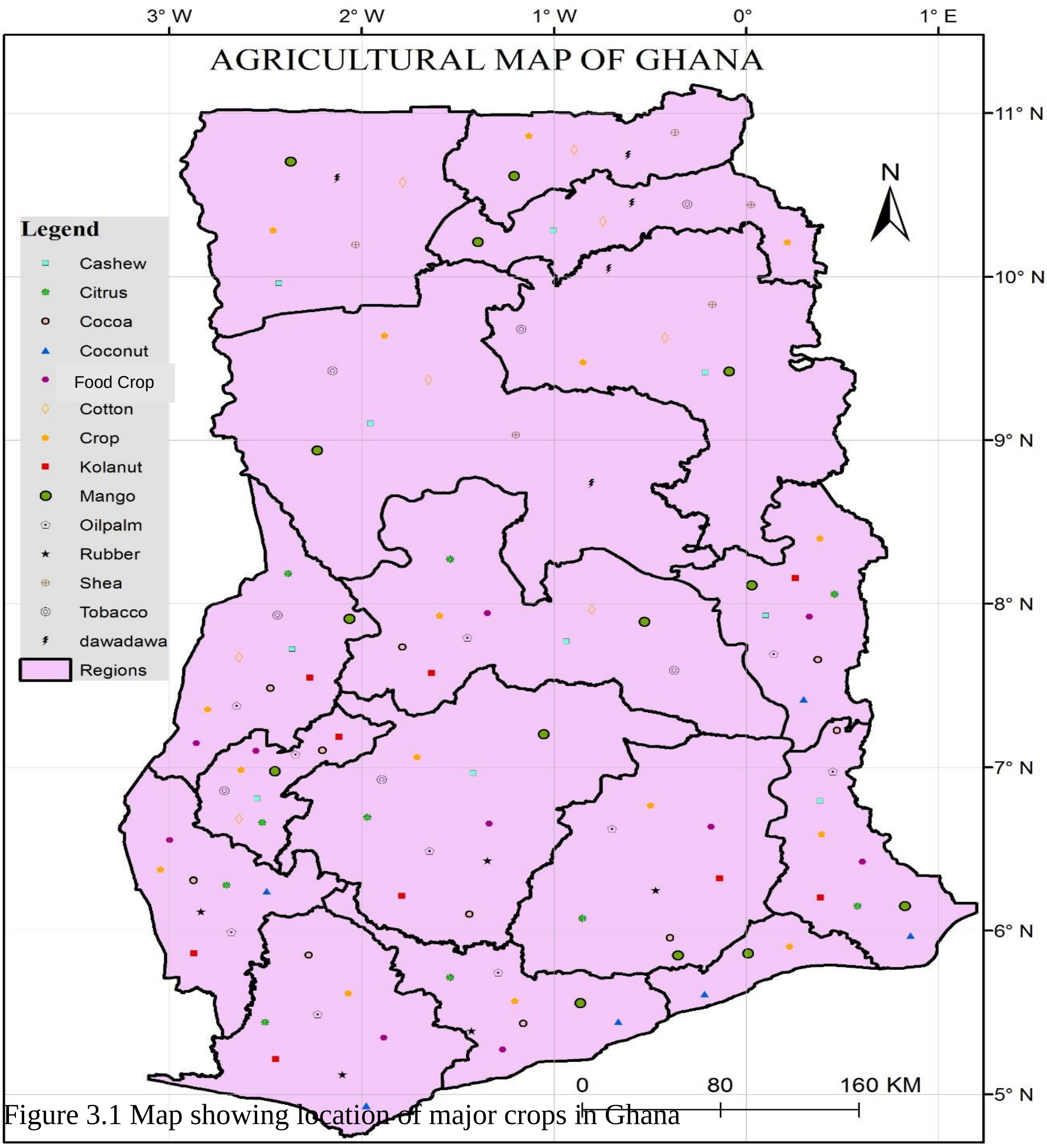


Figure 3.1 Map showing location of major crops in Ghana

Table 3.1 Regional Distribution of Crops in Ghana

Region	Cashew	Citrus	Cocoa	Coconut	Coffee	Cotton	Food Crops Crop	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		✓	✓	✓	✓		✓	✓		✓	✓			

Table 3.2a Cost Centre

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$21.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
D **Seeds/Corns/**	**Sticks/Sucker**										
	Nursed cocoa seedlings (1 125 @$ 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 3.3b 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 Mounds raining 20 days @ $10.00/day planting 20 day @ $10.00/day	 - - 200.00	 - - 200.00	 - - 200.00	 100.00 200.00 200.00	 - - 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) Extension services	500.00 500.00	375.00 500.00	375.00 500.00	125.00 -	125.00 -	125.00 -	125.00	125.00 -	125.00 -	125.00 -
	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

Table 3.3 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)

3.2 Mathematical Modelling for COMPACAL-G

The CC was used to compute the compensation (reimbursable cost) for the crop resources on the land. The farmer or land owner is thus fully reimbursed for all financial inputs. The defining mathematical equation from the CC is therefore formulated in terms of elementary algebra as:

$$T_1 = X_1 Cc_1 + X_2 Cc_2 + \cdots + X_n Cc_n + (\textstyle\sum_1^n X) C_G + (\textstyle\sum_1^n X) C_I \qquad 1.1$$

$$T_1 = X_1 Cc_1 + X_2 Cc_2 + \ldots + X_n Cc_n + (\textstyle\sum_{i=1}^n X_i)(C_G + C_i) \qquad 1.2$$

where

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

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

$$C_G = Contigency\ cost\ per\ hectar$$

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

3.3 Compensation for Future profits (Return on Investments)

The second package has to do with the compensation for 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 to be selectively applied for economic crops according to their economic life span. 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 disadvantage, creates tension, insecurity and loss of livelihood. The mathematical model for compensation for future profits is given as:

$$\boldsymbol{T_3 = X_1 F_{v1}(P/Ai, n) + X_2 F_{v2}(P/Ai, n) + \ldots + X_n F_{vn}(P/Ai, n)} \qquad 1.3$$

Where P/Ai = Present of Annual income

$F_{v2} \ldots F_{vn} =$ *Future Value of Crop per hectare per year*

n = number of years of economic life

i = interest rate

The Net Present Value (NPV) of Future Projected Income $[\boldsymbol{F_{v1}(P/Ai, n)}]$ for each crop is derived from financial Capital Budgeting model (Jaggerson, 2013):

$$\text{NPV} = Xc \sum_{t=0}^{n} \frac{R_t}{(1+i)^t} \qquad 1.4$$

Where R_t = net cash inflow – outflows per hectare per year (Annual yield)

Xc = no of hectares of crop

i = return on investment (ROI), $t = economic\ life\ span$ of crop

3.4 Statistical Significance of the COMPACAL-G Model

Table 3.4 provides the results of the regression analysis using data in the Cost Centre. In Regression analysis, 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 3.4), 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. The COMPACAL-G model, equation 1.2, hence satisfies a Linear Regression Model.

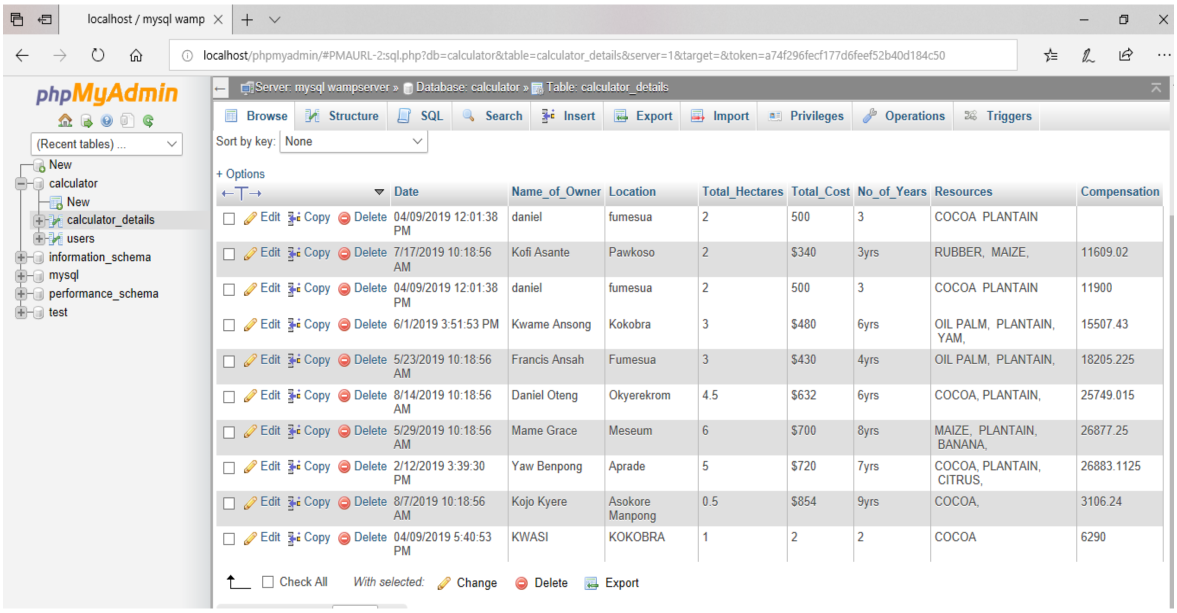
Table 3.4 Regression Analysis of COMPACAL-G Model of Cost Centre

```
        Serial number:  5012041632
          Licensed to:  Dara N. Lee
                        Economics

Notes:
      1.   (/v# option or -set maxvar-) 5000 maximum variables

. import excel "E:\final cost centre.xlsx", sheet("Sheet1") firstrow

. regress Compensation LandAcquisition Landdemarcation LandPreparation SeedsCornsSticksSucke
> nsionservices
note: LandPreparation omitted because of collinearity
```

Source	SS	df	MS
Model	9143690.65	7	1306241.52
Residual	302.533056	2	151.266528
Total	9143993.18	9	1015999.24

Number of obs	= 10
F(7, 2)	= 8635.36
Prob > F	= 0.0001
R-squared	= 1.0000
Adj R-squared	= 0.9999
Root MSE	= 12.299

Compensation	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LandAcquisition	1.354068	.0541092	25.02	0.002	1.121255	1.586881
Landdemarcation	1.32	.0289891	45.53	0.000	1.19527	1.44473
LandPreparation	0	(omitted)				
SeedsCornsSticksSuckers	1.286379	.0364259	35.31	0.001	1.129651	1.443107
Planting	1.338492	.0613421	21.82	0.002	1.074558	1.602425
Maintenance	1.321261	.0348138	37.95	0.001	1.171469	1.471052
Pesticidesfertilizer	1.419491	.1643312	8.64	0.013	.7124307	2.126551
Extensionservices	1.23484	.1105114	11.17	0.008	.7593476	1.710332
_cons	736.245	43.12694	17.07	0.003	550.6847	921.8052



Date	Name_of_Owner	Location	Total_Hectares	Total_Cost	No_of_Years	Resources	Compensation
04/09/2019 12:01:38 PM	daniel	fumesua	2	500	3	COCOA PLANTAIN	
7/17/2019 10:18:56 AM	Kofi Asante	Pawkoso	2	$340	3yrs	RUBBER, MAIZE,	11609.02
04/09/2019 12:01:38 PM	daniel	fumesua	2	500	3	COCOA PLANTAIN	11900
6/1/2019 3:51:53 PM	Kwame Ansong	Kokobra	3	$480	6yrs	OIL PALM, PLANTAIN, YAM,	15507.43
5/23/2019 10:18:56 AM	Francis Ansah	Fumesua	3	$430	4yrs	OIL PALM, PLANTAIN,	18205.225
8/14/2019 10:18:56 AM	Daniel Oteng	Okyerekrom	4.5	$632	6yrs	COCOA, PLANTAIN,	25749.015
5/29/2019 10:18:56 AM	Mame Grace	Meseum	6	$700	8yrs	MAIZE, PLANTAIN, BANANA,	26877.25
2/12/2019 3:39:30 PM	Yaw Benpong	Aprade	5	$720	7yrs	COCOA, PLANTAIN, CITRUS,	26883.1125
8/7/2019 10:18:56 AM	Kojo Kyere	Asokore Manpong	0.5	$854	9yrs	COCOA,	3106.24
04/09/2019 5:40:53 PM	KWASI	KOKOBRA	1	2	2	COCOA	6290

Figure 3.2 MySQL COMPACAL-G database

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Compensable Agricultural Resources

Modern geo-spatial technologies like remote sensing and GIS as well as ICT tools like ODK care useful tools to derive improved spatial data of major agricultural produce in Ghana. These technologies improve the duration of data collection which has been a major cause of compensation delays, which affect vulnerable farmers as well as project delivery. Fourteen (14) major compensable cash and food crops were identified across the country as compensable agricultural products. The major agricultural resources identified included the following:

(i) food crops (maize, cassava, yam, rice, plantain *etc.*);
(ii) cash crops (cocoa, coffee, rubber, oil palm, cashew *etc.*); and
(iii) citrus (orange, pineapple, mango, coconut *etc.*).

4.2 The COMPACAL-G Model

The model (Equations 1.2 and 1.3) provide a better avenue to adequately compensate farmers than the current practice by the Lands Commission, which does not adequately compensate for all the development cost, inconvenience and future income. It is fair and transparent. The model is statistically significant. COMPACAL-G will improve livelihoods for vulnerable groups, especially in rural communities who continue to lose their land to large mining companies, industrial establishments and government infrastructure projects.

4.3 MySQL COMPACAL-G Programme

The programme allows for easy, fast and efficient way of generating compensation. The system has a log-in administrator system to protect the integrity of the database. The system can easily retrieve, query, manage, analyse and store data.

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