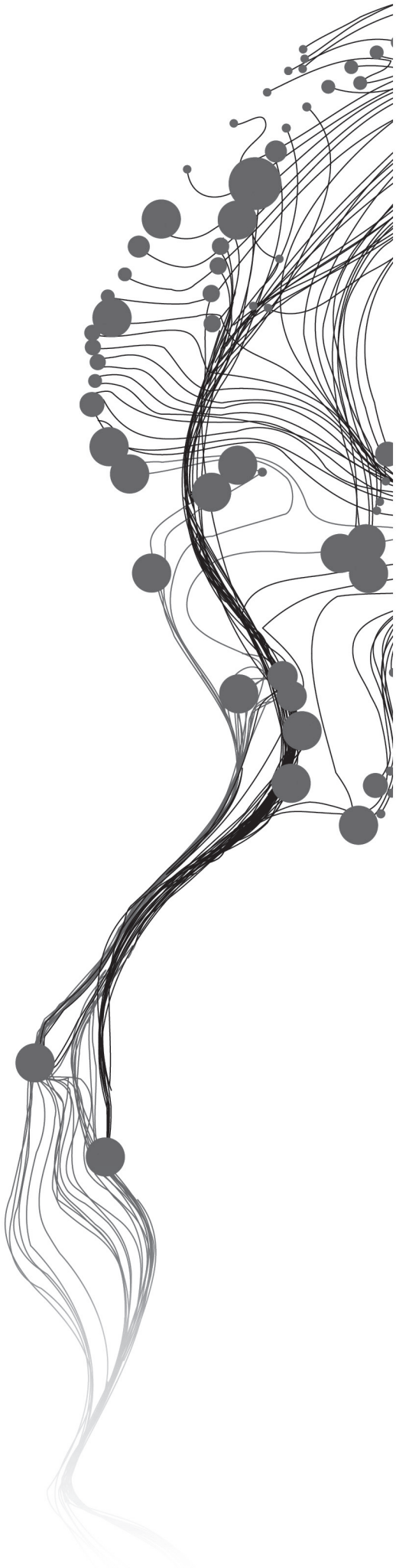
TOWARDS A DISTURBANCE-INTEGRATED COMPENSATION METHOD FOR LAND EXPROPRIATION: A CASE OF RWANDA

JOSEPH OBAJE ATAGUBA

March, 2014

SUPERVISORS:

Ir. E.M.C. Groenendijk
Dr. Ir. W.T. de Vries



TOWARDS A DISTURBANCE-INTEGRATED COMPENSATION METHOD FOR LAND EXPROPRIATION: A CASE OF RWANDA

JOSEPH OBAJE ATAGUBA
Enschede, The Netherlands, March, 2014

Thesis submitted to the Faculty of Geo-Information Science and Earth Observation of the University of Twente in partial fulfilment of the requirements for the degree of Master of Science in Geo-information Science and Earth Observation.
Specialization: Land Administration

SUPERVISORS:
Ms. Ir. E.M.C. Groenendijk
Dr. Ir. W.T. de Vries

THESIS ASSESSMENT BOARD:

Prof. dr. J.A. Zevenbergen	(Chair)
Ms. Ir. E.M.C. Groenendijk	(First supervisor)
Dr. Ir. W.T. de Vries	(Second supervisor)
Ms. Dr. M. van Eerd	(External examiner, IHS, Rotterdam)

ABSTRACT

Market value assessment techniques cannot value disturbance entitlements of expropriated landowners, thereby inhibiting their financial capacity to relocate and purchase equivalent property with market value compensation. This research aimed to develop disturbance-integrated compensation method which enhances compensation for expropriated landowners compared to assessed market value compensation. Data for designing prototype of disturbance-integrated compensation method were harnessed in connection with land expropriation and compensation for the proposed Bugesera international airport in Rwanda; among which include spatial information of expropriated parcels; market valuation report of expropriated properties; interview responses on expropriation and compensable entitlements; and double-bounded dichotomous bidding of landowners' willingness to accept compensation (WTAC) for disturbance in Karera cell. Synthesis of economic valuation literature with exploratory data led to development of disturbance-integrated compensation method to meet design criteria of summation of market value of real property with integral calculus of recursive cumulative logistic equation of each landowner's WTAC for disturbance entitlements comprising variables of removal cost, relocation cost, loss of livelihood, loss of income, psychological damages, and landowner's unique circumstances. Significant variables determining WTAC for disturbance in the study area include gender and education level, which are classified under unique circumstances of expropriated landowner; number of relocation trips and household size, which are classified under relocation cost; and quality of family ties after expropriation, which is classified under psychological damages. The definite integral calculus of recursive cumulative logistic function predicted disturbance compensation for expropriated landowners within the bounds of a censored maximum amount. Conclusions from the test of the prototype of disturbance-integrated compensation method indicate that it computes a significantly higher compensation for land expropriation compared to the market value method. While further research with larger sample size is required to validate this compensation method in other cases of mass expropriation for public purpose, the design criteria for this compensation method could be used to develop appropriate compensation techniques for expropriated persons without formal land titles.

Keywords: *Compensation, Land expropriation, Valuation, Willingness to accept compensation, Disturbance, Market value, Disturbance-integrated compensation method*

ACKNOWLEDGEMENTS

My first acknowledgement goes to God almighty for seeing me through all raging storms and obstacles in my career and giving me the courage to commence and successfully complete postgraduate education in the Netherlands. *Abba father, confitebor tibi in saeculum*.

The Holy Bible in the book of Luke 6:40 outlined that *"a pupil is not ranked above his teacher; but any pupil who has successfully completed his training will be made like his teacher"*. In view of this statement, I wish to specifically thank my thesis supervisors: Ir. E.M.C. Groenendijk and Dr. Walter de Vries and all my course lecturers for imparting the relevant skills required for research and practice of land administration. Furthermore, I appreciate contributions from Prof. Anne Van der Veen and Drs. Emile Dopheide.

I also want to thank all student affairs officers at Faculty of Geo-Information Science and Earth Observation (ITC) for arranging travel logistics for the conduct of my research fieldwork in Rwanda. I also acknowledge classmates from Rwanda for their support. To Ms. Biraro Mirielle, Mr. Francois Ntaganda, Mr. Potel Jossam, Mr. Sylvain Muyombano, Mr. Feliceien Nuroningiye, and Mr. Jean Manirakiza I say *"Murakoze"*. I also extend my profound appreciation to Mr. Peter Fosudo, Ms. Mkwaya Songo, and Mr. Volkwin Nekondo for their critical attitude towards my research. You all made me ponder on my work: *"How will readers interpret this statement when this thesis is placed on their desk?"* I will also miss Mr. Liyang Qian, Mr. Joshi Suresh, Mr. Nugroho Susetyo, Ms. Susan Keuber, Ms. Fikerte Yimer, and Ms. Saron Wube. We all made a wonderful class of students on the land administration course at ITC.

I wish to thank the following persons and organizations in Rwanda for their cooperation with data collection. They are the Director, Urbcon Consultancy Ltd., Kigali; the Manager, Brighton Enterprise Ltd., Kigali; the Managing Director, and staff of Landmark Ltd, Kigali; Staff of Rwanda Ministry of Infrastructure; Dr. Emmanuel Nkurunziza, Mr. Didier Sagashya and other staff of Lands and mapping department of RNRA; the Mayor of Bugesera district; the cell leader, and all village heads in Karera cell; residents of Karera cell; and my fieldwork assistant in the person of Mr. Patrick Ngabonzima.

At this juncture, I wish to thank NUFFIC for granting me a fellowship (NFP) to study MSc in Land administration at the University of Twente, the Netherlands. I also want to thank my employing organization (The Federal Polytechnic, Idah) in Nigeria for granting me study leave as well as financial support throughout the study period. To the officers of the polytechnic who made it possible for me to study in the Netherlands - Alhaji Abu Karim (Registrar), Mr. Ernest Okoriko (Deputy Registrar), Mrs. Florence F. Falana (Head, Department of Estate Management), Surv. C. Ogubuke (Dean, School of Environmental Studies), Dr. Baba Danjuma (Department of Languages), and other colleagues who know themselves to be in the train of my well wishers, I salute you!

Finally, I owe a profound gratitude to my father (Surv. Stephen O. Ataguba), who encouraged me throughout the tough periods of my social development, career, and studies. Many years ago when my dad studied Land surveying in Nigeria, he never figured it out that one of his sons will follow land related careers by pursuing degrees in Estate Management and Land Administration respectively. Daddy, can I say that you sowed one seed for yourself so that your son could reap two?

Joseph Obaje Ataguba

Enschede,
March 2014.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

CV	Contingent valuation
DDG	Deputy Director-General
DICM	Disturbance-integrated compensation method
$E(WTA_k)$	Estimated disturbance compensation for an expropriated landowner
FAO	Food and Agriculture Organization
Frw	Rwanda francs
LHS	Left hand side
MINIFRA	Rwanda Ministry of Infrastructure
RCAA	Rwanda Civil Aviation Authority
REMA	Rwanda Environment Management Authority
RHS	Right hand side
RNRA	Rwanda natural resources Authority
RP	Revealed preference
SP	Stated preference
SPSS	Statistical Packages for Social Scientists
WTA	Willingness to accept
WTAC	Willingness to accept compensation
$WTAC_d$	Willingness to accept compensation for disturbance
WTP	Willingness to pay

1. INTRODUCTION

1.1. Background

Persons whose land rights have been expropriated for public purpose receive compensation from the expropriator depending on country-specific legislative context of expropriation and compensation (Azuela & Herrera-Martín, 2009; Shapiro et al., 2013). This compensation is assessed for entitlements such as land, building(s) and unexhausted improvements, disturbance, and payments for other adverse socioeconomic impacts (Alemu, 2012; Giovannetti, 2004; Omar & Ismail, 2009).

Compensation for land expropriation is conceived to be an insurance against adverse effects arising from the government's land use regulations (Blume & Rubinfeld, 1984). As a form of insurance, this compensation aims at indemnifying or reinstating the affected party to a position prior to the expropriation order (Alias & Daud, 2006; Viitanen et al., 2010a). As an indemnity, compensation payment includes value of real estate which has been partly acquired by government for public purpose. On the other hand, it can be conceived as a reinstatement which comprises value of real estate that has been fully acquired by the state for overriding public interest.

Disturbance compensation is a sum payable to expropriated party in addition to compensation for market value of land, building(s), and other unexhausted improvements (Shapiro et al., 2013). Among entitlements which can be classified as disturbances are relocation costs, dismantling costs for assets, and loss of earnings (Omar & Ismail, 2009). Alemu (2012) and Alias and Daud (2006) argue that the addition of disturbance compensation to market value of expropriated properties shall enhanced compensation payable to affected persons (landowners and occupiers). Implication of this argument is the need to integrate market value compensation with disturbance compensation in what can be christened in this thesis as a *disturbance-integrated compensation method* for land expropriation. This conception is founded on the principle that government's use of eminent domain powers leads to interference with private rights held in land and complete forfeiture of these rights for overriding public interest (Viitanen et al., 2010b), such that it becomes the responsibility of the state to ensure that these land rights are appropriately compensated following interference arising from expropriations.

Like other governments around the world, the Rwandan government deploys expropriation to acquire land for infrastructural projects (Payne, 2011; Sagashya & English, 2006). For instance, the government in 2011 expropriated lands for the proposed Bugesera international airport project (Gahamanyi, 2012) where it is currently estimated that over 2000 families affected by the expropriation are still awaiting compensation (Habimana, 2013). Whereas the Rwandan Expropriation Law of 2007 provided for legislative framework for the process of expropriation and compensation, specific documents indicating approved prices of items to be compensated are published through Ministerial orders and Regulations such that assessment of compensation is on the basis of market value (REMA, 2011; Republic of Rwanda, 2007) while compensation for disturbance entitlements are not considered at all. Furthermore, a Newspaper report indicates dissatisfaction of affected persons with loss of livelihood and other disturbances arising from land expropriation coupled with delay in payment of compensation (Habimana, 2013). Whereas the situation of non-inclusion of disturbance entitlements in compensation for

expropriation may not necessarily apply to only Rwanda, there is a need to develop a prototype of disturbance-integrated compensation method.

A compensation method is a valuation model aimed at assessing value of entitlement of persons whose land rights have been expropriated for public purpose. Application of this model is expected to offer affected parties an equivalent value for the loss of their land rights and other entitlements as a result of the expropriation. Although some scholarly literature on land valuation and compensation for expropriations acknowledge the need for the expropriator to pay full compensations including market value and disturbances (Alemu, 2012; Alias & Daud, 2006; Norrell, 2008; Omar & Ismail, 2009), there are still gaps on how to monetize a collection of objective and subjective disturbance entitlements (Cernea, 1988; Chang, 2013; Kusiluka et al., 2011) let alone integrating them with market value of real properties for the purpose of achieving equivalent value of land rights and other intangible rights affected by the expropriation. In other words, it is necessary to develop a method of compensation which offers enhanced compensation package through the integration of disturbance cost of expropriated landowners with market value of their expropriated properties.

1.2. Justification

Cernea (1988), Heller and Hills (2008) and Nayak (2000) argue that displacement of people due to land expropriation leads to loss of land, housing and other immovable assets on land; disruption of commercial livelihoods; loss of family ties and ancestral heritage among other items. In addition, Cernea (1988) reiterated that expropriated parties do not always get compensated for a considerable proportion of some of these entitlements because of legislative gaps in the recognition of these entitlement and inability of market valuation methods to assess economic values of intangible and irreplaceable productive assets other than tangible assets and real estate.

The justification for this research is based on perception of expropriated landowners concerning what actually constitutes adequate compensation (Alemu, 2012; Omar & Ismail, 2009). Whereas valuation methods currently exist for the determination of the market value of property (Shapiro et al., 2013; Šumrada et al., 2013; Wyatt, 2007), it is beyond the capacity of these market valuation methods to capture use and non-use values embedded in disturbances arising from land expropriation (Alemu, 2012; Cernea, 1988; Norrell, 2008; Rowan-Robinson & Hutchison, 1995). This research addresses the knowledge gap concerning a feasible economic valuation method for disturbances associated with land expropriation with the aim of scaling up total assessed compensation payable to expropriated landowners.

Prominent among the beneficiaries of this research include government and their agencies conferred with eminent domain powers and infrastructural development. Among these governmental organizations include Ministries of infrastructure and their agencies, Cadastral and land administration offices, and physical planning agencies. Through this research, these governmental organizations will get to appreciate the need to involve expropriated landowners in valuation process leading to compensation payment.

The benefit of this research to property valuers is that it adds a new dimension to the practice of valuation for compulsory acquisition of land for public purpose through the integration of market value of real estate with the value of other economic assets tied to real estate for which conventional market valuation methods cannot assess. At the policy-making level, this research is expected to trigger debates on the reform of existing valuation practices for land expropriation and compensation especially in countries confronted with demands by its citizens and legislators concerning appropriate compensation claims arising from land expropriation as well as valuation methods for these claims.

1.3. Research problem

Market valuation methods such as replacement cost approach, market comparison-, and income capitalization methods have featured prominently in the assessment of market value compensation for land expropriation (Alemu, 2012; Famuyiwa & Omirin, 2011; Šumrada et al., 2013). 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; Alias & Daud, 2006; Nayak, 2000; Omar & Ismail, 2009). These specific disturbance entitlements comprise removal costs, relocation and incidental costs, loss of livelihood, loss of income and psychological costs (Alemu, 2012; Nayak, 2000; Omar & Ismail, 2009). Whereas there is a theoretical underpinning that disturbance-integrated compensation method is drawn from the perception of what constitutes adequate compensation for land expropriation, it is unknown how disturbance entitlements arising from land expropriation can be valued using economic valuation tools let alone their integration with market value of real estate as a formal method of assessing compensation for land expropriation.

1.4. Research objectives

1.4.1. Main objective

The main objective of this research is to develop disturbance-integrated compensation method which would most likely increase the total compensation payable to persons whose landownership rights have been expropriated for overriding public interest.

1.4.2. Specific objectives

Specific objectives for this research include:

1. to identify requirements for designing disturbance-integrated compensation method;
2. to design a prototype of disturbance-integrated compensation method; and
3. to test a prototype of disturbance-integrated compensation method.

1.5. Research questions

The following questions have been structured to address each specific objective:

Specific objective 1: to identify requirements for designing disturbance-integrated compensation method.

Research Questions:
(a) What are the compensable entitlements in disturbance-integrated compensation method?
(b) What is the perception of compensable entitlements in disturbance-integrated compensation method?
(c) What combination of valuation techniques is required for developing disturbance-integrated compensation method?

Specific objective 2: to design a prototype of disturbance-integrated compensation method.

Research Questions:
(a) What are the data required for modelling this compensation method?
(b) What are the design criteria for disturbance-integrated compensation method?
(c) How is a disturbance-integrated compensation method developed?

Specific objective 3: to test a prototype of disturbance-integrated compensation method.

Research Questions:
(a) What are the test criteria for this compensation method?
(b) What test criteria did the disturbance-integrated compensation method meet?

1.6. Analytical framework of disturbance-integrated compensation method

The design of disturbance-integrated compensation method for land expropriation is conceived using an analytical framework for the valuation of landed property explained in this section.

Given the equation: $C_{dm} \Rightarrow C_{cm} \cup C_d$ ..... (1)
Parameters in the equation are defined as follows:
C_{dm} symbolizes disturbance-integrated compensation
C_{cm} symbolizes assessed market value compensation
C_d is compensation for disturbances
$\cup$ symbolizes "union"
$\Rightarrow$ symbolizes "implies"
C_{dm} implies disturbance-integrated compensation, which is the union of market value of expropriated property, C_{cm} and disturbance compensation C_d.
Elements of market value of landed property, C_{cm}, is modelled as:
$C_{cm} = f(ln, bg, oi)$ ..... (2)
where *ln* is market value of land,
bg is market value of building, and
oi is market value of other improvements (including farm crops) on land
Furthermore, elements that make up disturbance compensation C_d, are modelled as:
$C_d = f(rm, re, lv, in, pc, uc)$ ..... (3)
where *rm* is removal costs,
re is relocation and incidental costs,
lv is loss of livelihood,
in is loss of income,
pc is psychological damages, and
uc is other unique circumstances of expropriated party
In equations 2 and 3, "*f(....)*" implies function of elements in the parenthesis

Hence, the equation, "$C_{dm} \Rightarrow C_{cm} \cup C_d$" can be interpreted as:
$C_{dm} = \{ln, bg, oi\} \cup \{rm, re, lv, in, pc, uc\}$
$C_{dm} = \{ln, bg, oi, rm, re, lv, in, pc, uc\}$ ..... (4)

A combination of market value and compensation for disturbance entitlements is distinct from standalone market value compensation because it is a summation of the value of expropriated real property and value of disturbance entitlements of expropriated persons (Alemu, 2012; Alias & Daud, 2006; Omar & Ismail, 2009). This hybrid method of compensation assessment has been christened disturbance-integrated compensation method (DICM) for the purpose of this research.

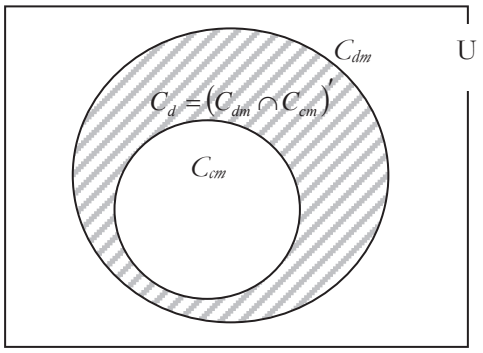


Figure 1: Analytical framework in Venn diagram

In disturbance-integrated compensation method (equations 1 and 4), market value of expropriated property, C_{cm} (equation 2) is added to disturbance compensation, C_d (equation 3). In other words, disturbance-integrated compensation method (DICM) is designed to embrace compensation for all

categories of disturbances (removal costs, relocation cost, loss of livelihood, loss of income and psychological costs) plus market value of land, buildings and immovable structures on land as at the date of expropriation.

This analytical framework is further explained with the aid of a venn diagram in Figure 1. The non-hatched small circle in the venn diagram is the market value compensation for expropriated properties (C_{cm}), while the hatched portion of the larger circle represents compensation for disturbances, C_d. Disturbance-integrated technique of compensation assessment (equation 1 or 4) includes sum of all elements in small circle (C_{cm}), and the hatched portion of the large circle, C_d. In other words, The expected outcome of this research (equations 1 and 4) describe the content of the set C_{dm} to include market value of land and landed properties as well as value of disturbances arising from land expropriation.

It can be deduced from the venn diagram that market value compensation, C_{cm} (equation 2) is a subset of disturbance-integrated compensation method, ($C_{cm} \subseteq C_{dm}$). Furthermore, complement of the subset C_{cm} within set C_{dm} is expected to contain all the elements in set C_{dm} that are not in set C_{cm}, which in this research are the elements of disturbance compensation, C_d symbolized as: $C_d = (C_{dm} \cap C_{cm})'$. In this research, the set C_{dm} shall be designed in two phases commencing with the modelling of the set $(C_{dm} \cap C_{cm})'$ and addition of the set C_{cm}.

Hence, a model for disturbance compensation shall be designed to pave the way for addition of market value to arrive at a prototype of disturbance-integrated compensation method for land expropriation. An implied feature of DICM is the use of stakeholder involvement towards integrating information on the economic value (indirect valuation) of losses known to expropriated parties and information on market value (direct valuation) of expropriated property which is known to professional valuers acting on behalf of the affected party or the acquiring authority (Chang, 2013; Louviere et al., 2000).

1.7. Research design

Case study and design research techniques have been deployed in response to *qualitative*- and *quantitative* approaches of this research. The rationale for this combination is that design research is suitable for the (re)development of artefacts of a land administration system (Çağdaş & Stubkjær, 2011), among which is compensation and land value models, while case study design was used to specify requirements for the development and evaluation of the artefact, which is the disturbance-integrated compensation method in the context of this study. Unit *of analysis* in this research comprise landowner in the study area whose land rights have been expropriated for public purpose. In addition, *variables* to be analyzed in this study are entitlements which makes up disturbance-integrated compensation for land expropriation as mentioned in the analytical framework. The following subsections help to elucidate how these research designs are utilized.

1.7.1. Case study techniques

Case study research design are tools for conducting intensive study on a problem without generalizing beyond the case, which may be a phenomenon or individual (Singh, 2006). Case study can be descriptive, explanatory or exploratory (Yin, 2003). Whereas exploratory case study is applicable to screening requirements for relevant variables of a model which a researcher wants to unravel (Creswell, 2003), explanatory strategy of case studies is aimed at determining the relationship among variables (Creswell, 2003; Singh, 2006). This study harnessed both exploratory and explanatory case studies for specific purposes. Exploratory strategy was deployed during fieldwork in order to elicit data for the design of compensation model while explanatory strategy was adopted to evaluate convergence or otherwise between outcome of compensation model and expectation of respondents in the study area.

1.7.2. Design research technique

Design research technique are routines for the development of artefacts capable of solving observed problems (Çağdaş & Stubkjær, 2011). Artefact in the context of this study connotes value computation method for determining compensation in the event of land expropriation for public purpose. This artefact was developed using data obtained from exploratory case study approach and application of a series of traditional system design stages comprising (1) analysis of existing situation, (2) analysis of model requirements, (3) developing design specifications, (4) model development, (5) testing, and (6) evaluation (Çağdaş & Stubkjær, 2011; Yeates & Wakefield, 2004).

1.8. Thesis structure

This thesis is arranged in seven chapters with a brief description of the content as follows:

Chapter One: Introduction
This chapter provides an overall introduction to the design of disturbance-integrated compensation method for land expropriation comprising a background and justification of study, research problem, research objectives and questions, and an analytical framework.

Chapter Two: Disturbance-integrated compensation method for land expropriation
This chapter is a review of literature on systems of compensation for land expropriation, concept of disturbance-integrated compensation method, and valuation methods necessary to actualize disturbance-integrated compensation for expropriated landowner.

Chapter Three: Data collection strategies for design criteria of disturbance-integrated compensation method
This chapter discusses the data collection strategies deployed towards specifying design criteria for disturbance-integrated compensation method for land expropriation in Rwanda. These include research design matrix, data collection instruments, and techniques of data analysis.

Chapter Four: Results on perception of design criteria for disturbance-integrated compensation method in Rwanda
This chapter presents and analyzes the perception of valuers, relevant government officials and expropriated landowners concerning compensable entitlements to be considered in the design of a prototype of disturbance-integrated compensation method for the study area.

Chapter Five: Design criteria for disturbance-integrated compensation method
This chapter addresses a collection of equations, test criteria, and processes (flowchart) which set the stage for the development of DICM for land expropriation in chapter 6.

Chapter Six: Design of a prototype of disturbance-integrated compensation method
Based on the design criteria identified in chapter five, this chapter addressed design of a model for the assessment of compensation for land expropriation which comprises market value and disturbance entitlements of affected landowners and further discussed results from the design of DICM.

Chapter Seven : Conclusion and Recommendations
This chapter assessed the achievement of research objectives for the design of DICM through a reflection on answers to questions posed in this study. Limitations of this research were highlighted while recommendations for further research and compensation assessment for land expropriation were outlined.

2. DISTURBANCE-INTEGRATED COMPENSATION METHOD FOR LAND EXPROPRIATION

2.1. Introduction

This chapter commences with an overview of systems of compensation, and concept of disturbance-integrated compensation method. Furthermore, answers to research questions under the following specific objectives were provided based on existing literature: For specific objective 1: *What are the compensable entitlements in disturbance-integrated compensation method? What combination of valuation techniques is required for developing disturbance-integrated compensation method?* and for specific objective 2: *What is the design criteria for disturbance-integrated compensation method?* The chapter concludes with the identification of requirements for designing disturbance-integrated compensation method.

2.2. Systems of compensation for land expropriation

Chang (2013) outlined systems of compensation for land expropriation for public purpose to include zero compensation, current value compensation, project value compensation, fair market value compensation and economic value compensation. In addition, a sixth system of compensation is the resettlement of expropriated persons.

Resettlement is a non-monetary form of compensation for real estate which entail the arrangement of alternative land and shelter for persons whose land rights have been compulsorily acquired by government for public purpose (Debnath & Choudhary, 2009; FAO, 2009; Feldman & Geisler, 2012). Resettlement as an alternative to monetary compensation for land expropriation is however beyond the scope of this thesis but is worth mentioning. The other systems of compensation are based on monetary values of entitlements.

Zero compensation implies that monetary compensation is not paid to an expropriated person. *Current value compensation* is the existing use value of a property as at the date of expropriation (Chang, 2013; Wyatt, 2007). Chang (2013) however asserts that current value cannot be higher than market value such that it is not a good measure of compensation for land expropriation.

Project- or development value compensation implies that expropriated parties share in value increase arising from the project (Chang, 2013). A key problem with this approach of compensation is uncertainty of realizing reasonable gross benefits which can cover the cost of the expropriation, project implementation and benefits transfer to expropriated parties (Niemann & Shapiro, 2008).

Fair market value is the assessed price of property which takes into account the bargaining strength of parties to a transaction (Wyatt, 2007) and excludes sentimental value which are essentially constructs of expropriated landowner/occupier (Heller & Hills, 2008). A serious weakness with the fair market value concept is its inability to provide a clear distinction between what constitutes market value and what constitutes other losses arising from expropriation.

Economic value is a combination of fair value and subjective value (Blume & Rubinfeld, 1984; Chang, 2013). Whereas economic valuations theoretically leads to full compensation, it has been criticized as unrealistic (Chang, 2013). Notwithstanding, this system of compensation provides a logical basis for combining

market value- and interview-based methods of compensation assessment. This is the system of compensation upon which the disturbance integrated compensation method is based.

2.3. Overview of disturbance-integrated compensation method

Within the context of this research, disturbance-integrated compensation method (DICM) is a computational model which represents the structure and content of the total amount payable to a person whose land right is expropriated for public purpose. With reference to section 2.5.3, chapters 5 and 6 of this thesis, it is derived from a study of the perception of landowners that adequate compensation equals the market value plus value of other claims (Alemu, 2012). As a model, it comprises different components which interact to produce a new outcome (Voinov, 2008), which in this context is possibly an enhanced monetary sum compared to market value compensation. These components of DICM (compensable entitlements) are identified and discussed in section 2.4.

2.4. Compensable entitlements in disturbance-integrated compensation method

The major categories of compensable entitlements in disturbance-integrated compensation method can be deduced from the analytical framework in Figure 1 to include real estate and disturbance entitlements.

2.4.1. Real estate

Real estate is the physical land as well as buildings and assets permanently affixed to the land itself (Wyatt, 2007). Furthermore, Wyatt (2007) argues that real property confers legal interest on the owner of real estate and entitles him to sell, lease, cultivate, subdivide and develop the land and building on it. For real estate, the subcategories of compensable entitlements include property rights held in *land*, *buildings*, *farm crops and economic trees*, and any *other physical improvements* on land. Other physical improvements on land include *fixtures*, *fittings*, and *specialized plant and machinery* used in business/industrial operations. When eminent domain powers are exercised by the government, private ownership rights in real estate are extinguished and the affected party is entitled to compensation. All these entitlements are captured in DICM and their values are assessed using market valuation techniques.

2.4.2. Disturbance entitlements

Disturbance compensation is the payment for other losses besides real estate incurred by expropriated landowners and occupiers. Omar and Ismail (2009) and Shapiro et al. (2013) argue that disturbance entitlements are distinct from land, building and immovable assets on expropriated land. Disturbance entitlements include removal costs, relocation costs, loss of livelihood, loss of income, psychological damages (Alemu, 2012; Nayak, 2000; Omar & Ismail, 2009), and possibly other unique circumstances of affected parties which should be captured to ensure adequate compensation. These entitlements have been briefly examined as follows:

(a) Removal cost
Removal costs are incurred if an expropriated landowner or occupier dismantles certain vital personal infrastructure for onward relocation (Shapiro et al., 2013).

(b) Relocation cost
Relocation cost include transport and other costs of having to move personal effects and belongings away from expropriated land to an alternative site (Šumrada et al., 2013; Syagga & Olima, 1996).

(c) Loss of livelihood
Compensation for loss of livelihood is a reparation for the cost associated with winding up a business in the event of land expropriation for public purpose (Wyatt, 2007). An alternative to compensation for this

disturbance is for the government to offer livelihood restoration scheme to affected parties (FAO, 2009; Giovannetti, 2004).

(d) Loss of income or earnings
This entitlement is distinct from the loss of livelihood in the sense that it is a payment for temporary loss of income of the expropriated party pending (alternative) livelihood restoration (Shapiro et al., 2013).

(e) Psychological damages
This entitlement arises from damages to the mental state of the mind as a result of forced sale of land (Niemann & Shapiro, 2008), as well as feeling of involuntary detachment from land (Cernea, 1988). Instances of this entitlement include impairment of family ties and human relations (Nayak, 2000), and emotional pains arising from loss of cultural, ancestral and religious attachment to land (Feldman & Geisler, 2012; Kusiluka et al., 2011). Although entitlements classified under this category of disturbance are difficult to monetize (Cernea, 1988; Kusiluka et al., 2011), their valuations could be made possible using stated preference methods (Kauko, 2004; Pearce et al., 2006), which further integrates emotions of respondents when it is used to calibrate contingent value models (Biel et al., 2011).

(f) Other unique circumstances of expropriated party
This entitlement is aimed at accounting for variation among expropriated landowners in terms of their socioeconomic characteristics. Like psychological damages, this category of entitlement is difficult to monetize except stated preference methods of valuation is applied. With reference to similar studies on application of contingent valuation to pricing behaviour of landowners, indicators of this entitlement have been outlined to include gender, age, household expenditure (after the expropriation), and education level of landowner (He & Asami, 2014; Lindhjem & Mitani, 2012).

2.5. Valuation methods for compensation assessment

Valuation is the measurement of implications of a policy on the welfare of individuals or society (Louviere et al., 2000). For an interest in real property, the motive of this measurement may be monetary or non-monetary. Within the context of land expropriation, valuation is a process of forming an opinion of the most likely price for which an interest in land and landed property can be given up by an expropriated party for overriding public interest (Wyatt, 2007). In this context, commodities that are actually valued are rights and interests held in land contrary to mere improvements on land (Goldstein, 1997). This is because value of land and landed property are measured using observed prices of transaction in rights and interests in land (Eccles et al., 1999). Among the various purposes of real property valuation, this research examines valuation for compensation arising from land expropriation for public purpose.

Valuation methods are mathematical models of how opinion of land and/or property values can be formed (Kauko, 2004). Within the context of this research, these methods have been categorized into three namely market valuation techniques, interview-based techniques, and the disturbance-integrated method of assessment which is a combination of market valuation- and interview-based techniques.

2.5.1. Market valuation techniques

Market valuation techniques are 1st generation of property valuation models which are most applicable to single property appraisals (Kauko, 2004). These techniques are used to determine the most likely selling price of property (Land and/or building only) as at the date of expropriation (Chang, 2013). The strength of market valuation techniques lies in their ability to determine the value of compensable entitlements classified under real estate as identified in section 2.4.1. Variants of these valuation technique include replacement cost approach where land value is added to depreciated replacement cost of structures on site

to arrive at market value (Shapiro et al., 2013); the income capitalization approach where rental value is capitalized using property investment yields, and the sales comparison approach where market value of expropriated property is determined with recourse to a comparable sold in the land/property market (Šumrada et al., 2013; Wyatt, 2007).

Although these techniques value expropriated property for compensation, outcome of valuations do not actually reflect the meaning of just compensation which implies payment that does not inhibit financial capacity of affected party (Viitanen et al., 2010a). Furthermore, these techniques have been criticized as contradicting basic rules of voluntary sale because expropriation is a forced sale of property (Alemu, 2012; Wyatt, 2007). Besides the difficulty of determining market values of property when expropriation notice has been circulated over time (Wyatt, 2007), applying market valuation techniques as standalone method for compensation valuation cannot capture the value of disturbances and other losses suffered by affected parties (Alemu, 2012; Cernea, 1988; Norrell, 2008). These gaps in the existing market value compensation technique necessitate the formulation of design criteria for the development of DICM in this research.

2.5.2. Interview-based techniques

Interview-based techniques have been categorized as 4th generation of real property valuation model, which combine the use of qualitative and quantitative valuation data (Kauko, 2004). These techniques can be theoretically traced to the concept of total economic value, which is the aggregate value of an environmental asset (Pearce et al., 2006). Total economic value comprises use value (the value of that asset in its existing use), and non-use value (value of the asset in its perceived or potential use) (Pearce et al., 2006). Indicated in Figure 2 are valuation tools used to determine total economic value comprising revealed preference techniques and stated preference techniques (Louviere et al., 2000; Pearce et al., 2006).

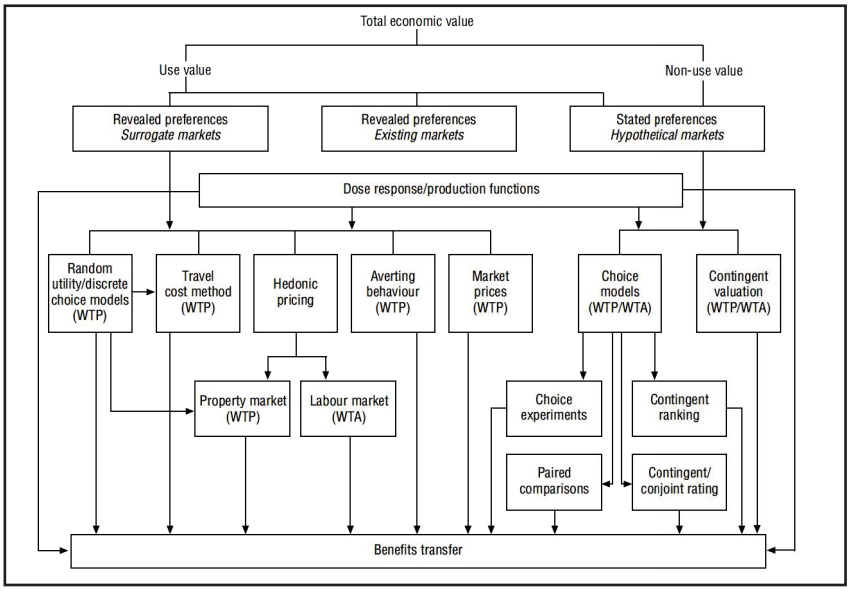


Figure 2: Total economic valuation techniques
Source: Pearce et al. (2006)

It can be deduced from Figure 2 that stated preference, SP techniques have the capacity to determine values of goods traded in surrogate- or hypothetical markets contrary to revealed preference "RP" techniques which are suitable for valuing goods traded only in surrogate markets (Figure 2). With recourse to modelling disturbance value component of the proposed compensation method in this research (see set $(C_{dm} \cap C_{cm})'$ in Figure 1), emphasis is on stated preference "SP" techniques. SP techniques depend on surveys to elicit both use and non-use values of a good from a target group of persons (Louviere et al., 2000). An advantage of SP- over RP technique is its ability to value goods that have behavioural footprints

such as change in the observed price or quantity (Pearce et al., 2006). On the other hand, a disadvantage of SP is the inability of respondents to comprehend valuation problem or respond to the survey (Kauko, 2004; Louviere et al., 2000). Notwithstanding, SP provides insights into valuation of goods with ex-ante and ex-post use potentials, while problem of data deficiency can solved using SP-RP data enrichment (Louviere et al., 2000).

With reference to Figure 2, SP techniques can be broadly categorized into contingent valuation (CV) and choice modelling (Pearce et al., 2006). Whereas choice modelling relates to the use of surveys to value multidimensional changes, contingent valuation (CV) entails eliciting current use value, future use value, and non-use values of environmental goods (Pearce et al., 2006). Elements of disturbance compensation arising from land expropriation for public purpose exhibit attributes of use- and non-use values implying that CV methodology is applicable towards teasing out the total economic value of disturbance.

Tools for eliciting contingent value of assets affected by adverse socioeconomic impacts including those from construction project (Gilchrist & Allouche, 2005) include willingness to pay (WTP) and willingness to accept (WTA) or equivalent variation (He & Asami, 2014; Kauko, 2004; Louviere et al., 2000; Pearce et al., 2006). Whereas WTP is appropriate for goods which do not necessarily confer a right to benefit on the respondent following a policy change, WTA compensation to forgo a right to a benefit is an appropriate value eliciting tool when a person is entitled to benefits arising from change in policy (Pearce et al., 2006).

Applicable methods for eliciting willingness to accept (WTA) include open-ended bidding, payment card, single-bounded dichotomous choice, double-bounded dichotomous choice (He & Asami, 2014; Pearce et al., 2006), one and a half bound dichotomous technique (Hanneman & Kanninen, 1999), and contingent raking method (He & Asami, 2014). Among these eliciting tools, there has been an increased preference of researchers towards applying dichotomous choice; open-ended; and sealed bid auction in WTA elicitation (List & Shogren, 2002). For the purpose of this research, the double-bounded dichotomous choice elicitation technique was utilized (Figure 5). This value eliciting technique leads to binary responses of Yes or No to stated amounts offered at the 1st and 2nd bids respectively (Bateman et al., 1999), after which respondents are asked to confirm their minimum WTA. The binary response data leads to the calibration of a binary logistic regression model of willingness to accept (WTA).

Binary logistic regression of WTA is compatible with the calibration of dichotomous response outcomes and its determinants especially when scatter plots of data (Figure 10) indicates a logistic relationship between variables (Nathanson & Higgins, 2008). Binary logistic regression analyses have been utilized over the years to calibrate a model of dichotomous choice responses to bid amounts and their associated determinants (Hanneman & Kanninen, 1999; Krishna et al., 2013; Radam & Mansor, 2005). When calibrated, it is expressed as natural logarithm of odds ratio for accepting a given bid amount (Hanneman & Kanninen, 1999; Loomis et al., 1997), which is directly proportional to the sum of estimated constant term "β_0", product of bid coefficient and the bid amount "$\beta_i \cdot (BID)$", and sum of products of determinants of the bid amount "$\sum(\beta_j \cdot (Z_j))$ " (equation 5):

$$Log_e\left[\Pr ob(Yes)/1-\Pr ob(Yes)\right] = \beta_0 + \beta_i \bullet (BID) + \sum\left(\beta_j \bullet \left(Z_j\right)\right) \quad (5)$$

Bucklan et al. (1999) recommended the varying of bid amount and the pooling of β_0 and $\sum(\beta_j \cdot (Z_j))$ at their mean values on the condition that it helps to cancel out the effect of negative or positive skewness (biasness) of dataset used in the calibration. In other words, if binary logit "*Log_e[Prob[Yes]/1 – Prob[Yes]]*" is the outcome vector which is the natural logarithm of odds (likelihood) for accepting a bid amount in CV surveys, values of Z_j in equation 5 are set to their estimated sample means, and sum of "$\sum(\beta_j \cdot (Z_j))$" and "$\beta_0$" are further reduced to a single constant term "α"; hence the equation:

$$\alpha = \beta_0 + \sum(\beta_j \bullet (Z_j)) \quad (6)$$

The implication is that equation 5 is further expressed as follows:

$$Log_e[\Pr ob(Yes)/1 - \Pr ob(Yes)] = \alpha + \beta_i \bullet (BID) \quad (7)$$

In similar studies of WTA, Hanneman and Kanninen (1999); He and Asami (2014) substituted a variant of equation 6 into a cumulative logistic probability distribution function expressed below:

$$\hat{p}_k = 1 - \{1/[1 + \exp-(\alpha + \beta_i(BID_k))]\} \quad (8)$$

Where $\hat{p}_k$ is the probability that a *kth* (specific) landowner will reject an offer of a bid amount as compensation. The logic behind equation 8 is that the likelihood of rejecting a bid amount as compensation decreases as the bid amount is increased (See Figure 8). Applying numerical integration to this cumulative probability function (equation 8) yields true estimate of WTA for an expropriated landowner (He & Asami, 2014), which is synonymous to the derivation of consumer surplus in economic valuations (Pearce et al., 2006). In other words, expected WTA "$E(WTA_k)$"for a *k*th (specific) landowner, given a lower (*L*) and upper (U) bounds of bids can be evaluated from equation 8 as:

$$E(WTA_k) = \int_L^U 1 - \left(\frac{1}{1 + \exp-(\alpha + \beta_i(BID_k))}\right) dBID \quad (9)$$

A study of WTA estimation have been examined under two contrasting scenarios of voluntary policy changes of forest owner's WTAC for forest conservation (Lindhjem & Mitani, 2012), and involuntary policy changes of land expropriation (He & Asami, 2014). It is however not clear if the valuation of both variants of policy changes are not significantly influenced by demographic characteristics of respondent such as age, gender and education. Suffice to say that although land expropriation is an involuntary policy change which might evoke disturbance on rights held in land, it is important to investigate if certain variables of landowner characteristics such as age, gender and education are significant determinants of binary logit of disturbance compensation contrary to the findings that these variables are insignificant determinants of WTA for voluntary forest conservation (Lindhjem & Mitani, 2012).

Heller and Hills (2008) view the system of allowing expropriated landowners to bargain compensation as a means of supporting perjury. Further compounding this problem in contingent valuation techniques is that estimates of WTA are higher than WTP estimates (Pearce et al., 2006). In order to verify this assertion, WTP and WTA were applied to the valuation of expropriated properties in China with results indicating overpriced WTA values owing to speculation of property owners (He & Asami, 2014). A weakness of that study is its emphasis on using WTA to elicit market value without considering the embedded impact of disturbance compensation on total economic value of expropriated property given up by an affected landowner. In order to avert similar problem, the use of WTA in this thesis has been restricted to pricing of disturbance compensation as an amount on top of market value compensation assessed by real property valuers. This estimate of disturbance compensation can be recalled from the analytical framework in Figure 1 as the set $(C_{dm} \cap C_{cm})'$ which shall be determined using the principle of consumer surplus (equation 9) contrary to direct adoption of bid amounts of WTAC. In other words, a third technique of compensation assessment which entails the combination of first and fourth generation of property valuation models was deployed in this research to design the DICM for land expropriation.

2.5.3. Disturbance-integrated method of assessment

Combining market valuation- with interview-based techniques is aimed at correcting relative disadvantages of both methods and enhancing the socioeconomic well being of expropriated parties (Table 1). This

combination of value assessment techniques is anchored on the possibilities for developing a hybrid valuation method for real estate (Kauko, 2004), especially for the purpose of land expropriation and compensation. One of the ways to achieve this is to re-design compensation method to include market value of expropriated real property and estimates of WTA compensation for disturbances, which in the context of this research is a *disturbance-integrated compensation method* (DICM).

In a related study of compensation for land expropriation, Alemu (2012) found that people's perception of adequate compensation for land expropriation include the sum of market value (*MV*), other claims and a premium, which is translated as equation 10 where "*other claims*" comprises disturbance, severance, and injurious affection; and premium implies other payments above market value (Alemu, 2012). Therefore, equation 10 is expressed as:

$$Total\ compensation = MV + other\ claims + premium \tag{10}$$

In reality, the current practice of compensation for land expropriation in Rwanda only considers the market value element in equation 10 (REMA, 2011; Republic of Rwanda, 2007), which has been adjudged to be too low to compensate a person whose land rights have been expropriated for public purpose (Norrell, 2008). If it is assumed that premium payment has been factored into disturbance compensation while compensation for severance, and injurious affection have been excluded from equation 10 on the ground that there was a full expropriation of land for public purpose, then equation 10 is reduced to:

$$Total\ compensation = MV + disturbance \tag{11}$$

The explanation of DICM within the context of a 4th generation property valuation model proposed by Kauko (2004) further warrants the expression of equation 11 as follows:

$$T_c = MV_k + WTAC_d \tag{12}$$

Where T_c = Total compensation for land expropriation; MV_k = Market value; and $WTAC_d$ = contingent value of disturbance entitlements, which are all consistent with suggestion for the combination of market valuations with interview-based approach to value elicitation as another approach to valuation of property rights (Kauko, 2004).

With reference to Table 1, the combination of these two techniques in sections 2.5.1 and 2.5.2 creates a synergy between use- and non-use value information for disturbance claims and the use value information that are embedded in assessed market value of expropriated real property. Most important is the integration of value information from expropriated parties and professional valuers acting on behalf of the expropriating authority (Chang, 2013; Louviere et al., 2000). Notwithstanding these advantages, the combination of market valuation- with interview-based techniques may not avert the inability of some respondents to comprehend stated preference valuation problem for disturbance compensation let alone the influence of opportunistic pricing behaviour that may ensue for the disturbance element of the compensation model. Beyond these disadvantages, the outcome from combination of market value with disturbance compensation is capable of meeting the expectation of expropriated landowners.

2.6. Concluding remarks

This chapter answers two research questions to specific objective 1 of this research: *What are the compensable entitlements in disturbance-integrated compensation method? What combination of valuation techniques is required for developing disturbance-integrated compensation method?* Disturbance-integrated compensation method (DICM), which is theoretically based on economic value compensation system, is a compensation assessment

technique which combines market value of real estate with value of disturbance entitlements arising from land expropriation. Compensable entitlements in DICM include real estate and disturbance entitlements. Real estate comprises land, buildings, farm crops and economic trees, and any other physical improvements on land such as fixtures, fittings, and specialized plant and machinery.

Table 1: Comparison of valuation techniques for compensation assessment

	Market valuation techniques[a.]	**Interview-based techniques[a.]**	**Disturbance-integrated method of assessment**
Advantages	1. Estimates the most likely selling price of real property. 2. Determines use values of (potentially) tradable assets. 3. Relies on data from land/real estate markets	1. Combines qualitative and quantitative data for value assessment. 2. Stated preference approach of this technique can measure use and non-use values of assets. 3. The technique can be used to value goods traded in existing-, surrogate-, and hypothetical markets.	1. Combines market valuations of real estate with contingent value of disturbances associated with expropriation. 2. Outcome of valuation does not inhibit the financial capacity of expropriated landowner. 3. Enriches valuation data to capture use and non-use values embedded in entitlements of an expropriated landowner.
Disadvantages	1. Technique is incompatible with compensation assessment for land expropriation. 2. Outcome of valuation inhibits the financial capacity of expropriated landowner. 3. Cannot capture use and non-use values embedded in non-tradable assets that constitute disturbances in expropriation.	1. Inability of respondents to comprehend valuation problem posed in a survey. 2. Valuations on the basis of WTA are higher than WTP. 3. Valuations may be influenced by opportunistic pricing behaviour of respondents.	1. Inability of respondents to comprehend stated preference valuation problem for disturbances 2. For this technique, stated preference valuation component for disturbances may be influenced by speculative bidding.

[a.] Sources:
Alemu (2012); Cernea (1988); Chang (2013); Kauko (2004); Louviere et al. (2000); Norrell (2008); Pearce et al. (2006); Viitanen et al. (2010a); Wyatt (2007)

On the other hand, disturbance entitlements comprises removal costs, relocation costs, loss of livelihood, loss of income, psychological damages, and other unique circumstances of expropriated landowner. The 2nd research question of specific objective 2 is posed as follows: *What are the design criteria for disturbance-integrated compensation method?* As indicated in Table 1, the development of DICM requires the combination of market valuation techniques for real estate with contingent valuation of disturbance, $WTAC_d$. However, the question of how a model of WTAC for disturbance can be developed (Section 6.6 (a)) in a given study area in order to facilitate full operation of DICM (equation 12) shall be addressed using perception of compensable entitlements harnessed from fieldwork (chapter 4) and further specification of a design criteria in chapter 5. Finally, the existing practice of using market value techniques to determine compensation for land expropriation does not afford expropriated landowners the full value of compensable entitlements (Alemu, 2012; Norrell, 2008). Motivated by the gap identified in this literature review, perception of landowners concerning compensable entitlements for land expropriation was harnessed and presented in chapter 4 with the purpose of providing information on design criteria for the development of DICM which would most likely increase compensation payable to expropriated landowners. In view of this, chapter 3 examines data collection strategy required for a further specification of these design criteria.

3. DATA COLLECTION STRATEGIES FOR DESIGN CRITERIA OF DISTURBANCE-INTEGRATED COMPENSATION METHOD

3.1. Introduction

Reflecting on the conclusion drawn from chapter 2 that the disturbance-integrated compensation method (DICM) is a combination of market valuation- and stated preference valuation techniques, chapter 3 aims to examine data collection strategies necessary to develop a design criteria for prototype of disturbance-integrated compensation method for land expropriation. Underpinning this chapter are the 1st and 2nd research questions of specific objective 2: *What are the data required for modelling this compensation method?* and *What is the design criteria for disturbance-integrated compensation method?* Other questions addressed as corollaries to this research question include: *How can these data be collected? What techniques of analysis are appropriate for these data?* and *What are the expected outcomes of these analyses*? This chapter also includes a variable-data collection matrix which is fundamental to the design criteria for DICM.

3.2. The study area

The design of DICM was carried out with recourse to landowners in Karera cell of Bugesera district of Rwanda whose lands had been expropriated by the government for the development of an international airport. Karera is among the five cells in Rilima sector of Bugesera district in Rwanda where some lands were expropriated for the proposed international airport (Appendix 1). The cadastral map in Figure 3 indicates that Karera cell comprises eight villages namely Kamahoro, Mutarama, Rwankomati, Gatare, Rwavuningoma, Gakurazo, Ruyenzi, and Rwimirama.

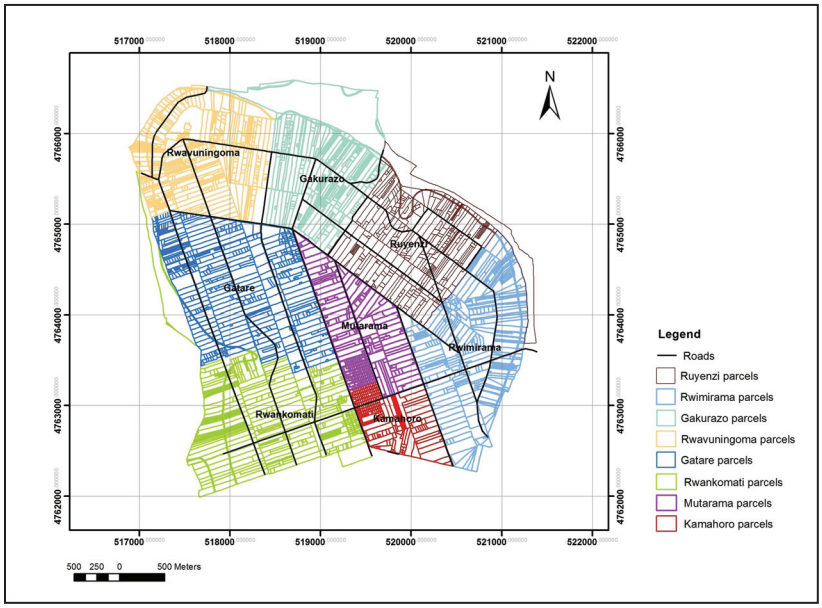


Figure 3: Cadastral map of Karera cell showing parcels in each village

The choice of Karera cell for this study is motivated by the highest concentration of expropriated parcels in the area, and availability of secondary data on expropriation for only that cell in the course of fieldwork.

Furthermore, administrative sub-division of Karera cell into eight villages facilitated the application of stratified random sampling of expropriated landowners.

3.3. Research plan

This study was conducted in three principal stages comprising the conceptual phase, data collection phase, and model development phase (Figure 4).

Stage 1: Conceptual phase

Activities in the conceptual phase of this research include statement of research problem, development of analytical framework, review of literature on compensation assessment methods for land expropriation and the selection of Rwanda as a case for developing a prototype of disturbance-integrated compensation method for land expropriation. This phase was concluded with the development of a variable-data collection matrix (Table 4) which details the connection between research questions, sources of data, strategy for data analysis and expected outcome of the analysis.

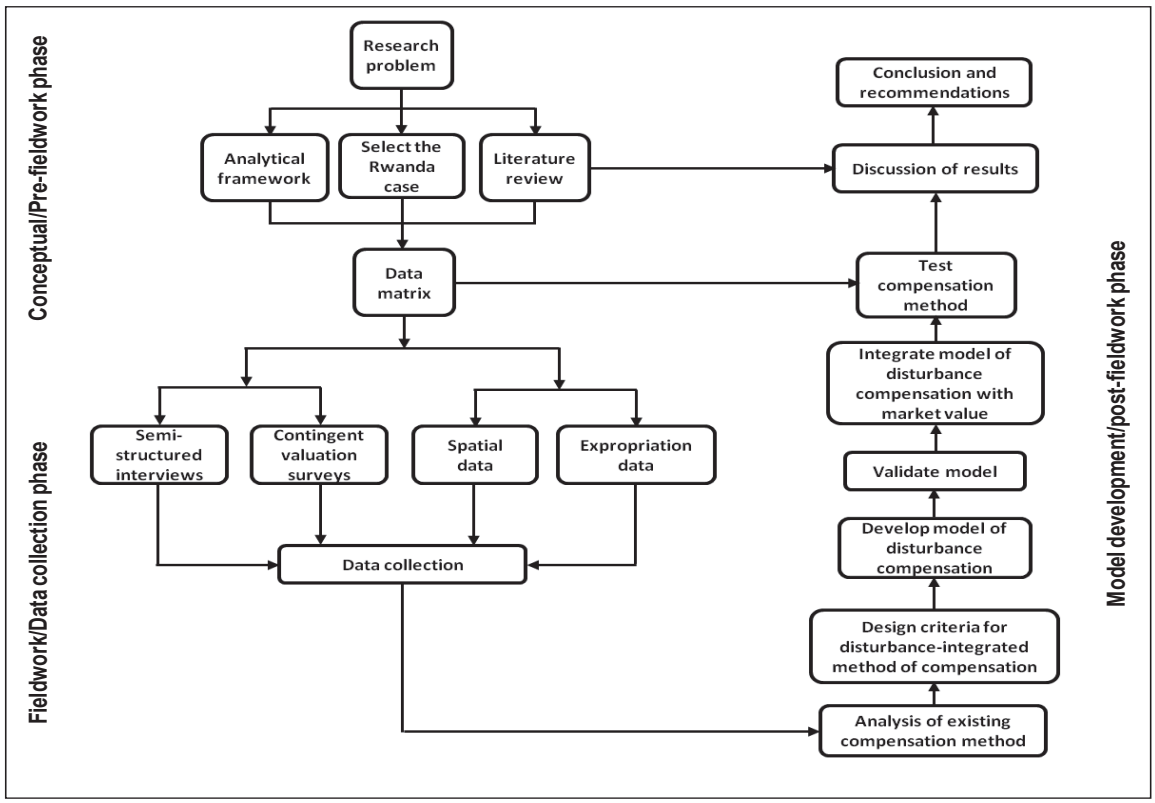


Figure 4: Research plan

Stage 2: Data collection phase

Data collection in Rwanda focused on compensation for lands that were expropriated in connection with a proposed international airport at Bugesera. A variable-data matrix (Table 4) was designed to guide the conduct of semi-structured interviews and CV surveys for disturbance compensation, and the collection of socioeconomic data of expropriated landowners. Other data collected at this stage include assessed market value compensation for expropriated properties, and spatial and cadastral data of the study area.

Stage 3: Model development phase

Data collection in the preceding phase culminated into the design of disturbance-integrated compensation method for land expropriation. The variable-data matrix further provided answers to questions concerning

the existing methods of compensation for land expropriation in Rwanda (Table 4) and the presentation of other results about the design criteria for disturbance-integrated compensation method (Chapter 4). Thereafter, a specification of design criteria for the disturbance-integrated compensation method was stipulated (Chapter 5). This culminated into development and validation of model for disturbance compensation, design and testing of disturbance-integrated compensation method and discussion of results from compensation modelling exercise (Chapter 6). The research was rounded off with conclusion and recommendations regarding the development of disturbance-integrated compensation method for land expropriation for public purpose (Chapter 7).

3.4. Sample size and sampling procedure

Three key stakeholders involved in land expropriation in the study area namely government officials, real property valuers and expropriated landowners were sampled for the purpose of this research. Random and non-random sampling techniques were deployed. Table 2 summarizes sampling technique adopted for each category of respondent interviewed during fieldwork in Rwanda.

Table 2: Categories of respondents and outcome of sampling procedure

Category of interviewee	Sub-category	Sampling technique	Sample size
Expropriated landowners	-	Stratified random sampling	36
Registered valuers	-	Judgemental sampling	3
Government officials	Staff of Lands and mapping agency, Rwanda Natural Resources Authority (RNRA)	Judgemental sampling	2
	Staff, Ministry of Infrastructure	Judgemental sampling	1
	Mayor, Bugesera district	Judgemental sampling	1
Total			43

A sample size of 36 landowners, representing nearly 2% of 1954 expropriated landowners in the sample frame was drawn (Table 3). Although this sample size is small compared to a minimum of 100 to 300 advocated for contingent valuation surveys (Louviere et al., 2000), this study deploys it for the purpose of developing a prototype of DICM considering the limited amount of time for fieldwork and sensitive nature of issues surrounding land expropriation in the study area.

Table 3: Sample frame and sample size for expropriated landowners

Village	Sample frame[a]	Stratified sample
Kamahoro	241	4
Mutarama	238	4
Rwankomati	240	4
Gatare	315	6
Rwavuningoma	298	6
Gakurazo	178	3
Ruyenzi	202	4
Rwimirama	242	5
Total	1954	36

[a] Source: Landmark Ltd., Kigali, October, 2013.

Proportionate stratified sampling technique was used to determine sample size of expropriated landowners that were interviewed. Strength of this technique lies in effective representation of elements in the sample frame (Singh, 2006). After determining proportionate sample for each stratum, the random number function of *Casio fx-991MS* scientific calculator was used to identify landowners that were interviewed in each village with results of the process indicated in Table 3.

Table 4: Variable-data matrix for the development of disturbance-integrated compensation method

Specific objective	Research questions	Variable	Indicators	Data sources	Data collection method	Data analysis techniques[a]	Anticipated outcome
1.	What are the compensable entitlements in disturbance-integrated compensation method?	Compensable entitlements	Real estate: Land, buildings, and other physical improvements on land Disturbance: Removal costs, relocation costs, loss of livelihood and loss of income, psychological damages and other unique circumstances of expropriated parties.	Scientific research articles	Literature search.	Identification of consensus in literature.	List of compensable entitlements to be included in disturbance-integrated compensation method.
	What is the perception of compensable entitlements in disturbance-integrated compensation method?	Perception of compensable entitlements	Agreement or otherwise with the incorporation of a compensable entitlements in disturbance-integrated compensation method.	Views and opinions of government officials, valuers, & expropriated landowners.	Administration of semi-structured interviews to respondents.	Frequency distribution and frequency counts of respondents' perceptions.	Refined list of compensable entitlements to be included in disturbance-integrated compensation method for the study area.
	What combination of valuation techniques is required for developing disturbance-integrated compensation method?	Valuation techniques	Market valuation techniques for real estate; and contingent valuation of disturbance entitlements.	1. Scientific research articles 2. Opinion of real property valuers	1. Literature search 2. Administration of semi-structured interviews to property valuers	1. Interpretation of valuers' responses 2. Identification of consensus between literature and interview responses.	Valuation techniques suitable for developing disturbance-integrated compensation method.
2.	What are the data required for modelling this compensation method?	Required data	Valuation and attribute data of expropriated parcels, compensable entitlements: Real estate and disturbance costs.	1. Scientific research articles 2. Real property valuation reports 3. Landowners' stated preference valuation of disturbance	1. Literature search 2. Collection of valuation report of expropriated properties 3. Eliciting WTAC for disturbance	1. Identification of consensus in literature 2. Classification and tabulation of data	Data specification and data collection for the design of disturbance-integrated compensation method.
	What are the design criteria for disturbance-integrated compensation method?	Design criteria	Assumptions, calibration, and estimation parameters for a logistic model of disturbance compensation; and model structure of DICM.	1. Scientific research articles 2. Respondent's view of compensable entitlements	1. Literature search 2. Administration of semi-structured interviews	Identification and analysis of consensus between literature and interview responses.	Design criteria and computational structure of disturbance-integrated compensation method.
	How is a disturbance-integrated compensation method developed?	Prototype of Disturbance-integrated compensation method	Addition of assessed market value compensation for real estate with estimated (contingent) value of disturbance entitlements.	1. Scientific research articles 2. Real property valuation reports 3. Landowners' stated preference valuation of disturbance	1. Literature search 2. Collection of valuation report of expropriated properties 3. Eliciting WTAC for disturbance	Logistic regression analysis of disturbance compensation and integration of estimated value of disturbance claims with assessed market value.	Flowchart for the design of disturbance-integrated compensation method for land expropriation; and a prototype of disturbance-integrated compensation method for land expropriation.

Table 4: Variable-data matrix for the development of disturbance-integrated compensation method (continued)

Specific objective	Research questions	Variable	Indicators	Data sources	Data collection method	Data analysis techniques[a.]	Anticipated outcome
	What are the test criteria for this compensation method?	Test criteria	Predictability of disturbance compensation for landowners, and an increase in total compensation above the assessed market value.	1. Scientific research publications 2. Views and opinions of expropriated landowners	1. Literature search 2. Administration of semi-structured interviews	Identification of consensus in literature.	List of test criteria for disturbance-integrated compensation method.
3.	What test criteria did the disturbance-integrated compensation method meet?	Compliance with test criteria.	Predictability of disturbance compensation for a landowner, and an increase in total compensation above the assessed market value.	1. Disturbance compensation data 2. Assessed values of compensable entitlements	Synthesis of results from application of disturbance-integrated compensation method.	Test of predictability of disturbance compensation; and paired sample test for difference between disturbance-integrated compensation and market value compensation.	Disturbance-integrated compensation being significantly higher than market value compensation.

a. See Sections 2.5, 3.7, 5.3, and 5.8 for explanation of these techniques.

Judgemental sampling technique was used to determine the sample size of government officials and real property valuers interviewed during fieldwork (Table 2). Rationale for applying this sampling technique is informed by prior knowledge of their role in compensation for land expropriation. A total of 43 respondents comprising 36 expropriated landowners, 3 valuers, and 4 government officials involved in land expropriation and compensation for the proposed airport project in the study area were sampled in order to facilitate data collection using semi-structured interviews (Table 2).

3.5. Variable-data matrix

Complementing the research plan in Figure 4 is the variable-data matrix in Table 4 which provides a summary of expectations from the design of disturbance-integrated compensation method for land expropriation. It commences from the left hand side (LHS) with specific objectives of this research; research questions; variables, indicators, and their data sources; methods of data collection and techniques of analysis; and finally the anticipated outcome. For each research question, there are related variables and indicators, which culminate into data collection, data analysis and an anticipated outcome of the analysis. According to Choguill (2005), this matrix accounts for every research process and helps to avert risks of omitting important steps. It is on the basis of the variable-data matrix in Table 4, that fieldwork and data collection process, design criteria, and development of a model for disturbance-integrated compensation method were carried out. This matrix also formed the basis for the discussion of appropriate data analysis technique(s) for each research question (Section 3.7) and their anticipated outcomes.

3.6. Data collection process

With reference to the variable-data matrix in Table 4, this section specifically discusses: scientific research articles used to address specific research questions, how spatial- and expropriation data were collected, how semi-structured interviews were administered to the three categories of respondents in Rwanda, and how WTAC for disturbance was elicited from expropriated landowners in Karera cell.

(a) Scientific research articles

In the course of literature search, a number of scientific research articles and publications were sorted according to specific research question and variables of the research which is addressed (Table 5). Existing literature was used to answer the six research questions in Table 5. While research questions in serial number 1 of Table 5 was addressed exclusively through identification and analysis of literature, answers to research questions in serial numbers 2, 3, 4, 5, and 6 were addressed using a synthesis of literature with analysis of empirical data for the design research.

Specifically, literature sources in serial numbers 1 and 2 of Table 5 were used to answer the 1st- and part of the 3rd research question of specific objective 1: "*What are the compensable entitlements in disturbance-integrated compensation method?* and *What combination of valuation techniques is required for developing disturbance-integrated compensation method?"* Furthermore, literature sources in serial number 4 were used to provide preliminary answers to question 2 of specific objective 2: *What are the design criteria for disturbance-integrated compensation method?* (See chapter 2). Chapter 5 further examines the synthesis of these literatures with fieldwork results on specification of compensable entitlements for DICM in the study area (chapter 4).

The 1st research question of specific objective 2 is put as follows*: "What are the data required for modelling this compensation method?"* This research question was partly answered through identification of consensus in literature (serial number 3 of Table 5). Consensus in the selected scientific literature on relevant data required to model WTA was synthesized with empirical data on the perception of respondents in chapter 5 to draw up a list of data specification for developing a contingent value model of disturbance compensation. These data include socioeconomic variables of age, educational qualification, and

household expenditure (He & Asami, 2014; Lindhjem & Mitani, 2012; Loomis et al., 1997; Radam & Mansor, 2005; Tapsuwan, 2005). In addition, literature specifying compensation valuation data for real property (Alemu, 2012; Omar & Ismail, 2009; Šumrada et al., 2013) were synthesized with results of fieldwork in chapter 4 to affirm people's expectation of compensable real estate entitlements.

Table 5: Relevant scientific research articles and publications with references

S/N	Research question	Variables/Purpose	References of scholarly publications
1	What are the compensable entitlements in disturbance-integrated compensation method?	Compensable entitlements	Alemu (2012); Cernea (1988); Feldman and Geisler (2012); He and Asami (2014); Kusiluka et al. (2011); Lindhjem and Mitani (2012); Nayak (2000); Omar and Ismail (2009); Shapiro et al. (2013); Syagga and Olima (1996); Wyatt (2007).
2	What combination of valuation techniques is required for developing disturbance-integrated compensation method?	Valuation techniques	Gilchrist and Allouche (2005); He and Asami (2014); Kauko (2004); Louviere et al. (2000); Pearce et al. (2006); Shapiro et al. (2013); Šumrada et al. (2013); Wyatt (2007).
3	What are the data required for modelling this compensation method?	Required data	Alemu (2012); Biel et al. (2011); Cernea (1988); He and Asami (2014); Lindhjem and Mitani (2012); Loomis et al. (1997); Pearce et al. (2006); Radam and Mansor (2005); Shapiro et al. (2013); Šumrada et al. (2013); Tapsuwan (2005); Wyatt (2007).
4	What are the design criteria for disturbance-integrated compensation method?	Design criteria	Alemu (2012); Dowdy et al. (2004); Field (2009); Gujarati (2004); Hanneman and Kanninen (1999); He and Asami (2014); Kauko (2004); List and Shogren (2002); Loomis et al. (1997); Radam and Mansor (2005).
5	How is a disturbance-integrated compensation method developed?	Prototype of disturbance-integrated compensation method	Alemu (2012); Bucklan et al. (1999); Dowdy et al. (2004); Field (2009); Gujarati (2004); Hanneman and Kanninen (1999); He and Asami (2014); Lindhjem and Mitani (2012); List and Shogren (2002); Loomis et al. (1997); Radam and Mansor (2005).
6	What are the test criteria for this compensation method?	Test criteria	Bucklan et al. (1999); He and Asami (2014); Norrell (2008); Tapsuwan (2005).

Results drawn from semi-structured interview in the study area was synthesized with literature sources in serial number 5 in order to derive a general equation representing DICM (equation 15). A combination of ideas from these literatures with the flowchart in Figure 9 culminated into development of DICM (chapter 6). Hence, all literature sources in serial number 5 of Table 5 contributed towards answering the research question: *How is a disturbance-integrated compensation method developed?* Lastly, research publications listed under serial number 6 of Table 5 were sourced to review literature on the test criteria for compensation valuation methods in order to pave the way for empirical data in chapter 6 to provide answers to the 1st research question of specific objective 3: "*What test criteria is the disturbance-integrated compensation method expected to meet?*"; thereby validating results from fieldwork.

(b) Spatial- and expropriation data collection

Pursuant to an introduction letter (Appendix 2) tenable at relevant organization, the Lands and mapping agency of RNRA granted access to shape files of Karera cell and its parcels which facilitated a description of study area (Section 3.2). Furthermore, compensation assessment/valuation report on expropriated

properties in Karera were harnessed from a firm of real property valuers in Kigali for the purpose of extracting sample frame and market valuation data required to design a prototype of DICM.

(c) Interviews

With exception of expropriated landowners who were interviewed in Kinyarwanda language, all other interviews were conducted in English. A sample of interview in Appendix 3 was administered to four government officials comprising a transport officer in the Ministry of Infrastructure, two officials of the Lands and Mapping department of RNRA, and mayor of Bugesera district. Furthermore, three real property valuers involved in compensation assessment for expropriated properties were administered a sample of interview in Appendix 4. Responses to these interviews were recorded in written and audio formats with respondent's permission. Following approval from Bugesera district administration (Appendix 5), a field assistant was hired to help administer interviews to a sample of expropriated landowners in Kinyarwanda language (Appendices 6A & 6B). Just like similar surveys of WTA where focus group interview was utilized (Lindhjem & Mitani, 2012), contingent valuation survey of disturbance compensation was carried out in focus groups with the help of village leaders in the study area. This process saved time and financial burden of conducting one-on-one interview. The focus group interview was moderated to ensure effective communication and response from interviewees, while responses provided by individual landowners were recorded in written English and audio formats in order to facilitate effective transcription of responses from Kinyarwanda to English language.

Whereas part 4 of all interviews administered to respondents (Appendices 3, 4, and 6A/6B) elicits their perception of equity likely to arise from applying DICM for land expropriation, data obtained were not analyzed in this research for two reasons: First, the scope of this research was narrowed towards developing a model of DICM; consequently, the analysis of perception of equity likely to arise from applying DICM for land expropriation is currently beyond the scope of this research. Secondly, the fundamental task in this research has been structured around an analytical framework for DICM contrary to a linkage between concepts of compensation and equity of assessed compensation for land expropriation.

With respect to semi-structured interview and contingent valuation survey in Appendices 6A/6B, analysis of answers to question 11 provided by a selection of landowners was discarded in favour of analysis of answers to question 9 which has wider implications for market value- and disturbance compensation cutting across all the 36 landowners in the sample frame.

(d) Contingent valuation of disturbance entitlements

The dichotomous choice technique with follow-up bidding (double-bounded dichotomous choice technique) was chosen as the appropriate contingent valuation tool for this study. There are two reasons for this choice of valuation tool. Firstly, it is a conservative approach towards eliciting WTA (Pearce et al., 2006). Secondly, it was successfully utilized in a similar study of land price formation by property owners during expropriation (He & Asami, 2014), thereby extending possibilities for applying it towards determining use and non-use values embedded in disturbance entitlements, which are ordinarily beyond the capacity of market valuations methods to determine.

Minimum and maximum willingness to accept compensation (WTAC) for disturbance were fixed at 500,000 Frw and 3,750,000 Frw respectively after considering price regime of land market in the study area. Furthermore, higher- and lower bidding intervals of (X + 500,000) Frw and (X - 250,000) Frw were established respectively in the design of contingent valuation (CV) surveys (Appendices 6A and 6B).

The flowchart in Figure 5 describes process of double-bounded dichotomous choice bidding that was incorporated in Question 10 of CV surveys (Appendices 6A and 6B). Landowners were randomly allocated equivalent variations (price set) ranging from 750,000 Frw to 3,500,000 Frw. Thereafter, they were individually asked if they are willing to accept the allocated price (1st bid price) as compensation for disturbance in addition to market value compensation for land, building and unexhausted improvements (real property). Those who accepted the initial amount were further asked if they are willing to accept lower bid of (X - 250,000) Frw, while landowners who refused the initial amount were asked if they are willing to accept a higher disturbance compensation of (X + 500,000) Frw.

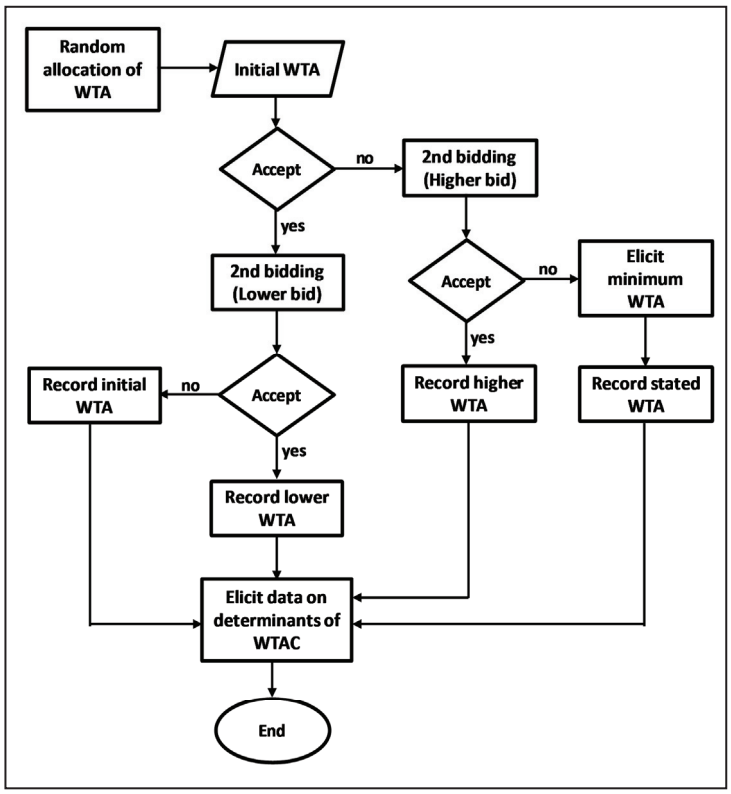


Figure 5: Double-bounded dichotomous choice bidding of WTAC

It is certain that bidding process enters a second round if a landowner rejects or accepts 1st bid amount until a final amount is agreed upon and recorded. Notwithstanding, the estimation of WTAC for disturbance was carried out with recourse to the 1st bid amount, while a Yes/No response is required in the 2-stage bidding thereby leading to four possible responses for the 1st bid – 2nd bid as Yes–Yes; Yes–No; No–Yes; and No–No respectively. The CV survey was concluded with the elicitation of each landowner's determinant of WTAC for disturbance.

3.7. Techniques for data processing and analysis

Qualitative and quantitative techniques were deployed towards analyzing exploratory data that led to the specification of design criteria for DICM. The qualitative skill deployed in this study is the identification of consensus in data and the interpretation of interviewee responses drawn from fieldwork. With reference to the variable-data matrix (Table 4), identification of consensus was directed towards deriving harmonious connotations from statements about specific aspects of DICM based on research data drawn from multiple sources. This skill was specifically applied to the discussion of results in chapters 4 and 6 for the purpose of validating existing literature with results drawn from interview responses and the design of DICM respectively.

Oral responses and storylines from interviewees relating to compensation for land expropriation were processed as text-based data and further interpreted for the purpose of designing DICM. Interpretation of responses and storylines from interviews have been argued to be relevant in design research (Golsteijn & Wright, 2013). Within the context of this research, collection and interpretation of these text-based data were made possible through the incorporation of specific open-ended probing questions in study questionnaires (Appendices 4, 5 and 6), audio recording of interview responses, and transcription of responses from all persons interviewed during fieldwork in the study area. The interpretation of responses to specific interview questions on compensation for land expropriation has been supported with direct quotations (Sections 4.3 and 4.4). Interpretation of these responses were further synthesized with Landowners' expectation of an enhanced compensation for land expropriation (Section 4.6) with a view to identifying rationale for the development of DICM based on specified design criteria in chapter 5.

With reference to the variable-data matrix in Table 4, data addressing the 1st research question of specific objective 1 were analyzed by identifying consensus in information from relevant research publications pertaining to indicators of compensable entitlements (Serial No. 1 of Table 5); such that the outcome of the process have been documented in chapter 2 as a list of compensable entitlements to be included in disturbance-integrated compensation method. Data pertaining to the 2nd research question of specific objective 1 were sorted, coded and presented using component bar charts indicating frequency counts of respondents' perceptions of compensable entitlements to be included in DICM as documented in chapter 4. The coding adopted for agree-disagree answers in the study questionnaire (Appendices 4, 5 and 6) include *"SA"* for strongly agree, *"AG"* for agree, *"NAD"* for neither agree nor disagree; *"DS"* for disagree; and *"SD"* for strongly disagree. Outcome of the 3rd research question of specific objective 1 was derived from the analysis of consensus between existing literature and interview responses from valuers concerning suitable valuation techniques for developing DICM.

Identification of consensus between interview data and existing literature for the design criteria of DICM was used to support outcomes of the 1st and 2nd research questions of specific objective 2 (Table 5). In addition, valuation/compensation report of expropriated properties and landowners' stated preference valuation of disturbance are quantitative data that further supported the outcome of the 1st research questions of specific objective 2. These data have been classified and tabulated to meet data specification for the design of disturbance-integrated compensation method in chapter 6. Analysis of data relating to the 3rd research question of specific objective 2: "*How is a disturbance-integrated compensation method developed?"* culminated into logistic regression analysis of disturbance compensation and integration of estimated value of disturbance claims with assessed market value in chapter 6. The outcome of this analysis was a prototype of disturbance-integrated compensation method for land expropriation in Karera cell. A consensus in existing literature was used to address the 1st research question of specific objective 3: *"What are the test criteria for this compensation method?"* These criteria include predictability of true WTAC for disturbance compensation; and an enhanced compensation for landowners compared to assessed market value (Table 5). Secondly, Table 4 specifically highlights that the outcome of 2nd research question of specific objective 3: *"What test criteria did the disturbance-integrated compensation method meet?"* is achieved by testing the predictive ability of recursive logit model of disturbance compensation (equation 17) and conducting paired difference test of significance of enhanced compensation arising from the application of DICM compared to market value compensation.

3.8. Concluding remarks

This chapter examines strategies for collection of data required for the specification of design criteria for DICM for land expropriation. Motivating this chapter are the research questions: *What are the data required for modelling this compensation method?* and *What is the design criteria for disturbance-integrated compensation method?*

Data required for the design of DICM were identified to include valuation and attribute data of expropriated parcels, and a specification of compensable entitlements comprising real estate and disturbance costs (See Table 4; Sections 1.6, 4.7 and 5.2 respectively). From the conclusion in chapter 2 that DICM for land expropriation is a combination of market valuation- and stated preference valuation of disturbance entitlements, relevant variables of the criteria include assumptions, calibration, estimation parameters for a logistic or logit model of disturbance compensation and a computational structure of DICM (See section 2.5.2, equation 15, and sections 6.6 and 6.7 respectively).

In connection with the 1st research question of specific objective 2, strategies deployed to collect data to specify a design criteria for DICM and further develop a prototype of DICM include literature search (Table 5), collecting valuation report of expropriated properties from real property valuers, and engaging expropriated landowners in a double-bounded dichotomous choice bidding of WTA compensation for disturbance. Furthermore, techniques of analysis appropriate to these data have been identified to include identification of consensus in literature, identification and analysis of consensus between literature and interview responses, data classification, and tabulation. With reference to the variable-data matrix (Table 4), outcome of the 2nd research question of specific objective 2 is a design criteria and mathematical model of DICM (chapter 5); whereas outcome of the 1st research question of specific objective 2 include data specification and collection leading to the design of a prototype of DICM in chapter 6.

Finally, the variable-data matrix (Table 4) provides a guide to complement research plan (Figure 4) for the design of DICM as well as the conduct of the remaining research processes. It is on the basis of this matrix that chapter 4 presents results of data collection in Rwanda pertaining the perception of compensable entitlements and data requirements for the design of a prototype of disturbance-integrated compensation method.

4. RESULTS ON PERCEPTION OF DESIGN CRITERIA FOR DISTURBANCE-INTEGRATED COMPENSATION METHOD IN RWANDA

4.1. Introduction

This chapter addresses the 2nd research question of specific objective 1: *"What is the perception of compensable entitlements in disturbance-integrated compensation method?"* and analyzes exploratory data from Rwanda to support the 3rd research question of specific objective 1: *"What combination of valuation techniques is required for developing disturbance-integrated compensation method?"*. With reference to the variable-data matrix (Table 4), data addressing these research questions have been processes and presented using techniques explained in section 3.7. Highlights of this chapter is the identification of gaps in the existing market value compensation method and rationale for DICM, refinement of compensable entitlements to be included in DICM for the study area, and a combination of valuation techniques suitable for developing DICM.

4.2. Socioeconomic characteristics of expropriated landowners

Recalling the relevance of socioeconomic variables in modelling WTA, Table 6 outlines the socioeconomic characteristics of a sample of expropriated landowners interviewed during fieldwork.

Table 6: Socioeconomic information of expropriated landowners

Variables	Attributes	Frequency (N = 36)
Age (Class interval in years)	21 - 30	8
	31 - 40	11
	41 - 50	6
	51 - 60	6
	61 - 70	2
	71 - 80	3
Gender	Female	8
	Male	28
Marital status	Single	1
	Married	32
	Widowed	2
	Separated	1
Years in occupation of land before expropriation	1 - 10	4
	11 - 20	6
	21 - 30	8
	31 - 40	11
	41 - 50	4
	71 - 80	2
Land use before expropriation	Agricultural	6
	Commercial	1
	Residential and Agricultural	27
	Residential, Agricultural, and Commercial uses	2
Monthly household expenditure after expropriation (in Rwanda Francs)	Less than 135,000	23
	135,000 - 154,999	10
	Greater than 155,000	3

Table 6 indicates that 28 out of 36 expropriated landowners are males as against 8 females in the sample. Information gathered from interviews also reveals that majority of landowners are married but without any paid employment thereby accounting for participation in civil society groups with operational mandates of cooperative societies. A cursory examination of age of landowners and their duration of land occupation prior to the expropriation indicates that 11 of them are aged between 31 and 40 years old or have lived on their land within the same period of years (31 to 40 years) before the expropriation.

Furthermore, the dominant land uses before the expropriation was reported to be a combination of residential and agricultural uses; implying that a predominant proportion of expropriated landowners in the sample depend on their parcels for shelter and food production.

Finally, three groups of landowners were identified in terms of the magnitude of household expenditure after expropriation to include those spending: less than 135,000 Frw per month (23 out of 36), 135,000 to 154,999 Frw per month (10 out of 36) and those spending above 155,000 Frw per month (3 out of 36). The contribution of these socioeconomic variables in Table 6 to landowners' bidding of WTAC for disturbance was addressed as compensable entitlements under unique characteristics of landowners in the logistic regression analysis of disturbance compensation in chapter 6.

4.3. Viewpoints of land expropriation as a form of disturbance to land rights

All categories of respondents perceive land expropriation as a form of disturbance to other land rights besides bringing an end to ownership rights (Table 7).

Table 7: Perception of respondents on expropriation as a form of disturbance to land rights

Category of Respondent	Summary of viewpoints
Government officials	According to the DDG of Lands and mapping department, land expropriation is a disturbance to other rights held in land. He reiterated that this phenomenon accounts for discussions on disturbance compensation at the policy level. The mayor of Bugesera replied that: *"Land rights are disturbed in the event of expropriation. After expropriation the last procedure is to compensate the affected parties"*. Another staff of RNRA interviewed replied that: *"... land expropriation is better a challenge than a disturbance"* while a staff of MINIFRA replied that *"Land expropriation is definitely a disturbance. Although it is unavoidable, the main issue is that it should be managed properly"*.
Real property valuers	Expropriation poses as disturbance to other rights held in land. In view of this, one of the real property valuers remarked that *"Expropriation in my own opinion should be matched with the project to be implemented irrespective of the loss of land rights"*. Another valuer respondend that *"Land expropriation is a form of disturbance to other land rights"*, while the 3rd valuer equally answered in affirmative.
Expropriated landowners	26 out of a sample of 36 expropriated landowners in Karera perceived land expropriation as a form of disturbance to other rights held in land. Specific disturbances identified by these landowners include relocation cost, loss of family contact, loss of income from farming, and economic hardship after relocation. 8 out of 36 landowners did not really perceive land expropriation to be a form of disturbance to land rights, while a landowner (Respondent No. 10) who replied that expropriation does not constitute disturbance contradicted himself by answering that *"....we have lost access to our forest and natural resources and I doubt if I can still have access to forest and these resources when I relocate to another land"*. Although one landowner (Respondent No. 31) did not provide valid answer to the question, another landowner (Respondent No. 9) suggested that expected compensation should be scaled-up in consideration of inflation and delayed payment. [See Appendix 7 for details]

Besides acknowledging land expropriation as a disturbance to other rights held in land, the DDG of Lands and Mapping reiterated that the Rwandan government is currently brainstorming at the policy level on

how to monetize disturbance compensation for land expropriation. In the same vein, real property valuers viewed expropriation as a disturbance to other rights held in land. Furthermore, 6 expropriated landowners were able to identify specific disturbance entitlements listed in Appendix 7 to include relocation cost, loss of income and loss of access to forest and natural resources among others. These views imply that respondents especially landowners are aware of disturbance and disturbance entitlements associated with land expropriation for public purpose.

4.4. Viewpoints on specific issues of compensation for land expropriation

In this section, Table 8 presents some direct quotations and summarized views of respondents on specific issues surrounding compensation assessment for land expropriation in the study area, among which are interview data to support the outcome of the 3rd research question of specific objective 1 concerning a combination of valuation techniques required for developing DICM.

First, with reference to relevant quotes on the subject matter of professional networking in compensation valuation (Table 8), real property valuers who are users of value assessment techniques underscore the importance of collaborating among themselves as well as collaboration with expropriated landowners for the purpose of determining value of compensable entitlements.

Secondly, all the four government officials interviewed acknowledged government's preference for cash compensation, while one of them did not rule out the possibility of compensation in kind as well as resettlement of affected parties in accordance with the provisions of the expropriation Law. In his words, a government official responded that: *"The first option is to pay them cash. The expropriation Law even stated that affected parties can be compensated in kind. Nevertheless, people prefer cash compensation"*.

Thirdly, property valuers were asked to comment on existing methods of real property valuation and compensation assessment in the study area of which their response in Table 8 summarily indicates a consensus of views concerning the combination of real property valuation methods for the assessment of compensation for land expropriation and in compliance with Article 31 of Real Property Valuation Law in the study area.

Fourthly, when asked on modalities for identifying disturbance costs incurred by expropriated landowners, 2 out of the 3 valuers acknowledged the use of elicitation methods aimed at asking expropriated landowners specific questions that will help to identify these disturbances (Table 8). Therefore, inference can be drawn that if disturbance-integrated compensation is a combination of market value and contingent value of disturbance entitlements, then the views of valuers in the study area affirms that DICM might be a combination of market valuation of real property and contingent value of disturbance entitlements arising from the expropriation.

Fifthly, there was a stalemate among the four government officials interviewed on subject of enhanced participation in compensation assessment following the allowance of expropriated landowners to bargain disturbance compensation with government (Table 8). This is because two out of the four officials agreed, while the other two officials disagreed. Contrary to this, all valuers agreed that such practice will enhance a more participatory compensation assessment. In a related development, one of the expropriated landowners interviewed stated that *"Government should negotiate compensation payment with persons whose interest in land has been expropriated. In addition, the compensation payable should be commensurate with the value of properties expropriated"*. Furthermore, 4 out of 36 expropriated landowners reiterated that they would have advocated for the valuation of their businesses and livelihoods lost in connection with the expropriation if they had been involved in the compensation assessment process.

Table 8: Viewpoints on issues of compensation assessment for land expropriation

Subject	Category of Respondent	Summary of viewpoints	
Professional networking in compensation valuation	Real property valuers	Certified property valuers in Rwanda are authorized to carryout valuations for all purposes including compensation for land expropriation. Valuers liaise with expropriated landowners and collaborate with their professional colleague in order to ensure successful valuation of expropriated properties located within the proposed airport site in Bugesera. According to one of the valuers, *" In most cases, assessment of compensation payable is done in conjunction with the affected parties "*. Another valuer reiterated that *"data used connection with the expropriation and compensation were obtained from ..... meetings and decisions from professional team of assessors"*.	
Approach to compensation payment	Government officials	According to the four government officials interviewed, government prefers to pay cash compensation for land expropriation. However, it is possible that government may compensate in the form of resettlement as stipulated in the expropriation law.	
Existing methods of real property valuation and compensation assessment	Real property valuers	Replacement cost method is ranked as the most preferred method of valuing expropriated real property, while market comparison- and investment methods are ranked in the second and third places respectively. One of the valuers further remarked that *"In addition to these methods of valuation, I have used property values that have been set by the government for the purpose of expropriation"*. Finally, all valuers interviewed on this subject assert that they tend to combine these valuation methods for the purpose of assessing compensation for land expropriation and in compliance with Article 31 of Real Property Valuation Law.	
Modalities for identifying disturbance costs incurred by expropriated landowners	Real property valuers	Two out of the three valuers interviewed acknowledged that identification of disturbance entitlements associated with land expropriation is possible through elicitation approach. In the words of the first valuer, *"Disturbances arising from land expropriation can be identified from the comments made by affected property owners"* while the second valuer reiterated that *"Disturbances arising from land expropriation can be identified by interrogating affected parties"*.	
Allowing expropriated landowners to bargain disturbance compensation with government will enhance their participation in compensation assessment.	Government officials	**Response**	**Frequency**
		Strongly agree	0
		Agree	2
		Neither agree nor disagree	0
		Disagree	2
		Strongly disagree	0
	Real property valuers	Strongly agree	1
		Agree	2
		Neither agree nor disagree	0
		Disagree	0
		Strongly disagree	0

Table 8: Viewpoints on issues of compensation assessment for land expropriation (continued)

Subject	Category of Respondent	Summary of viewpoints
Involving expropriated landowners in compensation assessment	Expropriated landowners	35 out of the 36 expropriated landowners responded that government did not engage them during the valuation of their expropriated properties. They however suggested two key areas where their involvement would have counted to include a non-coercive deal-, and negotiation with government over an acceptable compensation. In the words of an expropriated landowner, "*Persons should be able to negotiate with the government concerning expropriation and compensation. Government should not force us to sign any valuation agreement connected with expropriation*". In addition, there was a consensus among four landowners that they would have advocated for the valuation of their businesses and livelihoods lost in connection with the expropriation if they had been granted active participation in the process.
Sources of data for compensation assessment	Real property valuers	For the purpose of compensation assessment, valuers interviewed outlined sources of land value data to include government approved land prices published by government organizations like RNRA and local authorities; and real estate brokers. They further identified sources of building cost data to include government ministries and local authorities, real estate brokers, civil engineers and contractors. In addition to these sources, one of the valuers underscored the role of professional networking and reference to recent valuation exercises within the study area.
Publication of compensation payable for expropriated properties	Real property valuers	All valuers interviewed agreed that government had disclosed assessed market values of expropriated properties to their respective owners.
	Expropriated landowners	In a similar vein, the sample of landowners interviewed all agreed that government disclosed assessed market values of expropriated properties. However, 10 out of 36 expropriated landowners detested the content of that publication stressing that it failed to show breakdown of the value of each compensable entitlement. One of the expropriated landowners remarked as follows: *"I want the government to provide a break-down of the compensation payable for each of my expropriated properties so that I can cross check these figures with my own estimates".*
Existence of appeal process for compensation	Real property valuers	Although all valuers acknowledge the existence of an appeal process for compensation, they have diverging opinion over procedure and institutions involved. One of the valuers reiterated that appeals of valuations are handled by the council of valuers. With respect to assessment of compensation, the other two valuers assert that the process should begin with the expropriating authority since a dispute resolution committee has been inaugurated at district and sector administration offices for that purpose. Irrespective of these divergent views, it was confirmed that an appeal process exists for compensation for land expropriation.

Sixthly, valuers outlined the sources of data for assessing compensation for land and buildings in Table 8 to include government organizations, contractors and real estate brokers. It was observed that the ministerial order determining reference land prices outside Kigali city (Republic of Rwanda, 2010) and the valuation rates for crops and construction works approved by the Kigali city council in 2005 are used as compensation assessment rates. Whereas these results do not directly address specific objective 1, they are primers to empirical answers to the 2nd research question of specific objective 2: *"What are the data required for modelling this compensation method?"*, which shall be examined in chapter 5.

Finally, it can be observed from Table 8 that government has put in place an appeal process for compensation in addition to the practice of publishing compensation payable to expropriated landowners. However, expropriated landowners interviewed are not satisfied with the censorship of value of their compensable entitlements. An issue of transparency in value information arose in the course of interview as one of these expropriated landowners said he preferred government to provide him with a breakdown of the value of all his compensable entitlements for verification purposes (Table 8).

4.5. Socioeconomic changes justifying payment of compensation for land expropriation

This section presents results on agreement among the three categories of respondents concerning socioeconomic changes arising from expropriating private land rights for public purposes thereby justifying the importance of compensation payment (Figure 6).

(a) Change in Land rights

Figure 6(a) indicates that 18 out of 43 respondents strongly agree that payment of compensation is important because of changes in land rights associated with land expropriation. Among these 18 respondents include 15 landowners 2 government officials, and 1 valuer. Furthermore, 22 respondents comprising 19 landowners, 1 government official and 2 valuers agree that payment of compensation is important because of changes in land rights. On the overall scale, 40 out of 43 respondents acknowledge change in land rights as an important driver of compensation for land expropriation while 3 out of 43 respondents disagreed.

(b) Loss of buildings and immovable structures

With reference to Figure 6(b), 23 out of 43 respondents strongly agree that the loss of buildings and immovable structures on land is an important driver for compensation in the event of land expropriation for public purpose. Similarly, 18 out of 43 respondents agreed on this subject. On the other hand, a valuer was indifferent on this subject while a landowner disagreed. In the event of land expropriation for public purpose, it can be summarized that at least 41 out of 43 respondents comprising 35 landowners, 4 government officials and 2 valuers acknowledge loss of buildings and immovable structures on land as an important driver for compensation.

(c) Change in ancestral heritage

17 out of 43 respondents strongly agree that change in ancestral heritage is an important driver of compensation for land expropriation. Also consenting to this socioeconomic change are 21 out of 43 respondents, comprising 16 landowners, 3 government officials and 2 valuers who agree that it is an important driver of compensation for land expropriation. Inference can be drawn from Figure 6(c) that 38 out of 43 respondents acknowledge change in ancestral heritage to be an important socioeconomic change which should motivate payment of compensation for land expropriation contrary to a total of 5 out of 43 respondents who disagreed.

(d) Change in family ties

22 out of 43 respondents (predominantly expropriated landowners) in the study area strongly agree that a change in family ties is among the socioeconomic changes which makes compensation payment for land expropriation to be important. In a related result, 14 out of 43 respondents comprising 9 landowners, 3 government officials and 2 valuers agree that change in family ties makes compensation payment to be important. Figure 6(d) summarily indicates that 36 out of 43 respondents acknowledge that compensation payment is important because of a change in family ties in the event of expropriation contrary to a total of 7 out of 34 respondents who disagreed.

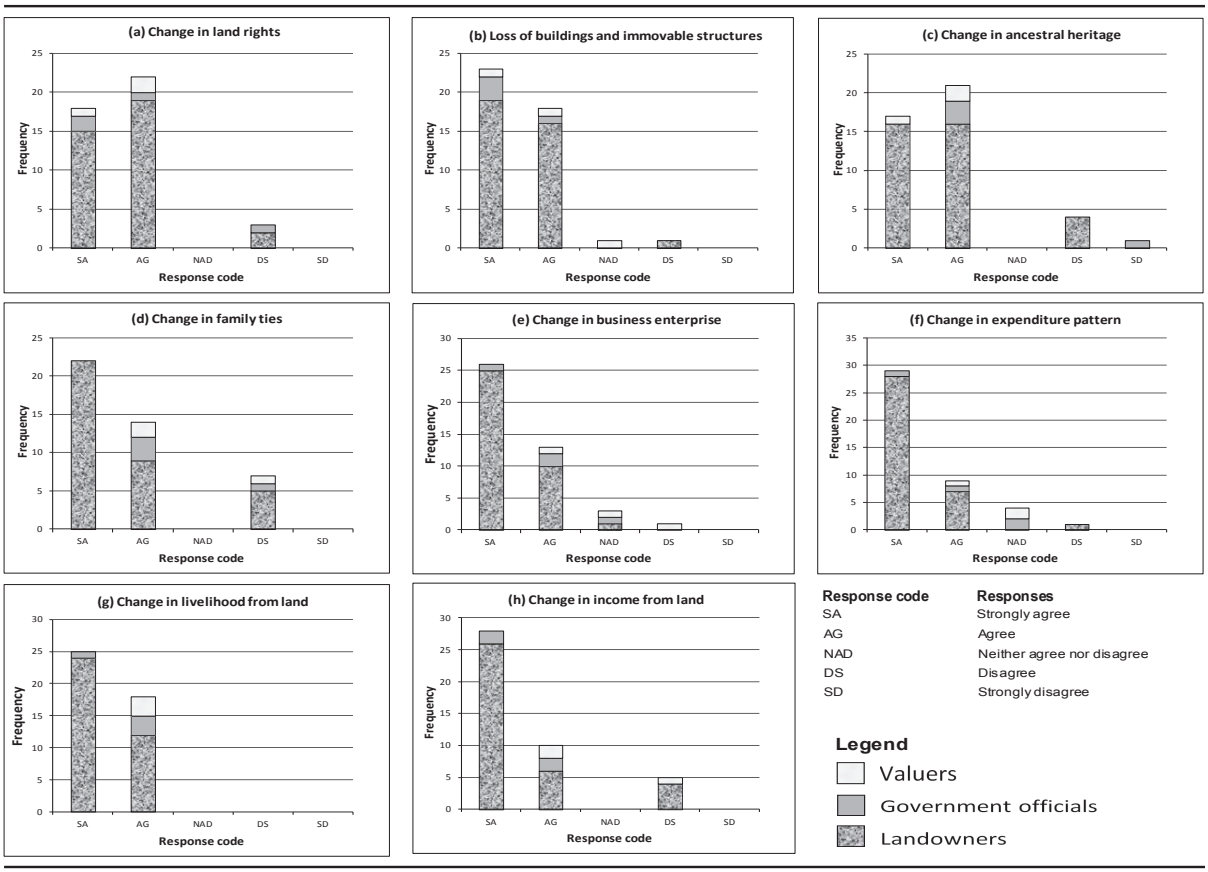


Figure 6: Views on socioeconomic changes justifying compensation for land expropriation

(e) Change in business enterprise

With reference to Figure 6(e), 26 out of 34 respondents (predominantly expropriated landowners) in the study area strongly agree that compensation payment is important because of a change in the condition of their business enterprise. Out of a total of 43 respondents, the frequency counts of respondents who agreed, were indifferent, and disagreed are 13, 3, and 1 respectively. Inference can be drawn from Figure 6(e) that majority of respondents comprising 39 out of 43 uphold the payment of compensation for land expropriation on the rationale of a change in the condition of their business activities on land.

(f) Change in expenditure pattern

29 out of 43 respondents strongly agree that compensation payment is important due to a change in their expenditure pattern arising from land expropriation. Out of a total of 43 respondents, the frequency counts of respondents who agreed, were indifferent, and disagreed are 9, 4, and 1 respectively. It can be observed from Figure 6(f) that 38 out of 43 respondents acknowledge change in expenditure pattern arising from land expropriation as an important reason for compensation payment.

(g) Change in livelihood from land

In Figure 6(g), 25 out of 43 respondents (predominantly expropriated landowners) strongly agree that a change in the livelihood of parties affected by land expropriation is an important reason for compensation payment. Further supporting this view are 18 out of 43 respondents in the study area. With these results, it can be deduced that all respondents interviewed acknowledge change in livelihood from land as an important reason for compensation payment in the event of land expropriation.

(h) Change in income from land

28 out of 43 respondents strongly agree that compensation payment is important due to a change in income from land (Figure 6(h)). Further supporting this view are 10 out of 43 respondents who agree with the subject, while 5 out of 43 respondents disagreed outright. Notwithstanding, it can be deduced that a total of 38 out of 43 respondents acknowledge change in income from land as an important reason for compensation payment in the event of land expropriation. The next section examines landowners expectations of enhanced compensation for expropriation.

4.6. Landowners' expectation of an enhanced compensation for land expropriation

Results in this section serve as a primer for section 4.7 which examines respondents' expectation of compensable entitlements in the event of land expropriation for public purpose. One of the landowners interviewed expects that compensation for land expropriation should not limit his financial ability to purchase an alternative property. In his words, *"..... I would have preferred that government considers my ability to purchase an equivalent parcel in another location. In addition, I would have preferred if market value of my land and properties were considered in the compensation assessment process"*. According to another landowner who made similar remarks, *"I would prefer that my property is valued appropriately so that the compensation I will eventually get can enable me to purchase an alternative property"*. Another landowner made similar statement in exercise of the fear that expected compensation may not be commensurate with the prevailing prices of landed properties in the study area. According to him, *"Government should negotiate compensation payment with persons whose interest in land has been expropriated. In addition, the compensation payable should be commensurate with the value of properties expropriated"*. In addition to the quest for compensation which is equivalent to value of expropriated properties, some of these expropriated landowners clamour for the consideration of all their entitlements including compensation for disturbances (See Table 7). In the words of one of these expropriated landowners *"I prefer government to value the livelihood of the people first before ascribing value to our expropriated properties. In this way, the compensation payable shall be adequate"*. Information derived from these statements include dissatisfaction of expropriated landowners with existing practice of compensation for land expropriation in the study area and the need to ensure that all compensable entitlements of expropriated persons are captured in a compensation assessment technique. The next section empirically identifies relevant compensable entitlements with reference to frequency distribution of respondents' agreement or otherwise over the inclusion of these entitlements in a compensation assessment technique.

4.7. Compensable entitlements for land expropriation

Analysis of responses concerning compensable entitlements which landowners expect government to include in a compensation package for land expropriation shall be used to answer the 2nd research question of specific objective 1: *"What is the perception of compensable entitlements in disturbance-integrated compensation method?"* Besides market value of real property which is currently featured in compensation assessment, the other entitlements constitute disturbance arising from land expropriation.

(a) Market value of real property

In Figure 7(a), 26 out of 43 respondents strongly agree that total compensation payable for land expropriation should include market value of real property. Furthermore, 13 out of 43 respondents agree

that total compensation payable for land expropriation should include market value of real property. Overall result from Figure 7(a) indicates that 39 out of 43 (majority of) respondents comprising 32 landowners, 4 government officials and 2 valuers generally agree that market value of real property is among the compensable entitlement arising from land expropriation.

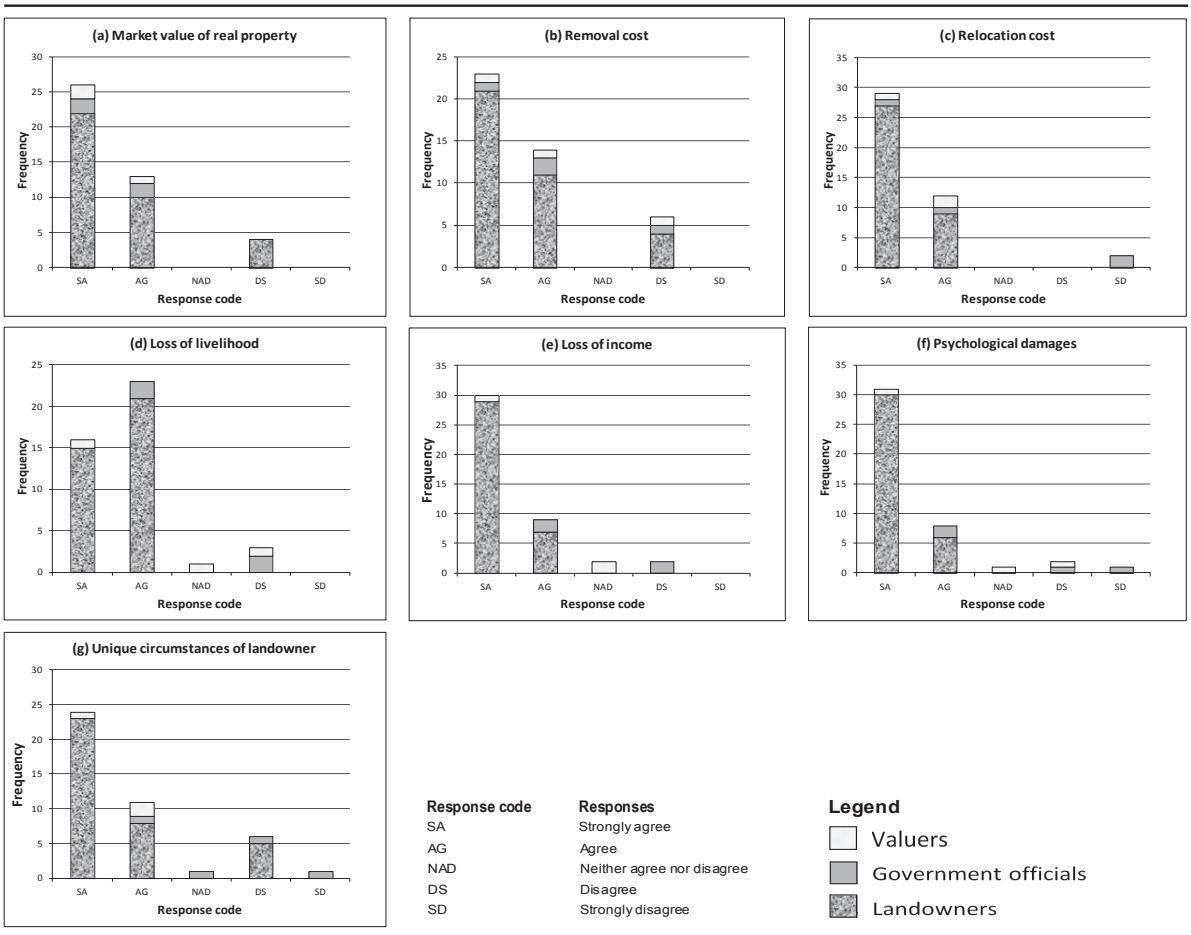


Figure 7: Views on compensable entitlements for land expropriation

(b) Removal cost

With reference to Figure 7(b), 23 out of 43 respondents strongly agree that removal cost should be integrated into total compensation payable for land expropriation. In a similar vein, 14 out of 43 respondents agree that this entitlement should be included in the total compensation payable to expropriated landowners. However, 6 out of 43 respondents disagreed with the inclusion of this entitlement in total compensation. Overall results in Figure 7(b) indicates that 37 out of 43 (majority of) respondents comprising 32 landowners, 3 government officials and 2 valuers generally agree that removal cost of landowners should be compensated in connection with land expropriation.

(c) Relocation cost

29 out of 43 respondents strongly agree that relocation cost of expropriated landowners should be included in total compensation payable for land expropriation. Whereas 12 out of 43 landowners agree with the inclusion of this entitlement, 2 out of 43 strongly disagree Figure 7(c). It can be summarized that 41 out of 43 (majority of) respondents comprising 36 landowners, 2 government officials and 3 valuers generally agree that value of relocation cost should be included in the total compensation package.

(d) Loss of livelihood

In Figure 7(d), 16 out of 43 respondents strongly agree that compensation for loss of livelihood on land should be included among total compensation payable for land expropriation. Similarly, 23 out of 43 respondents in the sample agree that compensation for loss of livelihood should be included in the total compensation payable. Furthermore, 3 out of 43 respondents disagreed with the inclusion of this entitlement, while 1 out of 43 respondents was indifferent over the subject. Overall result in Figure 7(d) indicates that 39 out of 43 (majority of) respondents comprising 36 landowners, 2 government officials and 1 valuer generally agree that compensation for loss of livelihood should be included in the total compensation for land expropriation.

(e) Loss of income

30 out of 43 respondents strongly agree that compensation for loss of income should be integrated into total compensation for land expropriation. Similarly, 9 out of 43 respondents agreed with the subject matter Figure 7(e). Out of the 43 respondents, 2 were indifferent while 2 disagreed that loss of income arising from land expropriation should be compensated. Notwithstanding, overall result in Figure 7(e) indicates that 39 out of 43 (majority of) respondents comprising 36 landowners, 2 government officials and 1 valuer generally agree that compensation for loss of income should be included in the total compensation for land expropriation.

(f) Psychological damages

With reference to Figure 7(f), 31 out of 43 respondents strongly agree that compensation for psychological damages should be integrated into total compensation payable for land expropriation. Related to this result is 8 out of 43 respondents who agreed on the subject. Figure 7(f) further indicates that out of the 43 respondents interviewed, 1 was indifferent, 2 disagreed and 1 strongly disagreed. Overall result in Figure 7(f) indicates that 39 out of 43 (majority of) respondents comprising 36 landowners, 2 government officials and 1 valuer generally agree that psychological damages of landowners should be compensated in connection with land expropriation.

(g) Unique circumstance of landowner

It is observed in Figure 7(g) that 24 out of 43 respondents strongly agree that compensation for unique circumstances of landowners should be integrated into total compensation payable for land expropriation. Related to this result is 11 out of 43 respondents who agreed with the same perception. Result in Figure 7(g) further shows that out of the 43 respondents interviewed, 1 was indifferent, 6 disagreed and 1 strongly disagreed. It can be summarized from Figure 7(g) that 35 out of 43 (majority of) respondents comprising 31 landowners, 1 government official and 3 valuers generally agree that unique circumstances of landowners should be compensated in connection with land expropriation.

4.8. Discussion of results from fieldwork

This section evaluates synergy between results from interview of respondents in Rwanda and literature in chapters 1 and 2, essence of which is to further evaluate gaps in the existing market value compensation method and identify rationale for design criteria of DICM for land expropriation.

Firstly, Cernea (1988); Heller and Hills (2008); and Nayak (2000) acknowledged that expropriated landowners incur other losses including land and right to other assets, which is in consonance with empirical results of landowners' perception of expropriation as a form of disturbance to other land rights such as business enterprise and access to forest resources besides bringing an end to ownership rights.

Secondly, it was further found in the course of exploratory studies that real property valuers in Rwanda network among themselves and also liaise with expropriated landowners for the purpose of collecting property valuation data. This confirms the literature in chapter 2 that compensation assessment entails capture of valuation information from expropriated parties and professional valuers acting on behalf of the expropriating authority (Chang, 2013; Louviere et al., 2000).

Thirdly, expropriating authorities pay compensation in cash or in kind as manifested in market value- and resettlement systems of compensation respectively (Chang, 2013; Debnath & Choudhary, 2009; Feldman & Geisler, 2012). A government official interviewed during fieldwork stated that expropriated parties prefer cash compensation notwithstanding the discretion of Rwandan government to pay cash compensation or implement resettlement programmes in lieu of cash compensation.

Fourthly, it is recalled that legislative context of land expropriation in a country influences how compensation is assessed (Azuela & Herrera-Martín, 2009; Shapiro et al., 2013). On this basis, it was found that statutorily published valuation rates for land, buildings, and farm crops are used as standard units of compensation assessment for land expropriation in Rwanda. Similarly, it was found that real property valuers in Rwanda use a combination of market valuation techniques for compensation assessment in compliance with Article 31 of Real Property Valuation.

Fifthly, it was found that the position of Pearce et al. (2006) concerning the application of value eliciting tool of willingness to accept (WTA) when a person is entitled to benefits arising from an adverse policy change aligns with the views of 2 out of 3 valuers in the study area who acknowledged the use of elicitation methods to identify disturbance costs of landowners affected by expropriation for public purposes. This further confirms that the application of market valuation techniques cannot fully capture the value of disturbance entitlements of expropriated persons (Alemu, 2012; Cernea, 1988; Norrell, 2008); thereby justifying the development of a new compensation assessment technique.

According to Wyatt (2007), compensation for loss of livelihood is a reparation associated with the cost of winding up a business in the event of land expropriation for public purpose. Aligned with this definition is the result indicating that four expropriated landowners in the study area would have advocated for the valuation of their businesses and livelihoods if they had been actively involved in the assessment process.

Furthermore, landowners identified two key areas where their involvement would have counted in compensation valuation to include non-coercive deal and negotiation with government over an acceptable compensation. Among these suggestion, negotiation of compensation is criticized as promoting perjury (Heller & Hills, 2008) and speculation (He & Asami, 2014). Notwithstanding, combining integral calculus of recursive logistic function of disturbance compensation (equation 9) with sequence of double-bounded dichotomous bids (Table 10) might avert risk of speculation in the valuation of disturbances.

Adverse socioeconomic consequences of land expropriation are translated into monetized values of compensable entitlements comprising real property (Wyatt, 2007) and disturbance (Alemu, 2012; Nayak, 2000; Omar & Ismail, 2009). In alignment with a synthesis of these literatures, at least 35 out of 43 respondents comprising expropriated landowners, government officials, and valuers in the study area agree that payment of compensation for land expropriation is important because of a change in socioeconomic circumstances of landowners as identified in section 4.5.

According to Viitanen et al. (2010a), just compensation does not inhibit the financial capacity of expropriated landowners. Results in section 4.6 show that this assertion align with preference of some

expropriated landowners for compensation at a monetary sum which will not inhibit their capacity to purchase alternative landed property. In a related finding, a landowner underscored valuation of livelihood of expropriated persons as a contribution towards adequacy of compensation.

Overall results in Figure 7 indicate that at least 35 out of 43 respondents comprising expropriated landowners, government officials, and valuers interviewed in the study area generally agree that compensable entitlements for land expropriation should include market value of real property; and value of disturbance entitlements comprising removal cost, relocation cost, loss of livelihood, loss of income, psychological damages and unique circumstances of landowners. This result of respondents' viewpoints further confirms the composition of compensable entitlements for land expropriation to include real property (Wyatt, 2007) and disturbance (Alemu, 2012; Nayak, 2000; Omar & Ismail, 2009).

Therefore, design criteria for a DICM for land expropriation is necessitated by results of exploratory studies and gaps in existing compensation method identified as follows:

(a) land expropriation as a form of disturbance to other land rights which cannot be totally monetized using available market valuation techniques except through elicitation methods;
(b) the demand by landowners to be involved in a participatory and non-coercive bargaining of compensation payable for land expropriation;
(c) the desire of landowners for an enhanced compensation which will enable them to relocate to another place and purchase property with the equivalent of compensation offered; and
(d) landowners' quest for a full consideration of their compensable entitlements including real property and disturbances, which shall be addressed in a compensation assessment technique.

4.9. Challenges encountered during data collection

There were two challenges encountered in the course of collecting data for the design criteria and development of a prototype of DICM for land expropriation in Rwanda. First is the sensitivity of the subject matter of compensation for land expropriation and limited availability of expropriation and compensation data which informed the decision of a small sample size. Secondly, the Rwanda Civil Aviation Authority, RCAA who were involved in expropriation and compensation for Bugesera airport denied access to data collection and interview with its staff. Alternatively, a staff of Lands and Mapping department of RNRA who liaised with RCAA during the expropriation was interviewed.

4.10. Concluding remarks

This chapter provides empirical answers to these research questions: *What is the perception of compensable entitlements in disturbance-integrated compensation method? What combination of valuation techniques is required for developing disturbance-integrated compensation method?* Exploratory data from Rwanda indicates that the development of DICM requires a combination of market valuation of real property and contingent value of disturbance entitlements arising from the expropriation. Furthermore, majority of respondents perceive compensable entitlements for land expropriation to include market value of real estate/property, removal cost, relocation cost, loss of livelihood, loss of income, psychological damages, and unique circumstances of landowner. Hence, the general perception of the design criteria for DICM is that it should include these seven compensable entitlements. Whereas market value of expropriated real property is an indisputable entitlement, the veracity or otherwise of disturbance entitlements in Figure 7(b) to (g) was determined using model calibration and estimation techniques for WTA described in chapter 5. Hence, the next chapter (chapter 5) examines design criteria for disturbance-integrated compensation method, including assumptions and quantitative techniques underpinning this compensation method.

5. DESIGN CRITERIA FOR DISTURBANCE-INTEGRATED COMPENSATION METHOD

5.1. Introduction

With reference to the variable-data matrix (Table 4), this chapter further explains answers to the 1st and 2nd research questions under specific objective 2: *"What are the data required for modelling this compensation method?"* and *"What is the design criteria for disturbance-integrated compensation method?"* The chapter further addresses primer to the 3rd research question of specific objective 2: *"How is a disturbance-integrated compensation method developed?"* (Methodology for developing DICM) as well as the 1st research question of specific objective 3: *"What are the test criteria for this compensation method?"* This chapter leads to four discrete outcomes comprising data specification and data collection for DICM, design criteria and equations of DICM, flowchart for the design of DICM, and a list of test criteria which DICM is expected to meet. The overall purpose of these outcomes is to produce a sequential plan and requirements for the design of disturbance-integrated compensation method (DICM) for land expropriation.

5.2. Variables and data requirements for disturbance-integrated compensation method

With reference to equation 12, the variable-data matrix (Table 4), landowners perception of compensable entitlements in DICM (section 4.7), and rationale for a design criteria of DICM for land expropriation (section 4.8), the two major data requirements for DICM are data on market value of real property and data for contingent value of disturbance entitlements.

(a) Market value of real estate/property
Market value data for expropriated properties include value of land and buildings, farm crops and economic trees, and other fixed assets on land as at the date of expropriation (Section 2.4.1). These values are determined by real property valuers and have been incorporated as data for the design of DICM.

(b) Disturbance compensation data
With reference to equations 5 and 12 in section 2.5, WTAC for disturbance ($WTAC_d$) can be further expressed as binary logistic function of vectors representing disturbance entitlements (Figure 7), which respondents generally agree should be included in compensation assessment methods (section 4.7):

$$Logit_{WTA} = f\left(\overrightarrow{DC}, \overrightarrow{OC}, \overrightarrow{RC}, \overrightarrow{RM}, \overrightarrow{LV}, \overrightarrow{LC}, \overrightarrow{PD}, \beta_0\right) \quad (13)$$

where $Logit_{WTA}$ = outcome vector which is the natural logarithm of odds (likelihood) for accepting a bid amount in CV surveys, *f(....)* implies *"function of"*, $\overrightarrow{DC}$ = bid amounts for disturbance compensation; $\overrightarrow{OC}$ = characteristics; $\overrightarrow{RC}$ = relocation cost; $\overrightarrow{RM}$ = removal cost; $\overrightarrow{LV}$ = loss of livelihood; $\overrightarrow{LC}$ = loss of income; $\overrightarrow{PD}$ = psychological damages; and β_0 = Constant term for unobservable aspects of $WTAC_d$. Binary logistic regression is adjudged suitable for modelling disturbance compensation because enabling data are derived from observational variables which are ordinarily beyond the control of any researcher. Data collection techniques for contingent value model of disturbance (equation 13) have been explained in Section 3.6(d). It is further observed in Table 9 that variables used in modelling logits of disturbance compensation have been grouped under vectors as in equation 13, where each vector is characterized by specific variables.

Table 9: Description of variables and data for modelling of disturbance compensation

Vector Label	Vector name	Variable symbol	Variable name	Variable description and coding	Data type
Logit	Log of odds for accepting bid [dependent variable]	OCM1	Outcome 1st bidding	Outcome of 1st bidding of disturbance compensation: Yes = 1; No = 0	Binary
		OCM2	Outcome 2nd bidding	Outcome of 2nd bidding of disturbance compensation: Yes = 1; No = 0	Binary
DC	Disturbance compensation	BID1	1st bid amount	Amount offered as disturbance compensation in the 1st round of dichotomous choice bidding.	Ratio
		BID2	2nd bid amount	Amount offered as disturbance compensation in the 2nd round of dichotomous choice bidding.	Ratio
OC	Unique circumstances of landowner	AGE	Age of respondent	Reported age of land owner in years.	Ratio
		GEN	Gender of respondent	Sex of respondent; 1 = male, 0 = female.	Binary
		HSE	Household expenditure after expropriation	Reported annual household expenditure after land expropriation: 1 = 'Less than 135,000'; 2 = '135,000 - 154,999'; 3 = '155,000 and above'	Ordinal
		EDU	Education level	Educational level of respondent. 1 = 'No education'; 2 = 'Primary education'; 3 = 'Secondary education'; 4 = 'Vocational/Technical'; 5 = 'Bachelors degree'; 6 = 'Graduate degree (Masters/Doctoral)'	Ordinal
RC	Relocation cost	NRT	Total number of relocation trips	Reported total number of trips made towards relocating personal effects and movable properties to alternative site.	Ratio
		HSS	Household size	Number of persons in the household prior to the expropriation.	Ratio
RM	Removal cost	TDA	Time taken to disassemble movable assets	Reported time (in days) taken to disassemble movable assets from expropriated land to an alternative site.	Ratio
LV	Loss of livelihood	LDL	Dependence of livelihood on expropriated land	Dependence of livelihood on expropriated land. 5-point scale: 5 = 'Highly dependent'; 4 = 'Dependent'; 3 = 'Partially dependent'; 2 = 'Independent'; 1 = 'Highly independent'	Ordinal
LC	Loss of income	CML	Cumulative number of months for which income from land had been lost	Reported number of months for which income from land was lost due to expropriation.	Ratio
PD	Psychological damages	DUR	Number of years domiciled on expropriated parcel	Duration in years for which land owner had lived on the expropriated land.	Ratio
		AAE	Ancestral attachment to expropriated land	Importance of ancestral attachment to expropriated land 5-point scale:: 5 = 'Very important'; 4 = 'Important'; 3 = 'Fairly important'; 2 = 'Less important'; 1 = 'Not important'	Ordinal
		QFT	Quality of family ties after expropriation	Reported quality of family ties after the expropriation. 5-point scale: 5 = 'Excellent'; 4 = 'Very good'; 3 = 'Good'; 2 = 'Fair'; 1 = 'Poor'.	Ordinal

Logit for disturbance compensation is expressed as a ratio (see LHS of equation 5), which is measured using binary responses of "Yes" for acceptance- and "No" for rejection of initial (1st)- and follow-up (2nd) bids. Secondly, the vector $\overrightarrow{DC}$ comprises regressors named BID1 and BID2 which represent 1st- and 2nd bids of WTAC for disturbance respectively.

$\overrightarrow{OC}$ in equation 13 is a vector of attitudinal and demographic characteristics of landowners (respondents) which include age (AGE), gender (GEN), and education level (EDU) in consonance with data specification in other similar studies of WTP/WTA calibration (He & Asami, 2014; Lindhjem & Mitani, 2012; Radam & Mansor, 2005). In the place of household income, household expenditure (HSE) after expropriation was incorporated among logit regressors in Table 9 because income does not constrain the tendency of respondents to overbid WTA (Pearce et al., 2006). Therefore, a rational household will not spend more than their earnings. The vector $\overrightarrow{RC}$, (relocation cost) was determined using household size (HSS), and total number of relocation trips (NRT). The vector, $\overrightarrow{RM}$ (removal cost) was measured using expected duration of time to disassemble movable assets (TDA). Results in chapter 4 suggest that the vector, $\overrightarrow{LV}$ (loss of livelihood) should be included among compensable entitlements of DICM, and it was measured by eliciting the level of dependence of landowner on expropriated land (LDL). In addition, $\overrightarrow{LC}$ (loss of income) was included among determining vectors for logit of disturbance compensation. This vector was measured using reported number of days for which respondents had lost income from land due to expropriation (CML).

It is recalled from section 2.4.2 that calibrated contingent value models should account for emotions of respondents (Biel et al., 2011). Some of these emotions can be used as indicators of psychological damages arising from land expropriation. In consonance with fieldwork, the vector, $\overrightarrow{PD}$ which connotes psychological damages arising from land expropriation was measured by eliciting data on number of years domiciled on expropriated parcel (DUR), level of ancestral importance attached to expropriated land (AAE), and expected quality of family ties after expropriation (QFT). Finally, the constant term, β_0 is not an input data requirement but an output which reflects unobservable aspects of logistic regression of disturbance compensation (Table 9).

Market value- and contingent value data for disturbance compensation were obtained from a sample of 36 expropriated landowners in the study area. In addition, disturbance compensation data for 31 cases (landowners) were selected for model calibration (Appendix 8), while disturbance compensation data for the remaining 5 cases selected at random (Appendix 9) were reserved for validating the recursive model of disturbance compensation (equation 14). For the purpose of operating the DICM, details of market value of real property (land, buildings, and crops) collected from valuers in the study area have been tabulated in Appendix 10.

5.3. Equations and model parameters of disturbance-integrated compensation method

Equation 12 is recalled from section 2.5.3 to represent disturbance-integrated compensation for land expropriation, which is made up of market value (MV_k) and contingent value of disturbance entitlements ($WTAC_d$). From that equation, market value compensation (MV_k) is determined as:

$$MV_k = V_L + V_B + V_C \tag{13}$$

Where MV_k is market value compensation for real estate/property of a landowner; V_L is value of land, V_B is value of buildings, and V_C is the value of farm crops. With reference to equation 13, the values of these variables of market value compensation have been summed up as indicated in Appendix 10.

Summarized in Table 10 are bid sequence for double-bounded dichotomous valuation of disturbance entitlements, possible range of WTA, and true estimate of WTA (area under the graph in Figure 8) for any landowner which have been extracted with reference to section 2.5.2 and contingent valuation data collection in section 3.6(d).

Table 10: Bid sequence and expected range of landowner's disturbance compensation

Bid sequence		Response (1st - 2nd)	Expected range of WTA	Upper bound of integral[b.]	Area under the curve[c.]
1st bid [a.]	2nd bid [a.]				
X_o	X_0 - 250,000	Yes - Yes	WTA ≤ (X_0 - 250,000)	(X_0 - 250,000)	Area A
X_o	X_0 - 250,000	Yes - No	(X_0 - 250,000) < WTA ≤ X_0	X_0	Areas A and B
X_o	X_0+500,000	No - Yes	X_0 < WTA ≤ (X_0 + 500,000)	(X_0 + 500,000)	Areas A to C
X_o	X_0+500,000	No - No	WTA > (X_0 + 500,000)	+∞	Areas A to D

a. Reference amounts are in Rwanda Francs
b. Lower bound is fixed at 0
c. The curve referred is the cumulative logistic function (Equation 8)
∞ Connotes infinity

Related to Table 10 is the graphical representation of equation 8 (Figure 8), where areas under the curve in Figure 8 represent value bands of disturbance compensation arising from sequence of landowner's bidding in Table 10.

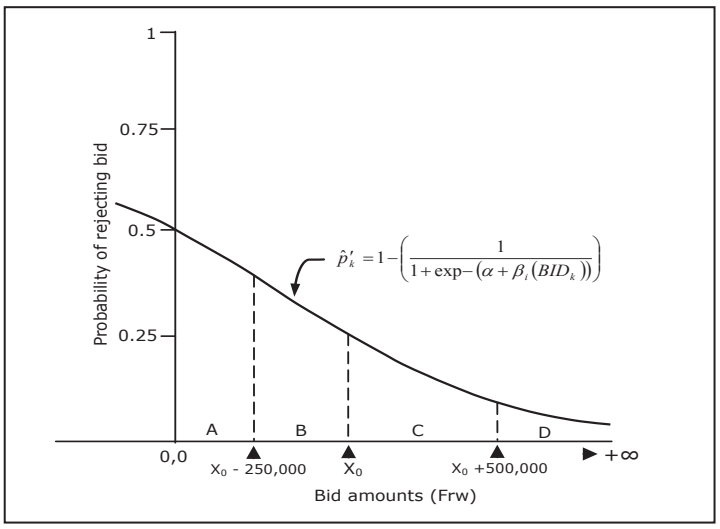


Figure 8: Cumulative logistic function for disturbance compensation

In consonance with the economic principle of consumer surplus, areas under the cumulative logistic function of disturbance compensation (Figure 8) are determined using numerical integral cited as equation 9 in this research (section 2.5.2), solution of which is expressed as:

$$E(WTA_k) = \left[-\frac{1}{\beta_i} \left\{ \log_e \left[1 + \exp -\left(\alpha + \beta_i \left(BID_k \right) \right) \right] + \alpha \right\} \right]_L^U \tag{14}$$

Where: $E(WTA_k)$ = Estimated disturbance compensation for a specific case of landowner, BID_k is the variable symbolizing bid amount of a specific case of landowner, k; L is the lower bound of bid amount, which in this study is set at 0 (zero); U is the upper bound of bid amount with the expectation that estimated WTA falls within a value boundary defined by the bidding sequence of landowner (Table 10); and other parameters retain their original meaning as mentioned in section 2.5.2.

Substituting the RHS of equation 14 into equation 12 leads to a mathematical model for disturbance-integrated compensation for land expropriation as follows:

$$T_c = MV_k + \left[-\frac{1}{\beta_i} \{ \log_e [1 + \exp -(\alpha + \beta_i (BID_k))] + \alpha \} \right]_L^U \quad (15)$$

Where equation 15 implies that total compensation for land expropriation equals the sum of market value and integral calculus of recursive equation of landowner's contingent value of disturbance entitlements (See Appendix 16 for a full mathematical note on DICM).

5.4. Assumptions of disturbance-integrated technique of compensation assessment

Assumptions for DICM can be categorized into general assumptions for the entire model (equation 15), specific assumptions for the market value component (equation 13), and specific assumptions for the logit regression model for disturbance compensation in equation 5.

(a) General assumptions for DICM

1. DICM is developed and applicable to specific cases of mass expropriation of land for public purposes. This is because each case of expropriation might be associated with unique indicators of disturbance entitlements; and
2. Addition of market value compensation to disturbance compensation should increase the total compensation payable for land expropriation.

(b) Specific assumptions for the market value component of the model

1. Opinion of value for entitlements classified under real property (estate) may be formed with reference to the application of market comparison-, replacement cost-, or income capitalization method or a combination of these methods; and
2. Market value compensation is the value of rights in physical property as at the date of expropriation, and does not include anticipated increase in the value of property arising from the proposed project that led to the expropriation (Wyatt, 2007).

(c) Assumptions and diagnostics for logit regression model of disturbance compensation

In consonance with the general assumptions for binary logistic regression models proffered by Field (2009) and Gujarati (2004), it is assumed that a calibrated binary logit regression model (equation 5) for disturbance compensation is expected to meet the following specifications:

1. Logarithmic linearity of predictors and disturbance entitlements;
2. Binary (dichotomous) outcomes of "Yes" or "No" for acceptance of a bid amount for WTAC;
3. Absence of multicollinearity among variables of disturbance compensation;
4. Independence of residuals of the logistic model; and
5. Model classification accuracy of above 75% for the acceptance or rejection of bid amounts.

5.5. Calibration technique for logistic model of disturbance compensation

Calibration of a logit model of disturbance compensation was carried out in two phases within SPSS environment. Using the data in Appendix 8, the first phase entailed backward stepwise calibration on the basis of the Wald test statistic which is essentially a chi-square distribution for goodness of fit of each variable in the equation (Field, 2009). This first screening tool provided insights into variables that contribute significantly towards predicting binary outcome ("Yes" or "No" responses) in both cases. Thereafter, those variables that contribute to the enhancement of the overall classification accuracy of the

logit model were manually selected and used to calibrate final models for the 1st and 2nd bid outcomes through the forced entry method.

5.6. Estimation parameters for the logistic model of disturbance compensation

Estimation parameters for logistic model include coefficients of independent variables and their standard errors, initial -2Log likelihood, -2Log likelihood of model, likelihood ratio, (Nagelkerke) pseudo R-Square, Chi-square of model, Hosmer and Lemeshow Test, and classification accuracy of model.

With reference to equation 11, coefficients of independent variables for logistic model of disturbance compensation comprises a constant term, β_0, coefficient of the bid amount β_i, coefficients of socioeconomic characteristics of landowners as well as independent variables that measure specific disturbance costs, summed up as "$\sum(\beta_j \cdot (Z_j))$". These coefficients are attributed to only those variables that contribute to the overall accuracy of the model. In addition, standard errors of these coefficients were used to detect problems of multicollinearity.

-2Log likelihood is a parameter that measures overall fit of estimated logistic model of disturbance compensation. A lower value of -2Log likelihood for the final model "$-2LL_m$" relative to -2Log likelihood for the initial model (with only constant term) "$-2LL_0$" indicates minimal deviance and improvement in the fit of model with data. Hence, likelihood ratio, R_L^2 measures the goodness of fit of $-2LL_m$ compared to $-2LL_0$ using the formula: $1 - (-2LL_m / -2LL_0)$.

Furthermore, Nagelkerke (pseudo) R-Square of logistic regressions measures the proportion of variability in the dependent variable which can be explained by regressors (Field, 2009). Hence, a regression equation with a higher pseudo R-Square has enhanced prediction ability for sample data.

For the model calibration task, Chi-square test aims to measure difference between observed binary outcomes of bidding with the predicted binary outcomes. For that reason, an acceptable logit model of disturbance compensation is expected to be significant at 5% level. On the other hand, Hosmer and Lemeshow statistic aims to test hypothesis that disturbance compensation data is not a good fit for the model. Therefore, Hosmer and Lemeshow test criterion for accepting a logistic model of disturbance compensation is a significance level (p-value) greater than 0.05.

Finally, the classification table reports the degree to which the calibrated model can predict acceptance or otherwise (binary outcome) of bidding for disturbance compensation. Although a logistic model is acceptable if its classification accuracy is above the hypothesized accuracy (Field, 2009), a classification accuracy of at least 75% is expected from the proposed logistic model of disturbance compensation.

5.7. Flowchart for the design of disturbance-integrated compensation method

Empirical results of a design criteria for DICM (Sections 4.8 and 4.10), model requirements for the development of DICM (sections 2.5, 5.2 - 5.6) and available valuation data from fieldwork (Table 9, Appendices 8, 9 and 10) were articulated with research plan in Figure 4 to produce a flowchart (Figure 9) aimed at providing schematic answer to the 3rd research question of specific objective 2: *"How is a disturbance-integrated compensation method developed?"* In summary, the process of developing DICM which is implemented in chapter 6 of this thesis commenced with the extraction of particulars of expropriated landowners from available valuation and attribute data for the study area. Market value- and disturbance compensation data were processed simultaneously. After calibration of a binary logistic model of disturbance, a numerical integral for cumulative logistic model of disturbance compensation was evaluated, validated, and used to estimate each landowner's true WTAC for disturbance. Design of the

compensation method ended with a mathematical model or prototype of DICM comprising the sum of market values with estimated value of disturbance entitlements (Appendix 16).

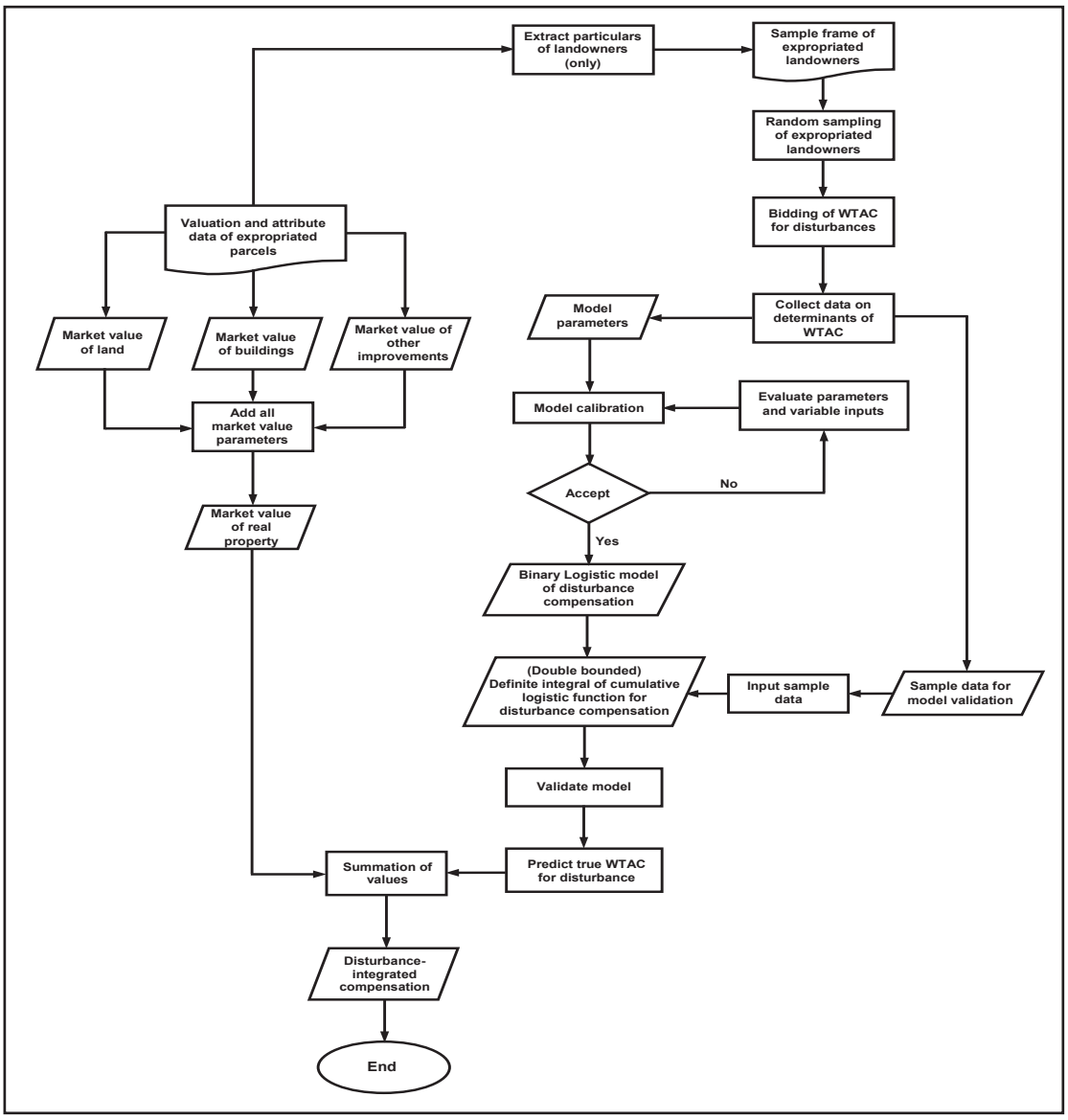


Figure 9: Flowchart showing the process for developing DICM for land expropriation

5.8. Expected test criteria for disturbance-integrated compensation method

With reference to selected literature on value modelling and compensation assessment techniques for land expropriation, this section provide answers to the first research question of specific objective 3: " *What are the test criteria for this compensation method?* " In similar studies, contingent values were predicted using average values of covariates drawn from sample data used in calibrating a logit model (Bucklan et al., 1999; He & Asami, 2014; Tapsuwan, 2005). In other words, these average values of covariates were pooled as constants and substituted in integral calculus of cumulative logistic model of contingent values while maintaining varying upper bid amounts across respondents (See equations 6 to 9; and 15). Secondly, it is recalled from chapter 2 that landowner's expectation of compensation for land expropriation is higher than market value (Norrell, 2008), thereby conforming with findings in chapter 4 that landowners prefer

compensation that will likely sustain their financial capacity to relocate from existing premises and purchase alternative property. In other words, it is expected that the addition of more compensable entitlements to market value under the DICM will lead to a significant marginal increase in assessed compensation. Therefore, expected test criteria for DICM as examined in chapter 6 include:

1. Predictability of a landowner's disturbance compensation from integral calculus of the recursive cumulative logistic model (equation 16); and
2. Significant increase in total compensation compared to assessed market value compensation.

5.9. Concluding remarks

The content of this chapter was structured around four research questions. The first question is: *What are the data required for modelling this compensation method?* Data required for designing DICM include value of real property entitlements and contingent valuation data which should include double-bounded dichotomous bidding of WTAC for disturbance, socioeconomic attributes, and value indicators of prominent disturbance entitlements identified by expropriated parties in the course of a contingent valuation survey. Secondly, empirical answers were provided for the question: *What are the design criteria for disturbance-integrated compensation method?* The design criteria for DICM comprise the summation of market value of real property with integral calculus of recursive cumulative logistic model of each landowner's WTAC for disturbance entitlements. Addressing the methodology for the development of DICM is the 3rd question: *How is a disturbance-integrated compensation method developed?* Articulation of empirical results of a design criteria for DICM (Sections 4.8 and 4.10), model requirements for the development of DICM (sections 2.5, 5.2 - 5.6), available valuation data from fieldwork (Table 9, Appendices 7, 8 and 9) and the design research plan in Figure 4 led to design of a flowchart describing how a prototype of DICM will be developed (Figure 9). This flowchart indicates that a prototype of DICM for land expropriation (as examined in chapter 6) can be developed by implementing processes of model calibration and validation for disturbance compensation, test of disturbance compensation and value summation using equation for the prototype of DICM (equation 15). Finally, answers to the research question: *"What test criteria is disturbance-integrated compensation method expected to meet?"* was further explained using a synthesis of literature with empirical findings in chapter 4 to include predictability of disturbance compensation for landowners, and an increase in total compensation above the assessed market value.

To conclude this chapter, the flowchart in Figure 9, equations embodied in the design criteria, and available valuation data from the study area (Appendices 8, 9, and 10) have set the stage for the development, validation and testing of DICM for land expropriation in chapter 6.

6. DESIGN OF A PROTOTYPE OF DISTURBANCE-INTEGRATED COMPENSATION METHOD

6.1. Introduction

With reference to the flowchart in Figure 9, design criteria in chapter 5 and valuation data from Rwanda, this chapter further explains the 3rd research question of specific objective 2: *"How is a disturbance-integrated compensation method developed?"* and then advances to provide answers to the 2nd research question of specific objective 3: *"What test criteria did the disturbance-integrated compensation method meet?"* Examined in this chapter include model development and validation for disturbance compensation, value summation, model evaluation with test criteria, and discussion of results on the design of a prototype of DICM.

6.2. Preliminary analysis

Using data in Appendix 8, preliminary tasks preceding the calibration of binary logistic model of WTAC for disturbance include analysis of descriptive statistics, correlation matrices- and scatter plots of regression variables.

(a) Descriptive statistics

It is observed in Table 11 that mean bid amount of WTAC for disturbance in the follow-up bid is higher than that of the initial bid by over 130,000 Frw. This result indicates predominant rejection of initial bid amount (BID1) in favour of higher bid amount (BID 2). Surprisingly, BID1 and BID2 recorded equal medians of 2,000,000 Frw notwithstanding differences in means.

Table 11: Descriptive statistics of independent variables

Statistic/ Variable	BID1	BID2	AGE	GEN	HSE	EDU	NRT	HSS	TDA	LDL	CML	DUR	AAE	QFT
Mean	2000000.00	2137096.77	42.29	0.81	1.42	2.10	5.23	5.87	83.71	4.97	37.35	26.19	4.35	1.32
S.E Mean	153804.79	139526.23	2.56	0.07	0.11	0.14	0.48	0.38	4.16	0.03	3.06	2.68	0.24	0.13
Median	2000000.00	2000000.00	39.00	1.00	1.00	2.00	4.00	6.00	90.00	5.00	36.00	29.00	5.00	1.00
Mode	750000.00[a]	1750000.00[a]	30[a]	1	1	2	4	6	90	5	48	5[a]	5	1
Std. Deviation	856348.84	776849.16	14.27	0.40	0.62	0.79	2.66	2.11	23.17	0.18	17.02	14.90	1.36	0.75
Minimum	750000.00	500000.00	23	0	1	1	1	3	30	4	12	1	1	1
Maximum	3500000.00	3500000.00	77	1	3	4	10	10	150	5	72	73	5	3

a. Multiple modes exist. The smallest value is shown.
S.E. Mean = Standard error of mean; Sample size N = 31

Recalling that relocation cost is driven by number of relocation trips "NRT" and household size "HSS", sample statistics indicate that expropriated landowners are expected to make an average of five trips in order to relocate an average of 6 members of their households including themselves.

Measuring removal cost with the variable - TDA, expropriated landowners have an average of 84 days to disassemble movable assets on expropriated land for onward relocation to alternative site. This period of time is reasonable considering legislative provisions for a maximum of 90 days for removal of personal belongings from land after compensation (Republic of Rwanda, 2007).

Using dependence of livelihood on land "LDL" to measure loss of livelihood arising from expropriation, mean value of 4.97 in Table 11 implies that landowners generally depend on their lands as a source of livelihoods. This is also confirmed by the predominance of the combination of agricultural and residential

uses of land prior to the expropriation. Similarly, it is observed that income from land was lost over an average of 35 months after the expropriation notice.

Measuring psychological damages are three variables namely DUR, AAE, and QFT. Results indicate that sample of landowners interviewed have lived on their lands for over 25 years, which is deemed a long period of time required to build sentimental attachment to land. Furthermore, a significant number of expropriated landowners were reported to have strong ancestral bond with their lands let alone decrying anticipated deterioration in family ties as a result of the expropriation.

(b) Correlation matrices of regression variables

Spearman's correlation matrices were generated for outcomes of 1st and 2nd bids of WTAC for disturbance respectively.

Table 12: Spearman's correlation matrix of 1st bid outcomes and independent variables

	OCM1	BID1	AGE	GEN	HSE	EDU	NRT	HSS	TDA	LDL	CML	DUR	AAE	QFT
OCM1	1.000													
BID1	0.424*	1.000												
AGE	0.029	0.370*	1.000											
GEN	-0.016	0.151	-0.068	1.000										
HSE	-0.086	0.017	-0.028	0.358*	1.000									
EDU	0.131	-0.078	-0.279	-0.011	0.024	1.000								
NRT	-0.356*	0.108	0.232	-0.080	0.203	0.007	1.000							
HSS	0.099	0.231	0.597**	0.056	0.048	-0.210	0.094	1.000						
TDA	0.087	0.272	0.283	-0.178	-0.225	0.082	0.063	0.097	1.000					
LDL	0.177	0.277	0.163	-0.089	0.133	0.000	-0.095	0.104	-0.070	1.000				
CML	0.071	0.105	0.135	-0.321	-0.420*	-0.034	-0.015	0.151	0.336	0.253	1.000			
DUR	-0.083	0.298	0.675**	0.407*	0.049	-0.191	0.033	0.394*	0.305	0.031	-0.082	1.000		
AAE	-0.184	-0.105	0.263	-0.286	-0.513**	0.112	0.052	0.090	0.257	-0.106	0.049	0.192	1.000	
QFT	0.277	0.108	-0.152	-0.007	0.017	0.166	0.055	-0.154	-0.326	-0.416*	-0.177	-0.211	-0.141	1.000

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

...

Table 13: Spearman's correlation matrix of 2nd bid outcomes and independent variables

	OCM2	BID2	AGE	GEN	HSE	EDU	NRT	HSS	TDA	LDL	CML	DUR	AAE	QFT
OCM2	1.000													
BID2	0.033	1.000												
AGE	-0.204	0.390*	1.000											
GEN	0.054	0.142	-0.068	1.000										
HSE	0.106	0.036	-0.028	0.358*	1.000									
EDU	0.018	-0.163	-0.279	-0.011	0.024	1.000								
NRT	0.164	0.281	0.232	-0.080	0.203	0.007	1.000							
HSS	-0.008	0.153	0.597**	0.056	0.048	-0.210	0.094	1.000						
TDA	-0.089	0.285	0.283	-0.178	-0.225	0.082	0.063	0.097	1.000					
LDL	-0.230	0.226	0.163	-0.089	0.133	0.000	-0.095	0.104	-0.070	1.000				
CML	-0.123	0.080	0.135	-0.321	-0.420*	-0.034	-0.015	0.151	0.336	0.253	1.000			
DUR	-0.207	0.347	0.675**	0.407*	0.049	-0.191	0.033	0.394*	0.305	0.031	-0.082	1.000		
AAE	-0.343	-0.017	0.263	-0.286	-0.513**	0.112	0.052	0.090	0.257	-0.106	0.049	0.192	1.000	
QFT	0.372*	-0.030	-0.152	-0.007	0.017	0.166	0.055	-0.154	-0.326	-0.416*	-0.177	-0.211	-0.141	1.000

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

Correlation matrix for the 1st bid outcome (Table 12) indicates that 5 out of 13 independent variables are negatively correlated with the binary outcome of 1st bid (OCM1). Furthermore, 1st bid amount "BID1" and number of relocation trips "NRT" are significantly correlated with the outcome for

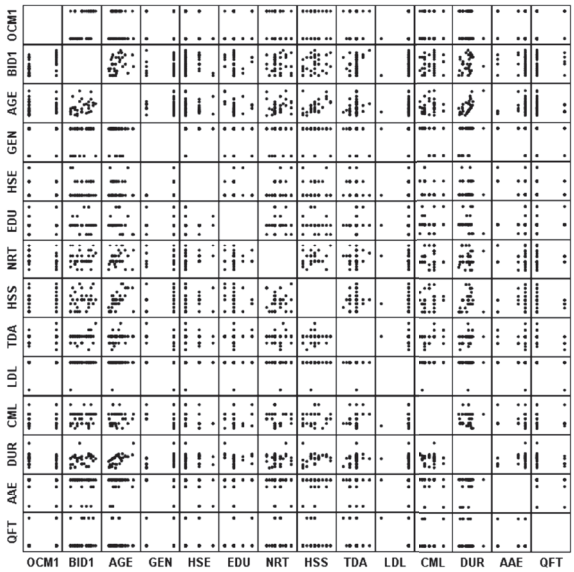
acceptance/rejection of bid amounts "OCM1" at 5% level. Contrary to Table 12, 7 out of the 13 independent variables are negatively correlated with binary outcome of 2nd bid "OCM2" in Table 13. Among these variables, is ancestral attachment to land "AAE", which exhibits significantly positive correlation with OCM2 at 5% level.

It was observed that 1st and 2nd bid amounts of disturbance compensation are significantly correlated with age of landowners ($p < 0.05$); implying that older respondents tend to bid higher amounts (Tables 12 and 13). For both bid outcomes, highly significant positive correlations ($p < 0.01$) were observed between age of landowners and their household size; and between age of landowners and duration of years "DUR" they have been domiciled on land before it was expropriated. Tables 12 and 13 further reveal significantly inverse relationship between household expenditure and indicator for loss of income at $p < 0.05$; implying that household expenditure after expropriation increases in response to loss of income from land. Surprisingly, a highly significant inverse correlation ($p < 0.01$) between ancestral attachment to land and household expenditure implies that small (high) household expenditure is needed to preserve (avert) strong (weak) ancestral attachment to land. It was however as expected that household size, HSS increases as period of residency on land prior to expropriation "DUR" increases ($p < 0.05$).

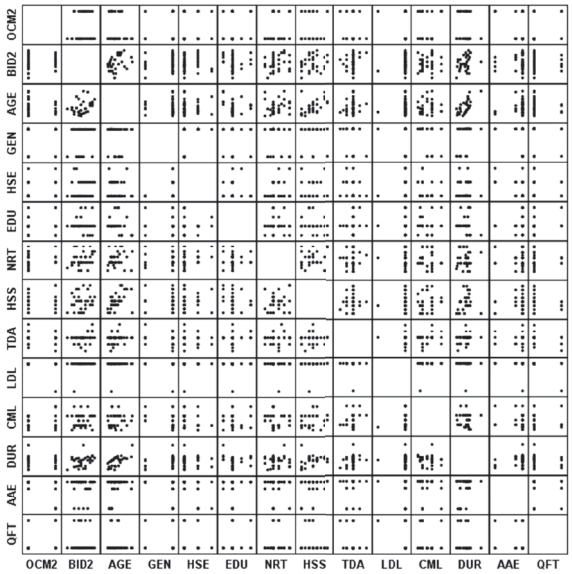
Implications of these correlations on the model calibration technique was further evaluated using scatter plots of independent variables, bid amounts and their binary outcomes.

(c) Scatter plots of regression variables

In order to make a decision on the appropriate content of equation for modelling disturbance compensation for the purpose of DICM, scatter plots for both the 1st response and the follow-up response were generated (Figure 10). It was observed that scatter plots of 1st and 2nd bid outcomes are visually similar. In addition, binary outcome variables OCM1 and OCM2 appear to be logistically correlated with all independent variables.



10-A: Scatter plot of 1st bid regressors



10-B: Scatter plot of 2nd bid regressors

Figure 10: Scatter plot of 1st and 2nd bid outcomes with independent

The logistic relationships among these variables justify the application of binary logit or logistic regression analysis (equation 5) to derive maximum likelihood function capable of predicting WTAC for disturbance.

6.3. Bidding sequence for WTA and distribution of responses

After applying double-bounded dichotomous bidding (Figure 5) to elicit WTA disturbance compensation from a sample of 36 expropriated landowners in the study area, the sequence and distribution of responses from expropriated landowners were extracted and arranged in Table 14 below:

Table 14: Distribution of responses to double-bounded dichotomous bidding

1st bidding (X_0)	Sequence of 2nd bidding		Bidding Response 1st - 2nd (lower)		Bidding Response 1st - 2nd (higher)		Total Frequency N =36
	Lower (X_0 - 250,000)	Higher (X_0 + 500,000)	Yes-Yes	Yes - No	No - Yes	No - No	
750,000	500,000	1,250,000	-	1	3	-	4
1,000,000	750,000	1,500,000	-	-	-	2	2
1,250,000	1,000,000	1,750,000	-	2	-	1	3
1,500,000	1,250,000	2,000,000	1	-	-	3	4
1,750,000	1,500,000	2,250,000	-	1	1	1	3
2,000,000	1,750,000	2,500,000	1	2	-	1	4
2,250,000	2,000,000	2,750,000	1	-	-	1	2
2,500,000	2,250,000	3,000,000	2	-	-	1	3
2,750,000	2,500,000	3,250,000	2	-	1	1	4
3,000,000	2,750,000	3,500,000	2	1	-	1	4
3,250,000	3,000,000	3,750,000	1	1	-	-	2
3,500,000	3,250,000	4,000,000	-	1	-	-	1

Contrary to 10 landowners who accepted the 1st bid and 2nd lower bid (Yes - Yes), it can be observed that majority of expropriated landowners rejected the 1st and 2nd higher bid amounts (No - No). Among the reasons adduced by these landowners for "No - No" response is the inability of these stated disturbance compensations to enhance their ability to purchase alternative properties. In the words of one of these landowners offered 1st and 2nd bid amounts in the sequence of 1,500,000 Frw - 2,000,000 Frw, *"I reject 2,000,000 Frw offered for disturbances because with any amount below 3,000,000 Frw, it would not be possible to purchase an alternative land of equivalent size. I still feel that there are some of my properties that were not enumerated and valued in connection with the expropriation and compensation. In addition, it is not possible to re-establish my activities on land with an amount below 3,000,000 Frw*". It is further observed that responses in Table 14 are fairly distributed except the (No - Yes) category with a total frequency of only 5 respondents. Data in Table 14 were used in conjunction with specification of lower and upper bounds of expected WTA in Table 10 to estimate disturbance compensation in this chapter (Section 6.6 (c)). The next section discusses calibration of logistic model of disturbance compensation.

6.4. Model calibration for disturbance compensation

Applying a combination of backward stepwise calibration methods and manual iteration to the dataset in Appendix 8, an equation of best fit was obtained for the 1st and 2nd bid outcomes. Although a summary of the calibration results have been presented in Table 15, detailed statistics for these equations have been documented in Appendices 11 and 12 respectively.

For both logit models in Table 15, positive (negative) coefficients of variables imply that an increase in the value of their predictors is directly (inversely) proportional to odds of accepting a bid. For instance, an increase in the value of a predictor of QFT for a specific landowner (logit models 1 and 2) is directly proportional to the likelihood of accepting a bid amount, while an increase in the value of a predictor of AAE in both models is inversely proportional to the likelihood of accepting same bid amount.

It can be observed that some variables in Table 15 are significant/insignificant predictors of likelihood of accepting bid amounts. Contrary to logit model 2 where the bid amount "BID2" does not significantly influence odds of bidding outcome, the choice of respondents towards accepting or rejecting a stated

amount is significantly influenced by 1st bid offered in logit model 1 ($p < 0.10$). Compared to logit model 2 where odds of outcome is significantly determined by only two variables namely ancestral importance attached to land "AAE", and quality of family ties after land expropriation "QFT" ($p < 0.10$) (ignoring the constant term), the odds of outcome for logit model 1 (ignoring the constant term) is significantly determined by six independent variables (with at least $p < 0.10$) including the initial bid amount "BID1". Among these six determinants of logit model 1 is the number of relocation trips "NRT" (representing the vector of relocation cost), which is significant at 5% level. It is further observed that the odds ratio of ancestral importance attached to land, "AAE" in logit model 1 is not significant but its inclusion in the calibration process enhanced overall accuracy of the model.

Table 15: Parameter estimates for dichotomous bidding of disturbance compensation

Parameter	Logit model 1 (1st bid outcome)		Logit model 2 (2nd bid outcome)	
	Coefficient (Standard error)	*Significance*	*Coefficient (Standard error)*	*Significance*
BID1	0.000003*(0.000)	0.057	-	-
BID2	-	-	0.0000002(0.000)	0.759
GEN	-5.285*(3.065)	0.085	-	-
EDU	2.345*(1.408)	0.096	-	-
NRT	-1.542**(0.760)	0.042	-	-
HSS	1.465*(0.786)	0.062	-	-
AAE	-1.499(1.051)	0.154	-0.939*(0.497)	0.059
QFT	3.306*(1.945)	0.089	1.152*(0.638)	0.071
Constant	-4.172(5.566)	0.454	1.782(2.744)	0.516
-2Log likelihood (Initial)	42.943		41.381	
-2Log likelihood (Model)	19.046		30.355	
Likelihood ratio (R_L^2)	0.556		0.266	
(Nagelkerke) Pseudo R-Square	0.717		0.406	
Chi-square (model)	23.897***	0.001	11.026**	0.012
Hosmer and Lemeshow Test	11.396	0.180	7.580	0.476
Model accuracy (Percentage)	87.1%		80.6%	

Notes
(a) *. Significant at the 0.10 level; **. Significant at the 0.05 level; ***. Significant at the 0.01 level
(b) Numbers in parenthesis are standard errors of coefficients

Variables that failed to predict odds of bidding for disturbance compensation in logit model 1 include AGE, HSE, TDA, LDL, CML, and DUR. It is further observed that these variables were also excluded from predictors of logit model 2 in addition to other variables namely GEN, EDU, NRT, and HSS for failing to predict odds of follow-up bids of disturbance compensation.

Chi-square test statistic for logit models 1 and 2 indicates that these models are significant at 1% and 5% levels respectively. Although Hosmer and Lemeshow test statistic in Table 15 further indicates that both logit models can significantly predict outcome of bidding for disturbance compensation, logit model 2 was discarded in favour of logit model 1 because logit model 1 performs better in terms of overall accuracy of prediction by over 6% compared to logit model 2. Secondly, a comparison of the (Nagelkerke) Pseudo R-square of both models indicates that logit model 1 explains about 72% of variability in disturbance compensation data compared to logit model 2 which explains only about 40%. Thirdly, it was observed that logit model 1 exhibits lower deviance and higher likelihood ratio compared to logit model 2, implying it is the best fit for maximum likelihood of accepting compensation for disturbance arising from land expropriation.

Standard error of coefficient of gender "GEN" was observed to be greater than 2. This implies a gender bias in expropriated parties interviewed. Notwithstanding, this bias might be attributed to predominance of males over females in the sample frame of expropriated landowners. Whereas this research develops a prototype of DICM, incidence of high standard errors of coefficient of gender variable in disturbance compensation could be minimized by calibrating logit models with data drawn from larger samples.

Equation 16 below is derived from Table 15 as the appropriate calibrated model for double-bounded dichotomous choice valuation of disturbance entitlements arising from land expropriation:

$$Log_e\left(\frac{\hat{p}}{1-\hat{p}}\right) = 0.000003(BID) - 5.285(GEN) + 2.345(EDU) - 1.542(NRT) + 1.465(HSS) - 1.499(AAE) + 3.306(QFT) - 4.172 \quad (16)$$

Where all variables retain their original meaning as defined in Table 9.

6.5. Evaluation of assumptions and diagnostics for chosen logit model

The choice of logit model 1 for the development of DICM was evaluated on basis of the following assumptions and diagnostics in Table 16:

Table 16: Results of logit model diagnostics and validation of assumptions

S/N	Model diagnostic	Indicator	Test result	Remarks	Decision
1.	Logarithmic linearity of predictors	Significance of regressors	Five regressors including BID1 are significant at $p < 0.10$, while NRT is significant at $p < 0.05$.	Regressors are significant in logit model (See Table 15)	Logit model 1 meets the criteria for developing a prototype of disturbance-integrated compensation method for land expropriation
2	Binary (dichotomous) outcomes of WTAC	Classification plot	Indicates each landowner's likelihood of accepting or rejecting a bid offer by responding "Yes" or "No".	Model 1 upholds Binary outcomes of bidding for WTAC. (See Appendix 13)	
3	Classification accuracy	Classification table	Logit model 1 predicts about 87% of dichotomous choice responses drawn from the sample.	Exceeds expected model accuracy criterion of 75% (See Appendix 11)	
4	Multicollinearity of regressors	Tolerance statistic (TS)	TS of model regressors are greater than 0.8.	Absence of multicollinearity among regressors. (See Appendix 13)	
		Variance inflation factor (VIF)	Average VIF of regressors is less than 1.2		
5	Independence of errors	Durbin-Watson test statistic, d_w	Durbin-Watson test statistic = 2.211[a.]	Negative correlation in residual terms of calibrated cases (See Appendix 13)	

[a.] Tolerable if within the range $1 \leq d_w \leq 3$ (Field, 2009).

6.6. Model of disturbance compensation

This section forms part of the analysis required to answer the research question: *How is a disturbance-integrated compensation method developed?* Also empirically answered is the research question: *What test criteria did the disturbance-integrated compensation method meet?* Addressing these questions include development and validation of a model for disturbance compensation model, and estimation of disturbance compensation for all landowners in the sample.

(a) Model of expected disturbance compensation

With respect to land expropriation for public purpose, equation 14 represents the general structure of compensation for disturbance in the study area. Parameters of this equation include $\alpha, \beta_i, BID_k, U, and\ L$ which have all been described in chapter 5. Mean values of GEN, EDU, NRT, HSS,

AAE, and QFT in Table 11 were used together with the constant term of logit model 1 to derive the pooled constant "α" (See equation 6) as -5.15019. Applying this value and coefficient of bid amount to equation 14, a numerical equation for disturbance compensation is expressed in equation 17 as:

$$E(WTA_k) = \left[1{,}718{,}700 - 333{,}333 \log_e \left\{ 1 + \exp\left(\frac{1{,}716{,}730 - (BID_k)}{333{,}333} \right) \right\} \right] \quad (17)$$

Where BID_k represents landowner's highest bid of WTAC for disturbance in accordance with the specification in Table 10.

(b) Validation of disturbance compensation model

Model 17 was validated by applying highest bid data from a sample of 5 landowners in Appendix 9. Results from these five validation cases in Table 17 show that equation 17 can predict most cases of expected compensation for disturbance arising from land expropriation.

Table 17: Model validation using five cases

Validation case	Bid sequence		Response (1st - 2nd)	Expected range of WTA	Highest bound of WTAC [a.]	Estimated WTAC for disturbance [b.]
	1st bid	2nd bid				
1	1,750,000	1,500,000	Yes - No	1,500,000 < WTA ≤ 1,750,000	1,750,000	1,503,800
2	2,250,000	2,750,000	No - No	WTA > 2,750,000	+∞	1,718,700
3	2,500,000	2,250,000	Yes - Yes	WTA ≤ 2,250,000	2,250,000	1,657,300
4	1,500,000	1,250,000	Yes -Yes	WTA ≤ 1,250,000	1,250,000	1,178,500
5	3,000,000	2,750,000	Yes -Yes	WTA ≤ 2,750,000	2,750,000	1,704,000

[a.] Highest bound of numerical integral of cumulative logistic equation for each landowner (Column "F" in Appendix 14)

[b.] Compensation for disturbance (in Frw) was estimated using equation 17

Furthermore, disturbance compensation is within the expected range of WTA for landowners who answered "Yes -Yes" and "Yes - No" in the bid sequence, while the expected WTA of a landowner in the "No - No" response category could not be achieved because equation 17 had censored true estimates of WTAC for disturbances to a maximum of 1,718,700 Frw for all expropriated landowners.

(c) Estimated disturbance compensation for all landowners

Addressing part of the 2nd research question of specific objective 3 is a test of predictability for disturbance compensation model (equation 17). Analytical summary of results from estimation of disturbance compensation for all landowners in Appendix 14 have been presented in Table 18. As expected, estimate of disturbance compensation for 17 landowners fell within expected value bands because their highest acceptable bids were below the censored maximum compensation for disturbance.

Table 18: Summary of predictability test for disturbance compensation model

Response to bidding (1st - 2nd)	Landowner's expected and actual value band of WTAC for disturbance (N = 36)			
	Symbolism of values within expected band	Frequency of cases	Symbolism of values outside expected band	Frequency of cases
Yes - Yes	WTA ≤ (X_0 - 250,000)	10	WTA > (X_0 - 250,000)	0
Yes - No	(X_0 - 250,000) < WTA ≤ X_0	4	WTA < (X_0 - 250,000)	5
No - Yes	X_0 < WTA ≤ (X_0 + 500,000)	3	WTA < X_0	2
No - No	WTA > (X_0 + 500,000)	0	WTA < (X_0 + 500,000)	12
	Total (Expected = Actual)	17	Total (Expected ≠ Actual)	19

Note: See Columns A to G in Appendix 14 for detailed tabulation of computed disturbance compensation for all cases

Contrary to the first result, it can be observed that predicted disturbance compensation of 19 out of a sample of 36 landowners did not meet their expectation of high bid of WTAC. A reason for this is the conservative characteristic of the double-bounded dichotomous estimation technique (Pearce et al., 2006).

Both phenomena of compensation prediction are attributed to the integral calculus of cumulative logistic (bid) function which censored expected disturbance compensation to a maximum of 1,718,700 Frw within expected bid range of $0 \leq BID_k \leq +\infty$ (Figure 8). Notwithstanding, WTA estimates from double-bounded dichotomous bidding of disturbance compensation (Column G of Appendix 14) were found to be efficient towards controlling speculative bidding of landowners.

Mean WTAC for disturbance is estimated from data in Appendix 14 as 1,571,221.22 ± 40,685.82 Frw, while median WTAC for disturbance is put at 1,704,000.00 Frw (Table 19). Furthermore, there is 95% chance that average estimated disturbance compensation could be a minimum of 1,488,624.62 Frw or a maximum of 1,653,817.82 Frw, while landowner's minimum disturbance compensation is estimated at over 700,000 Frw.

Table 19: Descriptive statistics of WTAC for disturbance (in Frw)

		Statistic	Std. Error
Mean WTA		1,571,221.22	40,685.82
95% Confidence Interval for Mean	Lower Bound	1,488,624.62	
	Upper Bound	1,653,817.82	
Median WTA		1,704,000.00	
Std. Deviation		244,114.91	
Minimum WTA		734,080.00	
Maximum WTA		1,718,657.00	

Implication of these results is that the integration of disturbance compensation with the existing market value assessment for real property is likely to increase total compensation for expropriated landowners in the study area by an average of about 1,500,000 Frw. The next section briefly examines the computation of disturbance-integrated compensation.

6.7. Estimate of disturbance-integrated compensation from prototype of value equation

At this stage, a model of disturbance compensation for land expropriation has been validated for selected cases of landowners and also adjudged to be prudent in estimating total value of disturbance entitlements. Furthermore, all data and equations for development of DICM have been collected and defined respectively. Hence, this section utilized these data to validate the research question: *How is a disturbance-integrated compensation method developed?* Equation 15 is a prototype of DICM for land expropriation. Where all parameters retain their original meanings as mentioned in chapter 5. The RHS of equation 17 is substituted for $WTAC_d$ in equation 12 to determine equation 18 which is the numerical equivalent of DICM in the study area:

$$T_c = MV_k + \left[1{,}718{,}700 - 333{,}333 \log_e \left\{1 + \exp\left(\frac{1{,}716{,}730 - (BID_k)}{333{,}333}\right)\right\}\right] \quad (18)$$

With reference to the flowchart in Figure 9 and using a prototype of DICM for the study area (equation 18), disturbance-integrated compensation for 36 expropriated landowner were computed (See details in Column I of Appendix 14). The ensuing figures appear to be higher than the stand-alone market value compensation.

6.8. Test of significance of enhanced compensation

Whereas the addition of disturbance compensation to assessed market values of expropriated properties (Appendix 14) led to an increase in the total compensation for individual landowners by an average of over 1,500,000 Frw (Table 20), conclusions cannot be hastily made concerning significance of this increase

until a paired-sample test of significance for the difference between disturbance-integrated compensation and market value compensation is conducted. Therefore, this section further answered the research question: "*What test criteria did the disturbance-integrated compensation method meet?*" by conducting a paired-sample test of significance for the difference between disturbance-integrated compensation and market value compensation (columns H and I of Appendix 14). With reference to the abridged version of test results (Table 20), it can be deduced that disturbance-integrated compensation for land expropriation is higher than market value compensation at 1% level of significance.

Table 20: Results of paired sample test for difference in compensation estimates

Mean difference[a.]	Standard Error [a.]	Standard Deviation [a.]	t-statistic	Degrees of freedom	Sig. (2-tailed)
1,571,235.56	40,687.30	244,123.82	38.617	35	0.000

[a.] Values in Rwanda Francs (Frw). See Appendix 15 for detailed results of test

Inference can be drawn that the prototype of DICM for land expropriation met the criteria of an increase in total compensation above the assessed market value compensation in the study area.

6.9. Discussion of results on a prototype of disturbance-integrated compensation method

Motivation for the design of DICM for land expropriation is to offer enhanced compensation package which includes market value of expropriated real property and disturbance costs of expropriated landowners (Figure 1) on the premise that standalone market value compensation is not an equivalent measure of landowner's reinstatement for losses arising from expropriation (Alemu, 2012; Norrell, 2008). With reference to the case of compensation for land expropriation in Rwanda, this chapter addressed vital phases in the development of a prototype of DICM including model calibration for disturbance compensation, summation of assessed market value with contingent value of disturbance entitlements, and a test of DICM using criteria of predictability of disturbance compensation for a landowner, and an increase in total compensation above the assessed market value.

It can be recalled from literature review that Bucklan et al. (1999); Hanneman and Kanninen (1999); He and Asami (2014) and Loomis et al. (1997) deployed logistic regression of dichotomous response data as calibration framework for recursive equations of contingent values of WTP/WTA. Specifically, He and Asami (2014) applied this calibration framework to compensation for land expropriation and identified speculative pricing of landowners to be a major driver of overpriced WTA. However, this study is an improvement over the research of He and Asami (2014) because WTA estimation is restricted to valuation of disturbance entitlements as an amount on top of real property valuer's assessment of market value compensation. Contrary to the problem of overpriced WTA found by He and Asami (2014), it was discovered in this research that overpricing of WTAC for disturbance was controlled using integral calculus of double-bounded logistic function which censored and revealed the maximum WTAC for disturbance as 1,718,700 Frw irrespective of landowner's overbidding of disturbance compensation.

In a study of forest owner's WTAC for voluntary forest conservation in Norway (Section 2.5.2), gender and education level were found to be insignificant regressors of WTA (Lindhjem & Mitani, 2012). Contrary to that study, this research on a prototype of DICM for land expropriation found those variables to be significant regressors of disturbance compensation in Rwanda. This phenomenon might be attributed to the difference between valuation implications of voluntary policy changes and involuntary policy changes among which is land expropriation for public purpose.

Šumrada et al. (2013) advocated the scaling up of market value compensation through the addition of incidental expenses such as transport costs and loss of income incurred by landowners. Comparing their

view with coefficients of the chosen binary logistic model of disturbance compensation in the study area, transport (relocation) cost was found to be a significant determinant of estimated WTAC for disturbance while loss of income was excluded from the model. Furthermore, logit variables representing removal cost, loss of livelihood, and loss of income did not contribute significantly towards predicting odds of accepting bid amount for disturbance compensation. Other variables eliminated from the model include age, household expenditure, and duration of time for which landowner had been resident on land prior to expropriation. Whereas exclusion of these variables is contrary expectations of expropriated landowners (chapter 4), there are chances that these exclusions might be attributed to the problem of multicollinearity.

Although the model of disturbance compensation developed in support of a prototype of DICM predicted 17 out of 36 cases of WTAC for disturbance as being within expected value bands of landowners, it failed to predict disturbance compensation for the remaining 19 cases (landowners) within their expected value bands because of a censorship of estimated WTAC for disturbance to a maximum of 1,718,700 Frw regardless of their high bidding. This censorship of disturbance compensation was driven by numerical integration of a right-tailed (asymptotic) cumulative logistic function of disturbance compensation from value bands of 0 to infinity (Figure 8), and further confirms that estimates of contingent values from double-bounded dichotomous data are conservative (Pearce et al., 2006), and efficient towards controlling speculative bidding of landowners.

It was further discovered that the summation of market value with disturbance compensation led to average increase of 1,500,000 Frw in total compensation for expropriated landowners in the sample. This increment implies that DICM leads to economic value compensation for land expropriation (Blume & Rubinfeld, 1984; Chang, 2013), which is an enhancement over assessed market value compensation. Finally, it can be deduced that the design and testing of DICM have addressed the gap of how to collectively monetize subjective and objective disturbance entitlements arising from land expropriation and integrate them into the total compensation package for affected landowners.

6.10. Concluding remarks

This chapter addressed two research questions. The first question is: *How is a disturbance-integrated compensation method developed?* Within the context of expropriation for Bugesera airport in Rwanda, a prototype of DICM was developed by designing a model (equation 18) which is a summation of assessed market value and an integral calculus of a cumulative logistic function containing coefficient of significant regressors of disturbance compensation. Secondly: *What test criteria did the disturbance-integrated compensation method meet?* The model of disturbance compensation that was designed in support of a prototype of DICM predicted only 17 out of 36 cases to be within landowners' expectation of disturbance compensation and further censored predicted disturbance compensation for the remaining 19 landowners to a maximum of 1,718,700 Frw. Given that disturbance compensation component of the prototype of DICM (equation 18) censored a maximum disturbance compensation for all expropriated landowners in the sample and can predict disturbance compensation within value bands of this censored amount, it is deduced that the model meets predictability criterion notwithstanding higher bid amounts stated by expropriated landowners. Furthermore, the application of a prototype of DICM for land expropriation leads to assessed compensation which is significantly higher than market value compensation. Therefore, DICM offers a reasonably higher compensation for land expropriation compared to market value assessment methods in the study area. The next chapter (chapter 7) concludes the research by reflecting on answers to all research questions, limitations of the study, and recommendations for the prototype of DICM.

7. CONCLUSION AND RECOMMENDATIONS

7.1. Introduction

The preceding chapter dealt with the development of a prototype of disturbance-integrated compensation method for land expropriation in the study area. With reference to the variable-data matrix in Table 4, this chapter reflects on answers to research questions posed to address specific research objectives in chapter 1, and critically evaluates the extent to which specific- and main research objectives were achieved. Also addressed in this chapter are the limitations of this research and recommendations.

7.2. Conclusion

This research aimed to develop disturbance-integrated compensation method (DICM), which would most likely increase compensation payable to persons whose landownership rights have been expropriated for overriding public interest. Development of this method of compensation as a prototype was addressed through the following specific objectives: (1). To identify requirements for designing disturbance-integrated compensation method; (2). To design a prototype of disturbance-integrated compensation method; and (3). To test a prototype of disturbance-integrated compensation method. A case of land expropriation for a proposed international airport at Bugesera in Rwanda was chosen for the design of DICM for land expropriation. This section evaluates the extent to which research questions put forward to address these specific objectives were answered; and concludes with a reflection on the research problem and achievement of the main research objective.

7.2.1. Reflective analysis of research objectives and research questions

This subsection provides a systematic reflection of research objectives and their associated research questions.

1. **Specific objective 1: To identify requirements for designing disturbance-integrated compensation method**

   (a) What are the compensable entitlements in disturbance-integrated compensation method?

   Compensable entitlements in DICM include real estate and disturbance entitlements. The entitlements classified under real estate (property) include land, buildings, farm crops and economic trees, fixtures, fittings, specialized plant and machinery, and other physical improvements on land. In addition, disturbance entitlements comprise removal costs, relocation costs, loss of livelihood, loss of income, psychological damages, and other circumstances that are unique to the expropriated landowner.

   (b) What is the perception of compensable entitlements in disturbance-integrated compensation method?

   Exploratory data from Rwanda indicates that majority of respondents perceive compensable entitlements for DICM for land expropriation to include market value of real estate/property, and value of disturbance entitlements comprising removal cost, relocation cost, loss of livelihood, loss of income, psychological damages, and unique circumstances of landowner.

   (c) What combination of valuation techniques is required for developing disturbance-integrated compensation method?

   Development of DICM requires a combination of market valuation techniques for real property (market comparison-, income capitalization-, and cost methods) with stated preference valuation

technique which elicits willingness of landowners to accept compensation for disturbances in addition to assessed market value of expropriated real property.

Addressing specific objective 1

In view of these findings, requirements for designing DICM for land expropriation include a list of compensable entitlements of expropriated landowners comprising real property and disturbance entitlements; and a combination of market valuation techniques for real property with contingent valuation technique of WTAC for disturbance.

2. Specific objective 2: To design a prototype of disturbance-integrated compensation method

(a) What are the data required for modelling this compensation method?

Data required for designing DICM include market value of real property entitlements and contingent valuation data for disturbance compensation. These contingent valuation data comprises double bounded dichotomous bidding of WTAC for disturbance, socioeconomic attributes of landowner, and value indicators of prominent disturbance entitlements identified by landowners in the course of the contingent valuation survey.

(b) What are the design criteria for disturbance-integrated compensation method?

The design criteria for DICM comprise the summation of market value of real property with integral calculus of recursive cumulative logistic equation of landowner's WTAC for disturbance entitlements.

(c) How is a disturbance-integrated compensation method developed?

A prototype of DICM for land expropriation is developed by deploying modelling process towards designing a valuation model which is a summation of assessed market value of real property and integral calculus of cumulative logistic function which contains significant determinants of landowners' disturbance compensation.

Addressing specific objective 2

A prototype of disturbance-integrated compensation method is designed to sum up assessed market value of expropriated real property with estimate of WTAC for disturbance that has been determined from integral calculus of cumulative logistic equation containing significant determinants of disturbance compensation.

3. Specific objective 3: To test a prototype of disturbance-integrated compensation method

(a) What are the test criteria for this compensation method?

Expected test criteria include ability of model of disturbance compensation developed in support of a prototype of DICM to predict disturbance compensation for expropriated landowner in the study area; and the significance of marginal increase in disturbance-integrated compensation compared to assessed market value compensation.

(b) What test criteria did the disturbance-integrated compensation method meet?

First, the recursive cumulative logistic equation censored a maximum amount of 1,718,700 Frw as disturbance compensation for all expropriated landowners in the sample and further predicts disturbance compensation within value bands of this censored amount. Hence, the recursive equation meets predictability criterion notwithstanding a departure from landowners' expectation of disturbance compensation which might be substantially driven by speculation. Secondly,

application of DICM leads to a significant increase in total compensation for land expropriation compared to compensation figures which are based on assessed market value.

Addressing specific objective 3

Test results indicate that the prototype of DICM predicts disturbance compensation within value bands of a censored maximum amount aimed at controlling speculative bidding among expropriated landowners, while ensuring a significant increase in total compensation for land expropriation contrary to assessed market value compensation. This finding affirms the analytical framework of this research which stated explicitly that disturbance-integrated compensation is the union (Šumrada et al.) of assessed market value and value of disturbance entitlements (Figure 1).

7.2.2. General conclusions on main research objective and research problem

This research was motivated by the knowledge gap concerning the valuation of disturbance entitlements associated with land expropriation using economic valuation tools and how the value of these entitlements can be integrated with market value of real property as a formal method of assessing compensation. It was anticipated that addressing this research gap will likely increase assessed compensation of expropriated landowners contrary to the existing use of market value methods.

A comparison of Figure 1 with equation 15 indicates that the market value component in the mathematical equation of DICM conforms with the set C_{cm} in the venn diagram that captures the analytical framework of this research. Similarly, the disturbance compensation component of equation 15 conforms with the set $C_d = (C_{dm} \cap C_{cm})'$; so that the entire equation for determining disturbance-integrated compensation conforms with the set $C_{dm} = C_{cm} \cup C_d$. (See Appendix 16 for mathematical notes on DICM).

In view of specific objectives achieved (Subsection 7.2.1), inference can be drawn that the disturbance-integrated compensation method has been developed in such a way that it captures value of real property and significant disturbance entitlements; and increases the total compensation payable to a sample of landowners in Karera cell of Rwanda who have been expropriated for overriding public interest of a proposed international airport at Bugesera district.

To conclude, it is now known that a disturbance-integrated compensation method for land expropriation can be designed such that total compensation equals the sum of market value of expropriated real property and disturbance compensation estimated from integral calculus of a recursive equation of landowner's WTAC for disturbance entitlement elicited using double-bounded dichotomous choice technique. This method of compensation was found to compute a significantly higher compensation for land expropriation compared to the existing market value approach to compensation.

7.3. Limitations of the study

This section briefly examines limitations of a prototype of DICM for land expropriation developed in the course of this research. First, the generic model for a prototype of DICM in equation 15 might be applicable to other cases of expropriation for public purpose depending on the content of expropriation laws in a country, and on the condition that there is mass expropriation of land for public purpose. However, empirical results from the numerical prototype of DICM in equation 18 as well as compensable entitlements of disturbance compensation in that equation applies strictly to a sample size of 36 landowners in Karera cell who were expropriated for the proposed international airport at Bugesera district of Rwanda and might not be generalized for a total of 1954 expropriated landowners in that cell.

Secondly, the generic model for a prototype of DICM in equation 15 is limited to valuation of real property and disturbance entitlements in the event of full acquisition of land for public purposes and does not apply to valuations for:

1. severance where partial acquisition of interest in land is executed for public purposes, and/or
2. injurious affection arising from depreciation in the value of land retained by a person after a portion of the original parcel is expropriated for public purpose.

Lastly, reliability of a calibrated contingent value models depends on the use of data from large sample sizes of around 100 to 300 respondents (Louviere et al., 2000). In view of this, another limitation of this research is the inability to conduct contingent valuation survey of disturbance compensation with at least a sample of 300 out of 1954 expropriated landowners in Karera cell of Bugesera district. This limitation is attributed to constraints of available research funding, and the pressure of having to manage limited fieldwork period to accommodate bureaucracy surrounding official approvals for data collection and fieldwork on the topic of compensation for land expropriation which attracts a significant level of sensitivity in the study area.

7.4. Recommendations

In view of limitations of this research, three recommendations have been put forward. Firstly, the binary logistic equation of disturbance compensation developed in connection with a prototype of DICM in this research was calibrated and validated using data from a sample of 31 and 5 out of 1954 expropriated landowners respectively. Although the strength of this research lies in the feasibility of developing DICM for land expropriation, further research on DICM should deploy data from larger samples of at least 300 expropriated landowners towards calibrating binary logistic model of disturbance compensation especially when there is mass expropriation of land for public purpose. On the other hand, data from at least 100 expropriated landowners might be reasonable to validate numeric integral of recursive logistic model designed to estimate actual disturbance compensation of these landowners. This improvement is expected to further strengthen the validity of the prototype of DICM developed in this research.

Secondly, it is recalled that the summation of market value of real property with integral calculus of a recursive equation of landowners WTAC for disturbance constitute design criteria for DICM, which was applied in the case of compensation for land expropriation for a proposed international airport in Rwanda. Further research on DICM for land expropriation might apply similar version of this design criteria towards developing appropriate compensation assessment techniques for landowners and persons without formal titles who are affected by mass expropriation for the construction of dams, irrigation projects, public utilities and other government sponsored projects across developing countries in Africa.

The last recommendation is directed to real property valuers who are potential users of DICM for land expropriation. Kauko (2004) envisioned 4th generation of property valuation models which are essentially combination of existing value assessment techniques geared towards addressing valuation problems for specific purposes, but not exclusive to compensation for land expropriation as examined in this study. This research specifically developed prototype of that 4th generation of value assessment technique as an artefact of land administration system that computes value of compensable entitlements of expropriated landowners which are beyond the scope of conventional market valuation methods. Although the design of this value assessment technique might be reasonably simple for most real property valuers to grasp, it is important that valuers desiring to use this method of compensation assessment should have a reasonable level of interviewing and numerate skills.

LIST OF REFERENCES

Alemu, B. Y. (2012). Expropriation, Valuation and Compensation Practice in Amhara National Regional State (ANRS) –The Case of Two Cities (Bahir-Dar and Gonder). *Nordic Journal of Surveying and Real Estate Research, 9*(1), 30 - 58.

Alias, A., & Daud, N. M. (2006). Payment of Adequate Compensation for Land Acquisition in Malaysia. *Pacific Rim Property Research Journal, 12*(3), 326 - 349.

Azuela, A., & Herrera-Martín, C. (2009). Taking Land Around the World: International Trends in Expropriation for Urban and Infrastructure Projects. In S. Lall, M. Freire, B. Yuen, R. Rajack & J.-J. Helluin (Eds.), *Urban Land Markets* (pp. 337-362). Netherlands: Springer.

Bateman, I. J., Langford, I. H., & Rasbash, J. (1999). Willingness-to-pay Question Format Effects in Contingent Valuation Studies. In I. J. Bateman & K. G. Willis (Eds.), *Valuing Environmental preferences: The Theory and Practice of Contingent valuation Method in the US, E.U. and Developing Countries* (pp. 511 - 539). Oxford: Oxford University Press.

Biel, A., Johansson-Stenman, O., & Nilsson, A. (2011). The willingness to pay–willingness to accept gap revisited: The role of emotions and moral satisfaction. *Journal of Economic Psychology, 32*, 908 - 917. doi: 10.1016/j.joep.2011.07.010

Blume, L., & Rubinfeld, D. L. (1984). Compensation for Takings: An Economic Analysis. *California Law Review, 72*(4), 569-628. doi: 10.2307/3480447

Bucklan, S. T., Macmillan, D. C., Duff, E. I., & Hanley, N. (1999). Estimating mean willingness to pay from dichotomous choice contingent valuation studies. *Journal of the Royal Statistical Society. Series D (The Statistician), 48*(1), 109 - 124.

Çağdaş, V., & Stubkjær, E. (2011). Design research for cadastral systems. *Computers, Environment and Urban Systems, 35*(1), 77-87. doi: 10.1016/j.compenvurbsys.2010.07.003

Cernea, M. M. (1988). Involuntary Resettlement in Development Projects: Policy Guidelines in World Bank-Financed Projects. *World Bank Technical Paper* (pp. 102). Washington, D.C.: World Bank.

Chang, Y.-C. (2013). *Private Property and Takings Compensation: Theoretical Framework and Empirical Analysis*. Cheltenham: Edward Elgar Publishing Ltd.

Choguill, C. L. (2005). The research design matrix: A tool for development planning research studies. *Habitat International, 29*(4), 615-626. doi: 10.1016/j.habitatint.2005.06.001

Creswell, J. W. (2003). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. California: Sage Publications.

Debnath, B., & Choudhary, T. (2009). Land Administration in Countries with State Ownership of Land. In N. Mohanty, R. Sarkar & A. Pandey (Eds.), *India Infrastructure Report* (pp. 260 - 263). New Delhi: Oxford University Press.

Dowdy, S., Weardon, S., & Chilko, D. (2004). *Statistics for Research*. (3rd ed.). New Jersey: John Wiley & Sons, Inc.

Eccles, T., Sayce, S., & Smith, J. (1999). *Property and Construction Economics*. London: International Thomson Business Press.

Famuyiwa, F., & Omirin, M. M. (2011). Infrastructure Provision and Private Lands Acquisition Grievances: Social Benefits and Private Costs. *Journal of Sustainable Development, 4*(6), 169 - 180. doi: doi:10.5539/jsd.v4n6p169

FAO. (2009). Compulsory acquisition of land and compensation. *Land Tenure Studies.* Rome: United Nations Food and Agriculture Organization, FAO.

Feldman, S., & Geisler, C. (2012). Land expropriation and displacement in Bangladesh. *The Journal of Peasant Studies, 39*(3-4), 971-993. doi: 10.1080/03066150.2012.661719

Field, A. (2009). *Discovering Statistics Using SPSS* (3rd ed.). London: SAGE Publications.

Gahamanyi, J. (2012, 14 June). Rwanda: Transport and Energy Top Budget Priority - Rwangombwa, Interview, *The New Times.* Retrieved from http://www.newtimes.co.rw/news/index.php?a=54776&i=15023

Gilchrist, A., & Allouche, E. N. (2005). Quantification of social costs associated with construction projects: state-of-the-art review. *Tunnelling and Underground Space Technology, 20*(1), 89-104. doi: 10.1016/j.tust.2004.04.003

Giovannetti, F. (2004). Ghana Water Sector Restructuring Project Resettlement Policy Framework. (Vol. 1). Rotterdam: Haskoning Nederlands BV.

Goldstein, R. J. (1997). Green wood in the bundle of sticks: Fitting environmental ethics and ecology into real property law. *Boston College Environmental Affairs Law Review, 25*(2), 347 - 430.

Golsteijn, C., & Wright, S. (2013). Using Narrative Research and Portraiture to Inform Design Research. In P. Kotzé, G. Marsden, G. Lindgaard, J. Wesson & M. Winckler (Eds.), *Human-Computer Interaction – INTERACT 2013* (Vol. 8119, pp. 298-315): Springer Berlin Heidelberg.

Gujarati, D. N. (2004). *Basic Econometrics*. New York: The McGraw−Hill Companies.

Habimana, S. (2013, 18 August). Rwanda: Bugesera Airport - Residents Decry Delayed Compensation, News Paper Report, *All Africa*. Retrieved from http://allafrica.com/stories/201308190281.html

Hanneman, W. M., & Kanninen, B. (1999). The Statistical Analyisis of Discrete-Response CV Data. In I. J. Bateman & K. G. Willis (Eds.), *Valuing Environmental preferences: The Theory and Practice of Contingent valuation Method in the US, E.U. and Developing Countries* (pp. 302 - 441). Oxford: Oxford University Press.

He, Z., & Asami, Y. (2014). How Do Landowners Price their Lands during Land Expropriation and the Motives Behind It: An Explanation from a WTA/WTP Experiment in Central Beijing. *Urban Studies, 51*(2), 412-427. doi: 10.1177/0042098013492227

Heller, M., & Hills, R. (2008). Land Assembly District. *Havard Law Review, 121*(6), 1465 - 1527.

Kauko, T. (2004). Towards the 4th generation - an essay on innovations in residential property value modelling expertise. *Journal of Property Research, 21*(1), 75-97. doi: 10.1080/0959991042000255631

Krishna, V. V., Drucker, A. G., Pascual, U., Raghu, P. T., & King, E. D. I. O. (2013). Estimating compensation payments for on-farm conservation of agricultural biodiversity in developing countries. *Ecological Economics, 87*(0), 110-123. doi: http://dx.doi.org/10.1016/j.ecolecon.2012.12.013

Kusiluka, M. M., Kongela, S., Kusiluka, M. A., Karimuribo, E. D., & Kusiluka, L. J. M. (2011). The negative impact of land acquisition on indigenous communities' livelihood and environment in Tanzania. *Habitat International, 35*(1), 66-73. doi: 10.1016/j.habitatint.2010.03.001

Lindhjem, H., & Mitani, Y. (2012). Forest owners' willingness to accept compensation for voluntary conservation: A contingent valuation approach. *Journal of Forest Economics, 18*(4), 290-302. doi: 10.1016/j.jfe.2012.06.004

List, J. A., & Shogren, J. F. (2002). Calibration of Willingness-to-Accept. *Journal of Environmental Economics and Management, 43*(2), 219-233. doi: 10.1006/jeem.2000.1182

Loomis, J., Brown, T., Lucero, B., & Peterson, G. (1997). Evaluating the validity of the dichotomous choice question format in contingent valuation. *Environmental and Resource Economics, 10*(2), 109 - 123. doi: 10.1023/A:1026403916622

Louviere, J. J., Hensher, D. A., & Swait, J. D. (2000). *Stated Choice Methods: Analysis and Applications*. Cambridge, U.K,: Cambridge University Press.

Nathanson, B. H., & Higgins, T. L. (2008). An introduction to statistical methods used in binary outcome modeling. *Seminars in Cardiothoracic and Vascular Anesthesia, 12*(3), 153-166.

Nayak, R. (2000). Risks associated with landlessness: An exploration toward socially friendly displacement and resettlement. In M. Cernea & C. McDowell (Eds.), *Risks and reconstruction: Experiences of resettlers and refugees.* (pp. 79–107). Washington, DC.: World Bank.

Niemann, P., & Shapiro, P. (2008). Efficiency and fairness: Compensation for takings. *International Review of Law and Economics, 28*(3), 157-165. doi: 10.1016/j.irle.2008.06.008

Norrell, L. (2008). Is the market value a fair and objective measure for determining compensation for compulsory acquisition of land? *Land Reform* (pp. 19-30). India: Centre for Science and Environment.

Omar, I., & Ismail, M. (2009). Kotaka's Model in land acquisition for infrastructure provision in Malaysia. *Journal of Financial Management of Property and Construction, 14*(3), 194 - 207. doi: 10.1108/13664380911000431

Payne, G. (2011). Land Issues in The Rwanda's Post Conflict Law Reform. In R. Home (Ed.), *Local Case Studies In African Land Law*. South Africa: Pretoria University Law Press.

Pearce, D., Atkinson, G., & Mourato, S. (2006). *Cost-Benefit Analysis and the Environment: Recent Developments*. France: OECD Publishing.

Radam, A., & Mansor, S. A. (2005). Use of Dichotomous Choice Contingent Valuation method to value the Manukan Island, Sabah. *Pertinaka Journal of Social Science & Humanities, 13*(1), 1 - 8.

REMA. (2011). Resettlement Policy Framework and Process Framework for Lake Victoria Environmental Management Project: Phase II. *Lake Victoria Environmental Management Project Phase II* (pp. 70). Kigali: Rwanda Environment Management Authority (REMA).

Law Relating to Expropriation in the Public Interest, 18/2007 Stat. (Republic of Rwanda, 2007, April 19).

Rowan-Robinson, J., & Hutchison, N. (1995). Compensation for the compulsory acquisition of business interests: Satisfaction or sacrifice. *Journal of Property Valuation and Investment, 13*(1), 44 - 65. doi: 10.1108/14635789510077287

Sagashya, D., & English, C. (2006, 9-10 March). *Designing and Establishing a Land Administration System for Rwanda: Technical and Economic Analysis.* Paper presented at the Conference on Land Governance in Support of the MDG's : Responding to New Challenges, Washington, USA.

Shapiro, E. F., Mackmin, D., & Sams, G. (2013). *Modern methods of valuation.* (11th ed.). New York: Routledge.

Singh, Y. K. (2006). *Fundamental of Research Methodology and Statistics.* New Delhi: New Age International (P) Ltd.

Šumrada, R., Ferlan, M., & Lisec, A. (2013). Acquisition and expropriation of real property for the public benefit in Slovenia. *Land Use Policy, 32*(0), 14-22. doi: 10.1016/j.landusepol.2012.10.004

Syagga, P. M., & Olima, W. H. A. (1996). The impact of compulsory land acquisition on displaced households: The case of the Third Nairobi Water Supply Project, Kenya. *Habitat International, 20*(1), 61-75. doi: 10.1016/0197-3975(95)00034-8

Tapsuwan, S. (2005, 26-28 September). *Valuing the willingness to pay for environmental conservation and management: A case study of scuba diving levies in Moo Koh Similan Islands Marine National Park, Thailand.* Paper presented at the 34th Australian Conference of Economists, Melbourne, Australia.

Viitanen, K., Falkenbach, H., & Nuuja, K. (2010a). *Compulsory Purchase and Compensation: Recommendations for Good Practice.* Copenhagen: International Federation of Surveyors, FIG.

Viitanen, K., Vo, D. H., Plimmer, F., & Wallace, J. (2010b). *Hanoi Declaration Land Acquisition in Emerging Economies.* Copenhagen: The International Federation of Surveyors (FIG).

Voinov, A. A. (2008). *Systems Science and Modeling for Ecological Economics.* London: Elsevier Science.

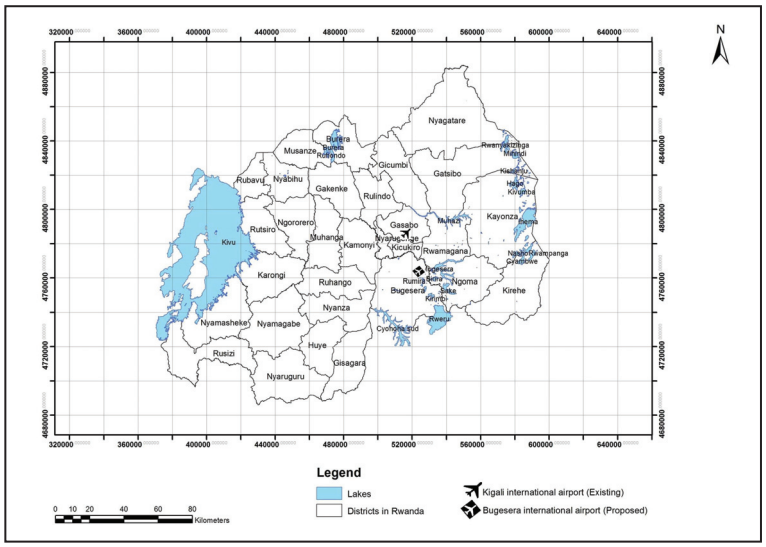
Wyatt, P. (2007). *Property valuation in an economic context.* Oxford: Blackwell Publishers.

Yeates, D., & Wakefield, T. (2004). *System Analysis and Design.* (2nd ed.). England: Pearson Education Ltd.

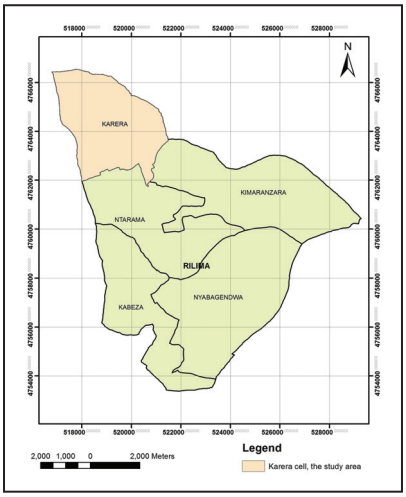
Yin, R. K. (2003). *Case Study Research: Design and Methods* (3rd ed.). London: Sage Publications.

APPENDICES

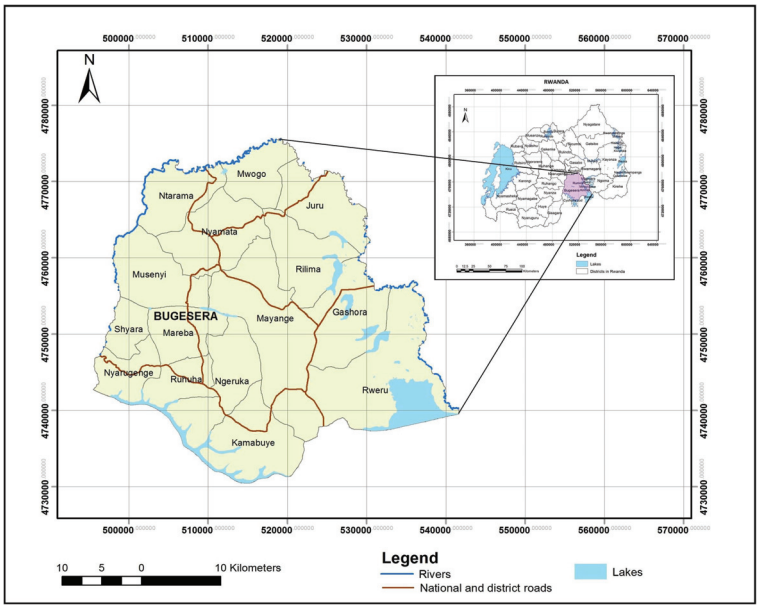
Appendix 1: Location maps of study area



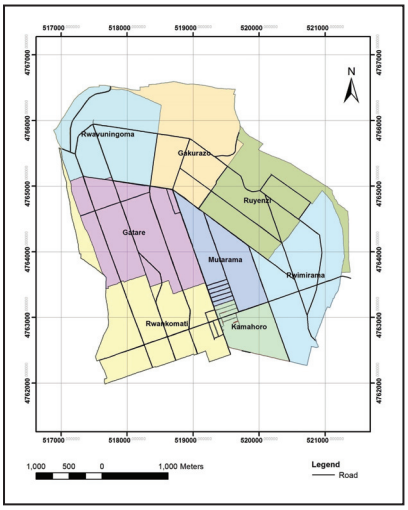
A: Map of Rwanda showing proposed site for Bugesera international airport



C: Map of Rilima sector



B: Location map of Bugesera district in Rwanda



D: Map showing Karera cell and its villages

Appendix 2: Letter in support of fieldwork in Rwanda

UNIVERSITY OF TWENTE.

TO WHOM IT MAY CONCERN

FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

DATE
23 September 2013
OUR REFERENCE
LA/13195/WdV/jm

PAGE
1 of 1

SUBJECT
Request for support

Dear Sir or Madam,

We herewith certify that Joseph Obaje Ataguba is registered at the University of Twente, Faculty of Geo-Information Science and Earth Observation (ITC), the Netherlands, as a student attending an 18-month Master of Science course in Land Administration (LA). ITC has more than 60 years of experience and develops and transfers knowledge in the field of Geographic Information Systems and Remote Sensing.

As part of the MSc course, Joseph Obaje Ataguba will be doing a research titled "Towards a Disturbance-integrated Compensation method for Land expropriation: A Case of Rwanda". The research will include a 'fieldwork' consisting of secondary and primary data collection, which will tentatively take place in Bugesera district from 28 September to 25 October 2013.

The research mainly concerns developing an integrated compensation method for land expropriation which comprises market value and value of other entitlements for affected parties. It is hoped that this research will contribute towards resolving the knowledge gap on how to integrate market value and other losses suffered in connection with land expropriation and increase the perceived degree of equity of compensation payable to affected parties.

ITC highly appreciates your support in providing him the necessary information during the stated fieldwork period.

We guarantee you that the information, that would be made available to Joseph Obaje Ataguba, will only be utilized for the research objectives and not for any other purpose. Besides, Joseph Obaje Ataguba will make proper acknowledgement and reference to the source of the information in the final document.

Yours sincerely,

i.a.

UNIVERSITY OF TWENTE. FACULTY ITC

Dr. ir. Walter T. de Vries
Course Coordinator Land Administration
Faculty of Geo-Information Science and Earth Observation (ITC)
University of Twente
P.O. Box 217
7500 AE Enschede
Netherlands
tel. +31 53 4874 475
fax +31 53 4874 575

w.t.devries@utwente.nl

P.O. Box 217
7500 AE Enschede
The Netherlands

ITC
www.itc.nl

Appendix 3: Semi-structured interview for government officials

UNIVERSITY OF TWENTE
FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

Land Administration Course

Research interview questions for officials of government agencies

Organization

☐ Rwanda Natural Resources Authority: Lands and mapping department

☐ Rwanda Ministry of Infrastructure: Transport department

☐ Rwanda Ministry of Infrastructure: Rwanda Transport Development Agency (RTDA)

☐ Bugesera District Administration

☐ Others, specify:

Preamble

This interview is part of data collection exercise for my MSc Land Administration course at the Faculty of Geo-Information Science and Earth Observation of the University of Twente, the Netherlands. The MSc thesis for which this interview is conducted is titled: "Towards a Disturbance-integrated Compensation method for Land expropriation: A Case of Rwanda". I shall give your responses the utmost confidentiality it deserves and count on your cooperation towards responding to this interview. Hence, your cooperation and assistance are highly appreciated. Thank you for sparing your time for this interview.

Objectives

Objectives of this interview are to:

1. identify entitlements to be considered when developing disturbance-integrated compensation method for land expropriation for public purpose; and
2. elicit perceived degree of equity of this method of compensation as far as it can be developed based on the requirements you have identified.

PART 1: INTERVIWEE INFORMATION

Interviewee Number: _____ Date: _____
Start time _____ End time _____
Name of interviewee: _____
Position held: _____
Specialty: _____
Contact Phone No.: _____ Email: _____

PART 2: GENERAL INSIGHT INTO LAND EXPROPRIATION IN RWANDA

1. What is your role in land expropriation and compensation for public purpose?

_____
_____
_____
_____

2. What are the challenges associated with compensation for land expropriation in Rwanda?

_____
_____

3. How do you handle these challenges in your capacity?

4. To what extent do land owners react to news of land expropriation for public purpose?

5. How did local residents of Bugesera district react over the news of land expropriation for an international airport project?

6. What other alternative methods of land acquisition did government explore before resorting to expropriation?

PART 3: COMPENSATION FOR LAND EXPROPRIATION

7. How are affected parties in Bugesera district compensated following land expropriation for airport project?

8. Are affected parties paid cash compensation or offered resettlement elsewhere?

9. Who assesses compensation for land expropriation?

10. Maps and geo-information are crucial to compensation assessment process.

- ☐ Strongly agree
- ☐ Agree
- ☐ Neither agree nor disagree
- ☐ Disagree
- ☐ Strongly disagree

11. How did government handle resettlement of affected parties when construction work on Bugesera airport was scheduled to commence?

12. Apart from bringing an end to an existing land right, do you see land expropriation for public purpose as a form of disturbance to other forms of rights held in land?

_____

_____

13. Payment of compensation is important because land expropriation lead to a change in the following socioeconomic circumstances of land owners.

Conditions for the development of disturbance-integrated method of compensation for land expropriation	Scale				
	5	4	3	2	1
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Land rights					
Buildings and immovable structures on land					
Ancestral heritage					
Family ties					
Business enterprise					
Expenditure patterns					
Livelihood from land					
Income from land					

14. Landowners displaced following expropriation of their land rights incur expenditure to mitigate the following disturbances arising from the expropriation.

Disturbance costs for which affected parties mitigate through incidental expenditure	Scale				
	5	4	3	2	1
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Removal and dismantling of assets					
Relocation to another site					
Loss of livelihood derived from land use					
Loss of income from land					
Psychological stress associated with the expropriation					

15. To what extent do you agree that the money which government pays as compensation for land expropriation should include the value of the following elements?

Requirements for developing disturbance-integrated method of compensation	Scale				
	5	4	3	2	1
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
(Market value of) land, buildings, and immovable structures					
Removal cost					
Relocation cost					
Compensation for loss of livelihood on land					
Compensation for loss of income from land					
Compensation for psychological damages					
(Valuation of) other unique circumstances of affected land owner					

16. Allowing affected parties to bargain their willingness to accept compensation for these disturbances with acquiring authorities shall lead to a more participatory approach to compensation assessment.

- ☐ Strongly agree
- ☐ Agree
- ☐ Neither agree nor disagree
- ☐ Disagree
- ☐ Strongly disagree

PART 4: PERCEIVED EQUITY OF DISTURBANCE-INTEGRATED COMPENSATION METHOD

17. If a compensation method for land expropriation is designed to contain market value of land and buildings as well as payment for disturbances, kindly assess this method of calculating compensation based on the following statements.

Elements and indicators	Scale				
	5	4	3	2	1
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Equivalence					
The compensation method considers all entitlements of affected parties					
Undue advantage against affected parties is minimized					

Elements and indicators	Scale				
	5	4	3	2	1
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Balance of interest					
The compensation method matches the interest of affected parties with that of the government					
The method matches the interest of affected parties with purpose of the expropriation					
Flexibility					
The method is an appropriate interpretation of expropriation laws					
With this method, it is flexible to identify items for which compensation should be paid.					
The method makes it flexible to determine value of items to be compensated.					
Inclusiveness					
This method recognizes compensation for land rights and other entitlements of legitimate land owners					
This method recognizes compensation for land rights and other entitlements of tenants and residents of informal settlement					
There is no limit to compensation for land rights and other losses suffered by legitimate landowners.					
There is no limit to compensation for land rights and other losses suffered by tenants and residents of informal settlement					
Fairness					
The application of this method leads to fair negotiation of compensation between affected parties and acquiring authority					
Compensation payment arising from the use of this method can support the poor and vulnerable groups					
The application of this method motivates prompt payment of compensation					
Entitlements included in this use of this method of compensation are reasonable					
Transparency					
It does not lead to poor quality of information exchange among stakeholders in land expropriation					
Corruption in compensation payment does not arise when this compensation method is utilized.					
The compensation method require adequate facts from affected parties and the land market.					
This method does not underrate stakeholder involvement in compensation assessment.					

Thank you

Appendix 4: Semi-structured interview for Real property valuers

UNIVERSITY OF TWENTE
FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

Land Administration Course

Research interview questions for Real Property Valuers

Preamble
This interview is part of data collection exercise for my MSc Land Administration course at the Faculty of Geo-Information Science and Earth Observation of the University of Twente, the Netherlands. The MSc thesis for which this interview is conducted is titled: "Towards a Disturbance-integrated Compensation method for Land expropriation: A Case of Rwanda". I shall give your responses the utmost confidentiality it deserves and count on your cooperation towards responding to this interview. Hence, your cooperation and assistance are highly appreciated. Thank you for sparing your time for this interview.

Objectives
Objectives of this interview are to:
1. identify entitlements to be considered when developing disturbance-integrated compensation method for land expropriation for public purpose; and
2. elicit perceived degree of equity of this method of compensation as far as it can be developed based on the requirements you have identified.

PART 1: INTERVIWEE INFORMATION

Interviewee Number: _____ Date: _____
Start time: _____ End time: _____
Name of interviewee: _____
Position held: _____
Specialty: _____
Contact Phone No.: _____ Email: _____

PART 2: VALUER INFORMATION
1. How many years of professional experience do you have in real property valuation?

☐ 1 - 3 years
☐ 4 - 6 years
☐ 7 - 9 years
☐ 10 - 12 years
☐ Above 12 years

2. Who are your clients?

_____
_____
_____

3. How often in a month do you get request from clients to do valuations?

☐ At least once
☐ 2 - 4 times
☐ 5 - 7 times
☐ 8 - 10 times
☐ More than 10 times

4. Were you involved in compensation assessment for land expropriation for the Bugesera airport?
☐ Yes ☐ No

5. Are private citizens authorized to consult you for valuations for land expropriation?

_____

_____

PART 3: COMPENSATION FOR LAND EXPROPRIATION

6. Rank 1st, 2nd and 3rd the following methods of valuation in their order of priority for assessing market value of property expropriated by the government for public purpose.
☐ Market comparison method
☐ Investment method
☐ Replacement cost approach

7. State other methods of valuation you have used to determine market value of land and buildings expropriated by the government.

_____

_____

8. (a) As required by Article 31 of the Real Property Valuation Law of Rwanda published in 2010, have you used a combination of valuation methods to determine compensation payable for land and buildings owned by a single household?
☐ Yes ☐ No

(b) If Yes, what were the combination of valuation methods you applied?

_____

_____

9. (a) What were the sources of data for land value?

_____

_____

(b) What were the sources of data for building cost?

_____

_____

(c) What other sources of data assisted you to value expropriated properties for compensation?

_____

_____

10. Do government authorities publish figures showing assessed market values for all expropriated properties?
☐ Yes ☐ No

11. Have you encountered resistance from members of a community whose lands were expropriated for public purpose?
☐ Yes ☐ No
(if Yes go to question 12. If No, skip question 12 and go to Question 13)

12. (a) If Yes, what were the causes of the resistance?

_____
_____
_____

(b)How was the matter handled?

_____
_____
_____

13. Is there any appeal process for grievances concerning compensation assessment?

_____
_____
_____

14. Apart from bringing an end to an existing land right, do you see land expropriation for public purpose as a form of disturbance to other forms of rights held in land?

_____
_____
_____

15. Payment of compensation is important because land expropriation lead to a change in the following socioeconomic circumstances of land owners.

Conditions for the development of disturbance-integrated method of compensation for land expropriation	Scale				
	5	4	3	2	1
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Land rights					
Buildings and immovable structures on land					
Ancestral heritage					
Family ties					
Businesses					
Expenditure patterns					
Livelihood from land					
Income from land					

16. Landowners displaced following expropriation of their land rights incur expenditure to mitigate the following disturbances arising from the expropriation.

Disturbance costs for which affected parties mitigate through incidental expenditure	Scale				
	5	4	3	2	1
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Removal and dismantling of assets					
Relocation to another site					
Loss of livelihood derived from land					
Loss of income from land					
Psychological stress associated with the expropriation					

17. How can you identify these disturbance entitlements when conducting property inspection and survey for compensation purposes?

_____

_____

_____

18. To what extent do you agree that the money which government pays as compensation for land expropriation should include the value of the following elements?

Requirements for developing disturbance-integrated method of compensation	Scale				
	5	4	3	2	1
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
(Market value of) land, buildings, and immovable structures					
Removal cost					
Relocation cost					
Compensation for loss of livelihood on land					
Compensation for loss of income from land					
Compensation for psychological damages					
(Valuation of) other unique circumstances of affected land owner					

19. Allowing affected parties to bargain their willingness to accept compensation for these disturbances with acquiring authorities shall lead to a more participatory approach to compensation assessment.
    - ☐ Strongly agree
    - ☐ Agree
    - ☐ Neither agree nor disagree
    - ☐ Disagree
    - ☐ Strongly disagree

PART 4: PERCEIVED EQUITY OF DISTURBANCE-INTEGRATED COMPENSATION METHOD

20. If a compensation method for land expropriation is designed to contain market value of land and buildings as well as payment for disturbances, kindly assess this method of calculating compensation based on the following statements.

Elements and indicators	Scale				
	5	4	3	2	1
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Equivalence					
The compensation method considers all entitlements of affected parties					
Undue advantage against affected parties is minimized					
Balance of interest					
The compensation method matches the interest of affected parties with that of the government					
The method matches the interest of affected parties with purpose of the expropriation					
Flexibility					
The method is an appropriate interpretation of expropriation laws					
With this method, it is flexible to identify items for which compensation should be paid.					
The method makes it flexible to determine value of items to be compensated.					
Inclusiveness					
This method recognizes compensation for land rights and other entitlements of legitimate land owners					
This method recognizes compensation for land rights and other entitlements of tenants and residents of informal settlement					
There is no limit to compensation for land rights and other losses suffered by legitimate landowners.					
There is no limit to compensation for land rights and other losses suffered by tenants and residents of informal settlement					

Elements and indicators	Scale				
	5	4	3	2	1
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Fairness					
The application of this method leads to fair negotiation of compensation between affected parties and acquiring authority					
Compensation payment arising from the use of this method can support the poor and vulnerable groups					
The application of this method motivates prompt payment of compensation					
Entitlements included in this use of this method of compensation are reasonable					
Transparency					
It does not lead to poor quality of information exchange among stakeholders in land expropriation					
Corruption in compensation payment does not arise when this compensation method is utilized.					
The compensation method require adequate facts from affected parties and the land market.					
This method does not underrate stakeholder involvement in compensation assessment.					

Thank you

Appendix 5: Letter of authorization to conduct fieldwork in Bugesera district

REPUBLIC OF RWANDA

Bugesera, 11/10/2013
N°.....270.05.07

EASTERN PROVINCE
BUGESERA DISTRICT
P.O. BOX 1 NYAMATA

Joseph Obaje Ataguba
University of Twente
The Netherlands
Tel: 0726689714

Re: Permission to conduct fieldwork and to collect data for research purposes in Bugesera District

Dear Joseph,

Reference is made to your letter that we received on October 09, 2013 bearing an attachment of the recommendation letter from Dr. Ir. Walter T. de Vries, the Land Administration course coordinator at the faculty of Geo-Information and Earth Observation at the University of Twente in Netherlands, requesting for permission to conduct fieldwork and collect data for research purposes.

I therefore, wish to inform you that you are authorized to conduct field work and collect data for the research project **"Towards a Disturbance - integrated Compensation method for Land expropriation: a case study of Rwanda".** The relevant District staff and the target community concerned with the Bugesera International airport project presented with this letter are requested to facilitate you to acquire the data relevant to your research project mentioned above.

However, I encourage you to share, at the end of the research, your research findings with the District authority for future reference. Thank you.

Sincerely,

RWAGAJU Louis
Mayor, Bugesera District

AKARERE KA BUGE

RUKUNDO Julius
Vice Mayor in Charge Of
Economic Development
Bugesera District

Appendix 6: Contingent valuation survey and semi-structured interview
(A) English version

UNIVERSITY OF TWENTE
FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

Land Administration Course

Contingent Valuation Survey and research interview questions

Preamble

Good day. My name is Joseph Obaje Ataguba. This interview is part of data collection exercise for my MSc Land Administration course at the Faculty of Geo-Information Science and Earth Observation of the University of Twente, the Netherlands. The MSc thesis for which this interview is conducted is titled: "Towards a Disturbance-integrated Compensation method for Land expropriation: A Case of Rwanda". I shall give your responses the utmost confidentiality it deserves and count on your cooperation towards responding to this interview. Hence, your cooperation and assistance are highly appreciated. Thank you for sparing your time for this interview.

Objectives

The objective of this interview is to know your opinion about:

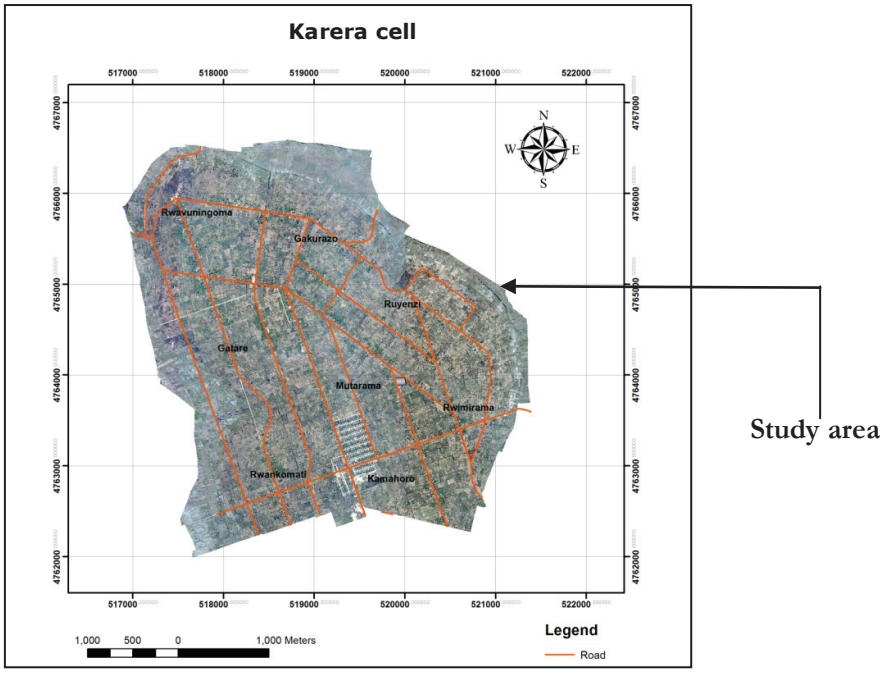
- items for which compensation should be assessed and paid in connection with land expropriation; and
- the price you attach to all these items apart from land and buildings expropriated by government for the airport project.

INTERVIEW INFORMATION

Interviewee Number: _____ Parcel id: _____
Date: _____ Time: _____

VALUATION PROBLEM

Land expropriation is one of the ways government acquire land for public infrastructure projects. In Bugesera district, the expropriation was in connection with the development of an international airport as indicated in the map of the study area, Karera.



Because your land situates within the proposed airport project area, you and members of your household had to prepare for relocation by dismantling and removing personal belongings from the land. Furthermore, it is possible that your source of income (livelihood) was dependent on the expropriated land and you shall suspend that livelihood for some time or (terminate it instantly) never go back to it. The expropriation may have led to a change in the income you derive from land. It is possible that the inclusion of your land among those lands to be expropriated for the airport project led to a change in the social relationships developed over the years in that location as well as the attachment of your household to land. These issues I have just explained are disturbances (disruption of land rights) associated with land expropriation.

Real property valuers have since determined the market value of land, buildings and immovable structures on land for compensation purposes but you still felt that the compensation should include other expenditure you have incurred to tolerate the adverse effects of these instances of disruption of land rights (disturbances) mentioned above.

I will like to emphasize that this survey is an academic exercise which is aimed at collecting information about your opinion of compensation for these instances of land rights disruption (disturbances) besides market value of land and buildings assessed by real property valuers.

In this survey, I will ask questions about your willingness to accept (WTA) compensation for disturbances arising from land expropriation for the airport development project. While you respond to questions in this survey, I want to remind you that like other households whose interest in land had been expropriated for this airport project, your household expenditure should not be more than household income level as at the date of the expropriation. In addition, you should remember that your household is constrained by other expenditure plans apart from money which you expect to spend in order to tolerate these disturbances.

PART 1: DISTURBANCE COMPENSATION ARISING FROM LAND EXPROPRIATION

1. Before government's expropriation of your land for airport project, it was located near:
   - ☐ Tourist attraction
   - ☐ Compacted murram road
   - ☐ Stone paved road
   - ☐ Asphalt road

2. Your land was used for what purpose before the expropriation?
   - ☐ Agricultural use only
   - ☐ Residential use only
   - ☐ Commercial use only
   - ☐ Residential and Agricultural uses
   - ☐ Residential and Commercial uses
   - ☐ Industrial use
   - ☐ Others, please specify: _____

3. Were you involved in the process of market value determination for compensation purpose?
   ☐ Yes ☐ No (If Yes go to question 4. If No, go to question 5)

4. How were you involved in the process of determining market value of your land and buildings?

   _____

   _____

5. Kindly explain how you would have been involved in the process of determining market value of your land and buildings?

_____

_____

_____

6. Did government authorities disclose to you how much was assessed as compensation for your expropriated property?

☐ Yes ☐ No

7. Apart from bringing an end to your existing land right, do you see land expropriation for public purpose as a form of disturbance to other forms of rights you have in land?

_____

_____

_____

8. Payment of compensation is important because land expropriation lead to a change in the following socioeconomic circumstances of land owners.

Conditions for the development of disturbance-integrated method of compensation for land expropriation	Scale				
	5	4	3	2	1
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Land rights					
Buildings and immovable structures on land					
Ancestral heritage					
Family ties					
Businesses					
Expenditure patterns					
Livelihood from land					
Income from land					

9. To what extent do you agree that the money which government pays as compensation for land expropriation should include the value of the following elements?

Requirements for developing disturbance-integrated method of compensation	Scale				
	5	4	3	2	1
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
(Market value of) land, buildings, and immovable structures					
Removal cost					
Relocation cost					
Compensation for loss of livelihood on land					
Compensation for loss of income from land					
Compensation for psychological damages					
(Valuation of) other unique circumstances of affected land owner					

PART 2: CONTINGENT VALUATION SURVEY

10. On top of the market value compensation for land, buildings and structures which shall be left behind following the expropriation of your land right for Bugesera international airport, supposed you were offered ***X*** Frw (identify in the box below the stated amount) as compensation for disturbances would you accept?

WTA compensation for disturbances in Frw

500,000	750,000	1,000,000	1,250,000	1,500,000	1,750,000	2,000,000

€ 1.00 = 871.35 Frw as at October 2013
Frw = Rwandan Francs and € = Euro

WTA compensation for disturbances in Frw

2,250,000	2,500,000	2,750,000	3,000,000	3,250,000	3,500,000	3,750,000

€ 1.00 = 871.35 Frw as at October 2013
Frw = Rwandan Francs and € = Euro

(a) Accept [go to question 10 (b)] ☐ Reject [go to question 10 (c)] ☐

(b) Please reflect on the minimum compensation you can accept; what if you were offered (***X*** - 250,000)Frw will you still accept?
Accept [go to question 11] ☐ Reject [go to question 12] ☐

(c) What if a compensation of (***X*** + 500,000)Frw is offered instead, will you accept it this time?
Accept [go to question 11] ☐ Reject [go to question 12] ☐

Indicate respondent's minimum willingness to accept compensation: _____ Frw

11. You accept compensation offered for disturbances because you would spend money to:

Disturbance costs for which affected parties mitigate through incidental expenditure	Scale				
	5	4	3	2	1
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Pay for removal and dismantling of assets					
Pay for relocation to another site					
Avoid loss of livelihood derived from land					
Avoid loss of income from land					
Handle psychological stress associated with the expropriation					

12. Could you explain the reasons why you rejected the amount offered to you as compensation for disturbances arising from land expropriation?

_____

_____

PART 3: RESPONDENT'S PROFILE AND DISTURBANCES FROM EXPROPRIATION

I shall ask you the following questions in order to know more about your preference for compensation for disruptions/disturbances arising from land expropriations and importance you attach to specific factors that might have influenced your preference. I will emphasize again that all responses you provide shall be treated as strictly confidential.

13. What is your age (in years)?
Respondent's age in years ☐

14. Gender
☐ Female ☐ Male

15. You are:
☐ Single ☐ Married ☐ Widowed ☐ Separated

16. What is the highest level of education you have attained?
☐ Primary education ☐ Vocational/Technical ☐ Graduate degree (Masters/Doctoral)
☐ Secondary education ☐ Bachelors degree ☐ Others

Others please specify: _____

17. Are you employed?
☐ Yes ☐ No

18. Are you a member of any civil society group or non-governmental organization?
☐ Yes ☐ No
(If Yes go to question 19)

19. Name of civil society group or non-governmental organization for which you are a member:

_____

20. How many persons including yourself lived in your household before the expropriation? ☐

21. Following the expropriation of your land, how many days do you expect that it will take your household to dismantle movable assets in order to relocate them to an alternative land?

_____

22. Would you give any person some amount of money as payment for services rendered towards the dismantling of movable assets from the expropriated land?

☐ Yes ☐ No

23. After the expropriation notice, were you forced to sell any of your belongings because you will not be able to use them when you relocate to an alternative place?

☐ Yes ☐ No

24. What is the total number of trips you expect to make when packing your belongings to an another location? [Hint: A movement from one point to another point at a given instance is counted as a single trip]

_____

25. To what extent was your livelihood dependent on the land expropriated by government for the airport project?

☐ Highly dependent ☐ Partially dependent ☐ Highly independent

☐ Dependent ☐ Independent

26. Since the expropriation, how many months did you lose income from your land (if any)?

_____

27. For how many years have you lived on this land before it was expropriated?

_____

28. How important is the ancestral value you attach to the expropriated land?

☐ Very important ☐ Fairly important ☐ Not important

☐ Important ☐ Less important

29. How do you perceive the quality of your relationship with other members of your clan after vacating this land?

☐ Poor ☐ Good ☐ Excellent

☐ Fair ☐ Very good

30. Since the expropriation of your land, how much Rwanda Francs is your monthly household expenditure?

☐ Less than 135,000 ☐ 155,000 - 159,999 ☐ 180,000 - 184,999

☐ 135,000 - 139,999 ☐ 160,000 - 164,999 ☐ 185,000 - 189,999

☐ 140,000 - 144,999 ☐ 165,000 - 169,999 ☐ 190,000 - 194,999

☐ 145,000 - 149,999 ☐ 170,000 - 174,999 ☐ 195,000 - 199,999

☐ 150,000 - 154,999 ☐ 175,000 - 179,999 ☐ 200,000 and above.

PART 4: PERCEIVED EQUITY OF DISTURBANCE-INTEGRATED COMPENSATION METHOD

31. If a compensation method for land expropriation is designed to contain market value of land and buildings as well as payment for disturbances, kindly assess this method of calculating compensation based on the following statements.

Elements and indicators	Scale				
	5	4	3	2	1
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Equivalence					
The compensation method considers all entitlements of affected parties					
Undue advantage against affected parties is minimized					
Balance of interest					
The compensation method matches the interest of affected parties with that of the government					
The method matches the interest of affected parties with purpose of the expropriation					
Flexibility					
The method is an appropriate interpretation of expropriation laws					
With this method, it is flexible to identify items for which compensation should be paid.					
The method makes it flexible to determine value of items to be compensated.					
Inclusiveness					
This method recognizes compensation for land rights and other entitlements of legitimate land owners					
This method recognizes compensation for land rights and other entitlements of tenants and residents of informal settlement					
There is no limit to compensation for land rights and other losses suffered by legitimate landowners.					
There is no limit to compensation for land rights and other losses suffered by tenants and residents of informal settlement					
Fairness					
The application of this method leads to fair negotiation of compensation between affected parties and acquiring authority					
Compensation payment arising from the use of this method can support the poor and vulnerable groups					
The application of this method motivates prompt payment of compensation					
Entitlements included in this use of this method of compensation are reasonable					

Elements and indicators	Scale				
	5	4	3	2	1
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Transparency					
This method of compensation does not lead to poor quality of information exchange among stakeholders in land expropriation					
Corruption in compensation payment does not arise when this compensation method is utilized.					
The compensation method requires adequate facts from affected parties and the land market.					
This method does not underrate stakeholder involvement in compensation assessment.					

32. Do you have any other comment?

_____

_____

_____

_____

Thank you

Appendix 6: Contingent valuation survey and semi-structured interview

(B) Kinyarwanda version

UNIVERSITY OF TWENTE
FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

Land Administration Course

Contingent Valuation Survey and research interview questions [Kinyarwanda version]

Ijambo ry'ibanze

Umunsi mwiza. Amazina yanjye ni Joseph Obaje Ataguba. Nkaba ndi gukora ubushakashatsi bujyanye n'amasomo yanjye ya masters mu bijyanye n'imicungire y'ubutaka (Land Administration) mu bijyanye n'ubumenyi bw'isi n'imihindagurikire y'isi muri kaminuza ya Twente, mu Buhorandi. Umutwe w'ubushakashatsi bwanjye witwa "Gushaka uburyo bwo kunoza ingurane nyuma yo kwimura abantu hitawe ku gaciro k'ibyangiritse: Inyigo ku Rwanda". Ndabizeza umutekano usesuye ku bisobanuro muzampa cyane ko amazina yanyu nta na hamwe azagaragara kandi ndabasaba gufatanya nanyje bityo ubu bushakashatsi buzatange umusaruro ufatika.

Intego

Intego y'ubu bushakashatsi ni ukumenya uruhande rwanyu ku bijyanye:

- ibintu bigenderwaho mu gutanga agaciro k'ngurane mu kwimura abantu; na
- Agaciro uhabwa kuri ibyo bintu byose nyuma yo gukurwa ku butaka bwari ubwawe ngo leta ihubake ikibuga cy'indege.

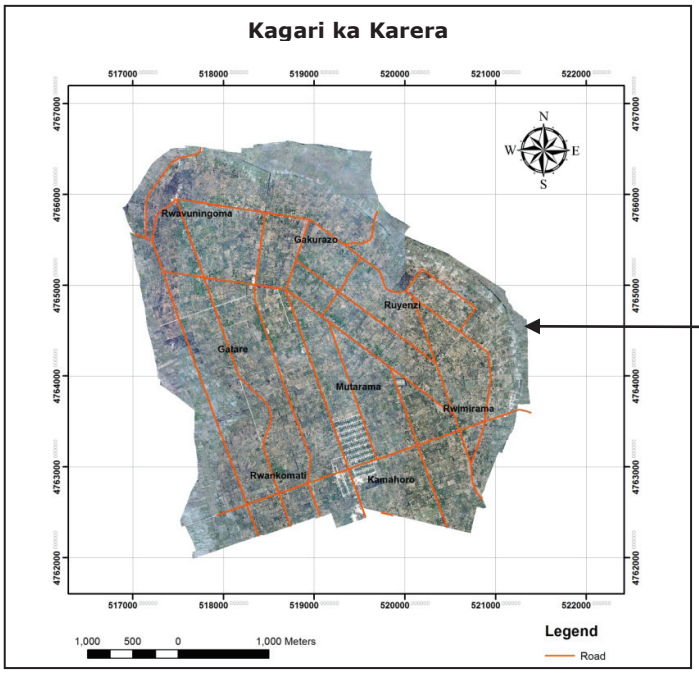
AMAKURU NKENERWA MU IBAZWA

Numero y'ubazwa: _____ No y'ipariseri: _____

Itariki: _____ Igihe: _____

IKIBAZO CY'AGACIRO

Kwimura abaturage ku nyungu rusange ni imwe mu nzira leta ikoresha mu rwego rwo gukomeza kongera ibikorwa remezo. Mu karere ka Bugesera, kwimura abantu bijyanye no gufasha leta mu bikorwa byo kubaka ikibuga cy'indege nkuko bigaragara ku ikarita ikurikira, Karera.



Ahakorerwa Inyigo

Kuberako ubutaka bwawe bwari buri aho leta yifuza kubaka ikibuga cy'indege, wowe n'umuryango wawe mugomba kwitegura kwimuka ndetse mukajyana ibyanyu byose bishobora kwimurwa. Kubw'ibyo, birashoboka ko amikoro yanyu mwayakuraga muri ubu butaka muri kwimurwamo noneho mukaba mugiye kubwimurwamo by'igihe runaka cyangwa burundu. Mu kwimurwa hakagombye gutangwa ingurane y'ayo mikoro yavaga muri ubwo buitaka. Birashoboka ko ibyari biri muri ubu butaka bwawe muri ubu butaka bwose bugiye kubakwamo ikibuga cy'indege bizateza imihindagurikire mu mibereho yawe no mu mibanire yawe n'abandi cyane ku baturanyi. Niyo mpamvu nasobanuye ko ari akajagari gatewe no kwimurwa kw'abantu.

Abashinzwe gutanga agaciro ku mitungo bamaze kugena ikiguzi cy'ubutaka, inyubako ndetse n'indi mitungo yose yimukanwa ndetse bagena ingurane ariko bigaragara ko mugifite ikibazo cyuko ingurane mwahawe igomba kongerwaho andi mafaranga mwatakaje mu rwego rwo kugabanya ingaruka zatejwe n'iryo yimurwa ryavuzwe hejuru.

Ndifuza gushimangira ko iri bazwa ari inyigo izifashishwa mu kwegeranya amakuru ku bijyanye n'ibyifuzo byanyu mu guhabwa ingurane hanashingiwe ku kaduruvayo katewe n'iyimurwa, nyuma yo kureba ibiciro ku isoko ry'ubutaka n'inyubako byamaze kubarwa n' ababifite mu inshingano.

Muri iri bazwa, nzabaza ibibazo ku bijyanye n'uburyo mwakira ingurane **(willingness to accept, WTA compensation)** nk'igisubizo cy'iyimurwa hagamijwe kubaka ikibuga cy'indege. Mu gihe musubiza ibi ibibazo muri iri bazwa, ndifuza kubibutsa ko nk'izindi ngo zose zatakaje ubutaka bwazo bitewe n'uyu mushinga w'iyubakwa ry'ikibuga cy'indege, ingano y'amafaranga urugo rutakaza ntabwo yakagombye kujye hejuru y'ayo rwinjiza nyuma yo kwimurwa. Mwakagombye kuzirikana kandi ko ingo zanyu zifite amafaranga agenewe gukoreshwa ibindi bintu bitari igihombo gituruka kuri uko kwimurwa.

IGICE CYA 1: INGURANE NK'IGISUBIZO KU IYIMURWA

1. Ni hafi y'uwuhe muhanda umutungo wawe wari uherereye mbere yuko wimurwa?
   - ☐ Hafi y'ubwiza nyaburanga
   - ☐ Umuhanda w'ibitaka
   - ☐ Umuhanda ukozwe n'amabuye
   - ☐ Umuhanda wa kaburimbo

2. ubutaka bwawe bwakorerwagamo iki mbere yo kwimurwa?
   - ☐ Ubuhinzi bwonyine
   - ☐ Imiturire yonyine
   - ☐ Ubucuruzi bwonyine
   - ☐ Ibindi, sobanura: _____
   - ☐ Imiturire n'ubuhinzi
   - ☐ Imiturire n'ubucuruzi
   - ☐ inganda

3. Ese wagize uruhare mu guha agaciro umutungu wawe ugiye kwimurwa?
   ☐ Yego ☐ Oya (Niba ari Yego subiza 4. Niba ari Oya subiza 5)

4. Ni gute wagize uruhare muri icyo gikorwa cyo guha agaciro ku mutungo wawe?

   _____
   _____
   _____

5. Ku bushake bwawe sobanura icyari kuba icyifuzo cyawe mu guha agaciro ubutaka bwawe n'inyubako zari zirimo?

   _____
   _____
   _____

6. Ese ubuyobozi bwa leta bwaba bwarakubwiye agaciro kahawe umutungo wawe?
☐ Yego ☐ Oya

7. Uretse kuba uburenganzira mwahoranye ku butaka bwararangiye, ese mubona kuba mwarimuwe ku bw'inyungu rusange ari iyangizwa ry'ubundi burenganzira mufite ku butaka?

_____

_____

8. Inyishyu y'ingurane ni ingenzi kuko iyimurwa ritanga impinduka mu mihahiranire ikurikira ya ba nyir'ubutaka.

Impanvu zo gushaka uburyo bwo kunoza ingurane nyuma yo kwimura abantu hitawe ku gaciro k'ibyangiritse	Igipimo				
	5	4	3	2	1
	Nibyo cyane	Nibyo	Nibyo ariko si nabyo	Sibyo	Sibyo na gato
Uburenganzira ku butaka					
Inyubako n'indi mitungo itimukanwa ku butaka					
Umurage gakondo					
Umuryango mugari					
Imirimo					
Uburyo bwo gutakazamo amafaranga					
Imirimo yinjiza ibiva mu butaka					
Umusaruro uva mu butaka					

9. Ni kukihe gipimo wemerako amafaranga leta yishyura ku ngurane nyuma kwimura abantu haba harimo agaciro k'ibi bintu bikurikira?

Ibigize uburyo bwo kunoza ingurane nyuma yo kwimura abantu hitawe ku gaciro k'ibyangiritse	Igipimo				
	5	4	3	2	1
	Nibyo cyane	Nibyo	Nibyo ariko si nabyo	Sibyo	Sibyo na gato
(Igicro ku isoko ry') ubutaka, inyubako, n'indi mitungo itimukanwa					
Agaciro k'ibyimuwe					
Ikiguzi gitangwa mu kwimuka					
Ingurane ku gutakaza imirimo yinjiza ibiva mu butaka					
Ingurane ku gutakaza umusaruro uva mu butaka					
Ingurane ku mpungenge					
(Agaciro ku) kindi kintu cyihariye kuri nyir'ubutaka.					

IGICE CYA 2: IGENZURA KU GACIRO GASABWA

10. Hejuru y'agaciro k'ingurane ku butaka, Inyubako n'indi mitungo itimukanwa ku butaka nyuma yo kwimurwa ku burenganzira bw'ubutaka bwawe ku kibuga cy'indege cya Bugesera, dufate ko baguhaye ***X*** Frw (Hitamo ayo wumva wakwifuza muri iyi mbonerahamwe ikurikira) nk'ingurane ku kwimurwa wumva wakwemera?

ku bijyanye n'uburyo mwakira ingurane mu manyarwanda (WTP in Frw)

500,000	750,000	1,000,000	1,250,000	1,500,000	1,750,000	2,000,000

€ 1.00 = 871.35 Frw nko mu kwa cumi 2013
Frw = Rwandan Francs na € = Euro

ku bijyanye n'uburyo mwakira ingurane mu manyarwanda (WTP in Frw)

2,250,000	2,500,000	2,750,000	3,000,000	3,250,000	3,500,000	3,750,000

€ 1.00 = 871.35 Frw nko mu kwa cumi 2013
Frw = Rwandan Francs na € = Euro

(a) Kwakira [jya ku kibazo cya 10 (b)] ☐ (b) Kwanga [jya ku kibazo cya 10 (c)] ☐

(b) Gerageza gutekereza ku ngurane nke yanyuma ushobora kwemera; wabyakira ute baguhaye (***X*** - 250,000)Frw wumva wakwemera?
Kwakira [jya ku kibazo cya 11] ☐ Kwanga [jya ku kibazo cya 12] ☐

(c) Wabyakira ute ingurane ya (***X*** + 500,000)Frw ariyo uhawe, ese iki gihe wabyemera?
Kwakira [jya ku kibazo cya 11] ☐ Kwanga [jya ku kibazo cya 12] ☐

Garagaza ayo wumva wakwemera kwakira nk'ingurane: _____ Frw

11. Wemera ingurane uhawe ku kwimurwa kuko ushaka gukoresha ayo mafaranga mu:

Ibijyanye n'iyimurwa abantu batakazaho amafaranga ngo bigabanuke	Igipimo				
	5	4	3	2	1
	Nibyo cyane	Nibyo	Nibyo ariko si nabyo	Sibyo	Sibyo na gato
Kwishyura ibyimuwe ku mutungo nyawo					
Kwishyura ahandi hantu ugiye gutura					
Kwirinda igihombo cyava mu mirimo iva mu butaka					
Kwirinda igihombo cy'umusaruro uva mu butaka					
Guhangana n'umunaniro wo mu mutwe uterwa no kwimurwa					

12. Ese wasobanura mpamvu ki utanyuzwe n'amafaranga wahawe nk'ingurane ku byabaye byose byatewe n'iyimurwa?

_____

_____

_____

IGICE CYA 3: ISHUSHO Y'ABABAZWA NDETSE N'IBIBAZO BITERWA NO KWIMURWA

Ndabaza ibi bibazo mu rwego rwo kumenya byinshi ku bijyanye n'ibyifuzo byanyu ku ngurane y'ibibazo byose byatewe n'iyimurwa ndetse n'inyungu mushingiraho mukora ayo mahitamo. Ndashimangira kandi ko ibisubizo byose mutanga bizigwaho ku buryo bwizewe.

13. Ufite imyaka ingahe (mu myaka)?
imyaka y'ababazwa mu myaka ☐

14. Igitsina
☐ Umugore ☐ Umugabo

15. Uri:
☐ ingaruka ☐ Urubatse ☐ umupfakazi ☐ Watandukanye n'uwo mwashakanye

16. Ni uruhe rwego rwo hejuru wagarukiyeho mu myigire yawe?
☐ Amashuri abanza ☐ Imyuga ☐ Masters/Doctoral
☐ Amashuri yisumbuye ☐ Kaminuza ☐ Ayandi

Sobanura ayo yandi: _____

17. Ufite akazi?
☐ Yego ☐ Oya

18. Hari irindi huriro ubamo ryihariye cyangwa irindi ritari irya leta ?
☐ Yego ☐ Oya
(Niba aribyo jya ku kibazo cya 19)

19. Izina ry'ihuriro ryihariye cyangwa irindi ritari irya leta:

_____

20. Mwari bangahe mu rugo rwanyu mbere y'iyimurwa? ☐

21. Nyuma yuko mwimuwe, ni iminsi ingahe bizafata imiryango yanyu kwimura imitungo yimukanwa mu rwego rwo kiyishyira ahandi mugiye gutura?

_____

22. Ese hari umuntu waba uzishyura amafaranga mu rwego rwo kugufasha kwimura imwe mu mitungo yimukanwa muyivana aho mwabaga batarabimura?
☐ Yego ☐ Oya

23. Nyuma y'itangazo ry'iyimurwa, waba warasanze ukwiye kugurisha bimwe mu byari ibyawe ubitewe nuko utari bushobore gukomeza kubikoresha uri aho utuye ubu?
☐ Yego ☐ Oya

24. Ni inshuro zingana zite wasabwaga gukora igihe warimo gutunda imitungo yawe uyimurira ahandi hantu?[Ubusobanuro: Kuva ahantu hamwe muri aho hombi ujya ahandi bibarwa nk'inshuro imwe]

_____

25. Ni kuruhe rugero ubutaka bwawe bwari bugufutire runini mbere yuko wimurirwa gutura ahandi?
☐ Bwambeshagaho bikomeye ☐ Bwambeshagaho gake ☐ Ntibwambeshagaho na gato
☐ Bwambeshagaho ☐ ntibwambeshagaho

26. Mu gihe cy'iyimurwa, ni ameze angana iki watakaze mu kubyaza umusaruro ubutaka bwawe (angina iki)?

_____

27. Wari umaze imyaka ingahe uba kuri ubu buraka bakwimuyeho?

_____

28. Ni agaciro kangana iki ubu butaka bufite nk'isano hagati yawe n'abasekuruza bawe?

☐ Ni ingenzi cyane ☐ Ingenzi mu rugero ☐ Si ingenzi
☐ Ingenzi ☐ Ingenzi gake

29. Utekereza ko imiterere y'isano hagati yawe n'abandi banyamuryango izamera ite nyuma yo kuba warimutse ku butaka wahozeho?

☐ Mbi ☐ Nziza ☐ Nziza birenze
☐ Mu rugero ☐ Nziza cyane

30. Mu kwimurwa ku butaka bwawe, ni amafaranga y'u Rwanda angahe watanze mu kwezi kumwe ngo wite ku muryango wawe ?

☐ Munsi ya 135,000 ☐ 155,000 - 159,999 ☐ 180,000 - 184,999
☐ 135,000 - 139,999 ☐ 160,000 - 164,999 ☐ 185,000 - 189,999
☐ 140,000 - 144,999 ☐ 165,000 - 169,999 ☐ 190,000 - 194,999
☐ 145,000 - 149,999 ☐ 170,000 - 174,999 ☐ 195,000 - 199,999
☐ 150,000 - 154,999 ☐ 175,000 - 179,999 ☐ 200,000 kuzamura.

IGICE CYA 4: KUTABOGAMA ABATURAGE BIFUZA MU BIJYANYE NO GUHABWA INGURANE MU KWISHYURWA NYUMA YO KWIMURWA

31. Niba uburyo bw'ingurane ku butaka bwimuweho abantu bwarashyiriweho isoko ry'agaciro k'ubutaka n'inyubako; n'inyishyu ku kwimurwa kw'abaturage, ni byiza gusuzuma ubu uburyo bwo kubara ingurane hashingiwe ku ntego zikurikira:

Iby'ibanze n' ibirango	Igipimo				
	5	4	3	2	1
	Nibyo cyane	Nibyo	Nibyo ariko si nabyo	Sibyo	Sibyo na gato
Isano					
Uburyo bw'ingurane bukubiyemo ibintu byose bifitanye isano n'abagenerwabikorwa					
Ubushobozi bwo kuriganya abagenerwabikorwa buragabanuka					
Ikigereranyo cy'ibikenewe					
Uburyo bw'ingurane busanisha n'inyungu z'abagenerwabikorwa n'iza leta					
Ubu buryo busanisha inyungu z'abagenerwabikorwa n'igitekerezo cy'iyimurwa					

Iby'ibanze n' ibirango	Igipimo				
	5	4	3	2	1
	Nibyo cyane	Nibyo	Nibyo ariko si nabyo	Sibyo	Sibyo na gato
Ubwumvikane					
Ubu nibwo buryo bwiza bwo gusobanura itegeko ry'iyimurwa					
Birumvikana kugaragaza ingingo ngenderwaho mu kwishyura ingurane					
Ubu buryo bworoshya itangwagaciro ry'ibintu bigiye kwishyurwa ku ngurane					
Ibihuriweho					
Ubu buryo bwifashisha ingurane y' burenganzira ku butaka ndetse n'igiciro kigenwe na nyir'ubutaka					
Ubu buryo bwifashisha ingurane y'uburenganzira ku butaka ndetse n'ikindi kiguzi cy'ahandi hantu ho kuba hacirirtse					
Nta mupaka ku mategeko agenga ingurane y' burenganzira ku butaka ndetse n'ikindi kiguzi cy'ahantu ho guturwa.					
Nta mupaka ku mategeko agenga ingurane y' burenganzira ku butaka ndetse n'ikindi kiguzi cy'ahantu ho kuba hacirirtse					
Ubutabera					
Ikoreshwa ry'ubu buryo ryoroshya ubwumvikane hagati y'abagenerwabikorwa na leta					
Iyo ubu buryo buri gukoreshwa, ingurane yishyuwe yifashishwa mu gufasha abakene					
Ubu buryo kandi bufasha mu kwihutisha iyishyurwa ry'ingurane					
Ibiri muri ubu buryo bwo kwishyura ingurane birasobanutse					
Umucyo					
Ubu buryo bwo gutanga ingurane ntabwo bushingira ku makuru apfuye atanzwe hagati y'abagenerwabikorwa mu iyimurwa.					
Ruswa mu kwishyurwa kw'ingurane ntabwo igomba kubaho mu gihe ubu buryo buri gukoreshwa					
Uburyo bw'ingurane busaba ibimenyetso bifatika bivuye ku bagenerwabikorwa ndetse no ku isoko ry'ibutaka					
Ubu buryo ntabwo butesha agaciro ibitekerezo by'abagenerwabikorwa mu gufata inyanzuro ku ngurane					

32. Hari ikindi wongeraho?

_____

_____

_____

_____

Murakoze!

Appendix 7: Responses from expropriated landowners concerning expropriation as a disturbance

Question 7. Apart from bringing an end to your existing land right, do you see land expropriation for public purpose as a form of disturbance to other forms of rights you have in land?					
Respondent (Landowner's) ID [a.]	Response	Respondent (Landowner's) ID [a.]	Response	Respondent (Landowner's) ID [a.]	Response
07	I do not see it as a disturbance. The only problem is that the compensation which has been assessed for my property is not sufficient to purchase an alternative property.	12	I do see land expropriation as a form of disturbance. For instance, government stopped us from carrying out our activities on land after the expropriation, in addition, we cannot even grow cash crops.	17	Yes
08	There are disturbances associated with land expropriation. My economic condition has worsened. The assessed compensation is not adequate enough to enable me purchase an alternative land elsewhere.	13	I see land expropriation as a form of disturbance to land rights. For instance, since the expropriation for the international airport, we cannot build houses any longer because of the restrictions placed by the government.	18	Yes
09	There are disturbance associated with land expropriation. For instance, my economic condition shall worsen as a result of the expropriation. Furthermore, the problem of delayed payment has been compounded by inflation. Therefore, the government should add another money on top of the assessed compensation in order to take care of the problem of inflation and delayed payment.	14	For me, land expropriation constitute a form of disturbance to land rights because after the expropriation for the airport project in Bugesera, we cannot enjoy our land rights like before; We cannot even expand our business on land any longer.	19	Yes
10	I do not see any disturbance associated with expropriation for public interest. But It will be more appropriate if my land is valued properly so that I can be confident to purchase an alternative land in another location. Moreover, we have lost access to our forest and natural resources and I doubt if I can still have access to forest and these resources when I relocate to another land.	15	Yes	20	Yes
11	I do not see it as a form of disturbance.	16	Yes	21	Yes

Refer to question 7 in Appendices 6A and 6B

a. Respondents were numbered according to the sequence in which they were interviewed during field work

Appendix 7: Interview responses from expropriated landowners concerning expropriation as a disturbance (continued)

Question 7. Apart from bringing an end to your existing land right, do you see land expropriation for public purpose as a form of disturbance to other forms of rights you have in land?					
Respondent (Landowner's) ID [a.]	Response	Respondent (Landowner's) ID [a.]	Response	Respondent (Landowner's) ID [a.]	Response
22	Yes	29	Not at all	36	Yes
23	Yes	30	No	37	Yes
24	Yes	31	For me to vacate my land, I have to get compensated.	38	Yes
25	Yes	32	I do not see it as such	39	Yes. I see land expropriation as a form of disturbance. For instance, I will end up losing contact with my family members. It is possible that life at the alternative location may be very difficult for me. Furthermore, I believe I will not be able make the same income I make from my land before the expropriation.
26	Yes	33	No	40	Yes
27	Not at all	34	Yes. I really see land expropriation as a form of disturbance to land rights.	41	Yes. While the government had told us to relocate following the expropriation, there are disturbances associated with this.
28	I do not see it as such.	35	Yes	42	Yes. There are disturbance associated with land expropriation.

Refer to question 7 in Appendices 6A and 6B

a. Respondents were numbered according to the sequence in which they were interviewed during field work

Appendix 8: Data for calibration of logistic model of disturbance compensation

Respondent ID[a.]	Design Case	OCM1	BID1	OCM2	BID2	AGE	GEN	HSE	EDU	NRT	HSS	TDA	LDL	CML	DUR	AAE	QFT
07	1	0	1,500,000	0	2,000,000	35	1	2	2	6	6	45	5	24	29	5	1
08	2	0	2,000,000	0	2,500,000	38	1	2	2	6	6	60	5	24	12	4	1
09	3	1	3,250,000	0	3,000,000	45	1	2	2	6	5	60	5	24	35	4	3
10	4	0	1,000,000	0	1,500,000	65	1	3	3	6	9	90	5	24	34	5	1
11	5	0	750,000	1	1,250,000	31	1	1	2	6	5	90	4	18	28	5	3
12	6	0	1,500,000	0	2,000,000	27	1	1	3	4	3	90	5	18	24	5	1
14	7	1	2,750,000	1	2,500,000	39	1	1	4	4	5	90	5	18	36	5	1
15	8	1	3,500,000	0	3,250,000	49	0	1	2	7	6	150	5	48	28	5	1
16	9	1	2,000,000	0	1,750,000	30	1	1	2	4	7	90	5	48	26	5	1
18	10	0	2,750,000	0	3,250,000	45	1	1	4	8	5	120	5	48	41	5	1
19	11	0	1,000,000	0	1,500,000	40	0	1	2	10	6	90	5	48	11	5	1
20	12	1	750,000	0	500,000	38	0	1	2	2	3	90	5	48	1	5	1
21	13	0	1,500,000	0	2,000,000	23	1	1	2	1	4	90	5	48	20	5	1
22	14	0	3,000,000	0	3,500,000	59	1	2	2	8	7	90	5	48	36	5	1
23	15	0	1,750,000	0	2,250,000	77	1	1	1	8	3	90	5	48	73	5	1
24	16	1	3,250,000	1	3,000,000	51	1	1	2	10	10	90	5	48	22	5	1
25	17	1	1,250,000	0	1,000,000	36	1	1	2	3	5	90	5	48	32	5	1
26	18	0	2,500,000	0	3,000,000	48	1	1	1	4	7	90	5	48	31	5	1
27	19	1	1,250,000	0	1,000,000	41	1	2	2	4	8	90	5	12	38	5	1
28	20	0	2,750,000	1	3,250,000	53	1	2	1	4	6	90	5	12	42	5	1
30	21	0	750,000	1	1,250,000	33	1	1	2	4	7	60	5	72	30	4	1
31	22	1	3,000,000	1	2,750,000	32	1	2	2	4	6	120	5	72	29	1	1
32	23	1	2,250,000	1	2,000,000	47	0	1	4	4	6	90	5	72	13	5	3
34	24	1	2,000,000	1	1,750,000	32	1	2	2	4	6	60	5	24	13	1	3
35	25	1	2,750,000	1	2,500,000	30	1	1	2	6	4	30	5	24	5	5	3
36	26	0	750,000	1	1,250,000	26	1	3	2	10	3	60	5	24	10	1	1
37	27	1	2,500,000	1	2,250,000	28	1	2	2	4	3	90	5	24	5	1	1
39	28	0	1,750,000	1	2,250,000	54	0	1	1	10	10	90	5	36	31	5	1
40	29	1	2,000,000	0	1,750,000	60	1	1	2	1	9	60	5	36	35	5	1
41	30	1	3,000,000	0	2,750,000	75	1	1	1	1	9	90	5	36	39	4	1
42	31	0	1,250,000	0	1,750,000	24	0	1	2	3	3	60	5	36	3	5	1

a. Respondents were numbered according to the sequence in which they were interviewed during field work

Appendix 9: Data for validating logistic model of disturbance compensation

Respondent ID[a.]	Validation Case	OCM1	BID1	OCM2	BID2	AGE	GEN	HSE	EDU	NRT	HSS	TDA	LDL	CML	DUR	AAE	QFT
13	1	1	1,750,000	0	1,500,000	60	1	1	2	6	11	90	5	18	43	1	1
17	2	0	2,250,000	0	2,750,000	80	1	1	1	10	5	120	5	48	76	5	1
29	3	1	2,500,000	1	2,250,000	27	0	1	1	4	5	90	5	12	25	5	1
33	4	1	1,500,000	1	1,250,000	66	0	2	1	4	3	120	5	72	41	1	1
38	5	1	3,000,000	1	2,750,000	38	1	3	2	4	6	90	5	24	12	1	3

a. Respondents were numbered according to the sequence in which they were interviewed during field work

Appendix 10: Market value data for land, buildings and farm crops

Respondent ID[a.]	Market value compensation in Frw			Total
	Land	Buildings	Crops	
07	82,800.00	407,802.00	2,268,298.00	2,758,900.00
08	82,800.00	221,874.00	3,578,929.00	3,883,603.00
09	82,800.00	566,849.00	2,706,434.00	3,356,083.00
10	96,600.00	113,420.00	5,185,283.00	5,395,303.00
11	33,137.00	459,962.00	1,197,431.00	1,690,530.00
12	267,440.00	15,465.00	0.00	282,905.00
13	1,856,100.00	2,985,204.00	1,457,131.00	6,298,435.00
14	436,494.00	1,213,112.00	1,627,226.00	3,276,832.00
15	1,752,600.00	631,470.00	1,581,505.00	3,965,575.00
16	82,800.00	821,837.00	929,207.00	1,833,844.00
17	277,656.00	715,567.00	1,623,752.00	2,616,975.00
18	320,121.00	830,638.00	833,909.00	1,984,668.00
19	2,519,328.00	4,343,226.00	3,044,150.00	9,906,704.00
20	137,338.00	301,325.00	0.00	438,663.00
21	1,111,590.00	1,594,246.00	1,408,445.38	4,114,281.38
22	1,380,000.00	3,761,583.00	2,858,041.97	7,999,624.97
23	1,949,871.00	4,530,115.00	1,160,665.52	7,640,651.52
24	2,760,000.00	11,921,024.00	4,179,463.71	18,860,487.71
25	20,700.00	457,315.00	1,159,274.50	1,637,289.50
26	2,634,006.00	3,944,563.00	2,784,739.94	9,363,308.94
27	812,191.00	1,212,227.00	2,636,025.00	4,660,443.00
28	140,732.00	314,600.00	1,572,235.00	2,027,567.00
29	118,238.00	108,255.00	1,105,260.00	1,331,753.00
30	643,317.00	895,191.00	1,335,082.00	2,873,590.00
31	35,732.00	16,886.00	3,430,947.00	3,483,565.00
32	536,268.00	230,164.00	356,195.00	1,122,627.00
33	2,235,835.00	1,168,745.00	3,845,680.00	7,250,260.00
34	1,299,491.00	993,214.00	3,810,053.00	6,102,758.00
35	140,760.00	152,233.00	0.00	292,993.00
36	138,000.00	196,314.00	3,292,588.00	3,626,902.00
37	95,717.00	98,887.00	0.00	194,604.00
38	114,959.00	123,372.00	4,601,967.00	4,840,298.00
39	82,800.00	503,898.00	2,655,965.90	3,242,663.90
40	2,628,072.00	2,236,964.00	2,416,695.80	7,281,731.80
41	590,943.60	725,104.00	1,345,039.40	2,661,087.00
42	774,814.80	600,156.00	2,446,476.30	3,821,447.10

Source: Landmark Ltd, Kigali. Valuation report on land required for construction of Bugesera international airport and related facilities, May 2013

a. Respondents were numbered according to the sequence in which they were interviewed during field work

Appendix 11: Model statistics for outcome of 1st bid of WTAC for disturbances

Iteration History

Iteration		-2 Log likelihood	Coefficients						
			Constant	BID1	GEN	EDU	NRT	HSS	AAE	QFT
Step 1	1	26.004	-0.260	0.000001	-1.018	0.346	-0.329	0.196	-0.402	0.565
	2	22.192	-0.933	0.000001	-1.912	0.793	-0.577	0.456	-0.670	1.130
	3	20.052	-2.035	0.000002	-3.121	1.377	-0.911	0.825	-0.980	1.936
	4	19.193	-3.263	0.000002	-4.321	1.927	-1.281	1.205	-1.277	2.725
	5	19.051	-4.002	0.000003	-5.094	2.265	-1.494	1.418	-1.456	3.193
	6	19.046	-4.165	0.000003	-5.277	2.341	-1.540	1.463	-1.497	3.301
	7	19.046	-4.172	0.000003	-5.285	2.345	-1.542	1.465	-1.499	3.306
	8	19.046	-4.172	0.000003	-5.285	2.345	-1.542	1.465	-1.499	3.306

Initial -2 Log Likelihood = 42.943
Estimation terminated at iteration number 8 because parameter estimates changed by less than 0.001.

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	23.897	7	0.001
	Block	23.897	7	0.001
	Model	23.897	7	0.001

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	19.046[a]	0.537	0.717

a. Estimation terminated at iteration number 8 because parameter estimates changed by less than 0.001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	11.396	8	0.180

Classification Table[a]

Observed		Predicted		
		OCM1		Percentage Correct
		No	Yes	
OCM1	No	15	1	93.8
	Yes	13	12	80.0
Overall Percentage				87.1

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	BID1	0.000003	0.000	3.621	1	0.057	1.000	1.000	1.000
	GEN	-5.285	3.065	2.973	1	0.085	0.005	0.000	2.060
	EDU	2.345	1.408	2.773	1	0.096	10.429	0.660	164.712
	NRT	-1.542	0.760	4.116	1	0.042	0.214	0.048	.949
	HSS	1.465	0.786	3.474	1	0.062	4.327	0.927	20.198
	AAE	-1.499	1.051	2.033	1	0.154	0.223	0.028	1.753
	QFT	3.306	1.945	2.889	1	0.089	27.279	0.603	1234.305
	Constant	-4.172	5.566	0.562	1	0.454	0.015		

a. Variable(s) entered on step 1: BID1, GEN, EDU, NRT, HSS, AAE, QFT.

Casewise List[b]

Case	Selected Status[a]	Observed	Predicted	Predicted Group	Temporary Variable	
		OCM1			Resid	ZResid
17	S	Y**	0.064	N	0.936	3.814

a. S = Selected, U = Unselected cases, and ** = Misclassified cases.
b. Cases with studentized residuals greater than 2.000 are listed.

Appendix 12: Model statistics for outcome of 2nd bid of WTAC for disturbances

Iteration History

Iteration		-2 Log likelihood	Coefficients			
			Constant	BID2	AAE	QFT
Step 1	1	31.068	0.820	0.0000001	-0.620	0.857
	2	30.388	1.449	0.0000002	-0.856	1.115
	3	30.355	1.745	0.0000002	-0.931	1.151
	4	30.355	1.782	0.0000002	-0.939	1.152
	5	30.355	1.782	0.0000002	-0.939	1.152

Initial -2 Log Likelihood = 41.381
Estimation terminated at iteration number 5 because parameter estimates changed by less than 0.001.

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	11.026	3	0.012
	Block	11.026	3	0.012
	Model	11.026	3	0.012

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	30.355[a]	0.299	0.406

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	7.580	8	0.476

Classification Table[a]

Observed		Predicted		
		OCM2		Percentage Correct
		No	Yes	
OCM2	No	18	1	94.7
	Yes	5	7	58.3
Overall Percentage				80.6

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	BID2	0.0000002	0.000	0.094	1	0.759	1.000	1.000	1.000
	AAE	-0.939	0.497	3.565	1	0.059	0.391	0.148	1.036
	QFT	1.152	0.638	3.263	1	0.071	3.164	0.907	11.043
	Constant	1.782	2.744	0.422	1	0.516	5.942		

a. Variable(s) entered on step 1: BID2, AAE, QFT.

Casewise List[b]

Case	Selected Status[a]	Observed	Predicted	Predicted Group	Temporary Variable	
		OCM2			Resid	ZResid
3	S	N**	0.883	Y	-0.883	-2.754

a. S = Selected, U = Unselected cases, and ** = Misclassified cases.
b. Cases with studentized residuals greater than 2.000 are listed.

Appendix 13: Diagnostics and validation of assumptions for Logit model 1

13.1 Classification plot for Logit model 1

```
            Step number: 1

            Observed Groups and Predicted Probabilities

       8 +                                                                                                    +
         I                                                                                                    I
         I                                                                                                   YI
F        I                                                                                                   YI
R      6 +                                                                                                   Y+
E        I                                                                                                   YI
Q        I                                                                                                   YI
U        I                                                                                                   YI
E      4 +N                                                                                                  Y+
N        IN                                                                                                  YI
C        IN                                                                                                  YI
Y        IN                                                                                                  YI
       2 +N         N                                           Y                                            Y+
         IN         N                                           Y                                            YI
         INN    YN  N   N    N  N       N        Y NN Y   N     N               Y                  Y Y      YYI
         INN    YN  N   N    N  N       N        Y NN Y   N     N               Y                  Y Y      YYI
Predicted ---------+---------+---------+---------+---------+---------+---------+---------+---------+----------
  Prob:   0       .1        .2        .3        .4        .5        .6        .7        .8        .9         1
  Group:  NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY

          Predicted Probability is of Membership for Yes
          The Cut Value is .50
          Symbols: N - No
                   Y - Yes
          Each Symbol Represents .5 Cases.
```

13.2 Multicollinearity of test for Logit model 1 regressors

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	BID1	0.906	1.104
	GEN	0.893	1.119
	EDU	0.925	1.081
	NRT	0.957	1.045
	HSS	0.833	1.200
	AAE	0.858	1.166
	QFT	0.930	1.075

a. Dependent Variable: OCM1

13.3: Durbin-Watson test for independence of errors in Logit model 1

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.691[a]	0.477	0.318	0.419	2.211

a. Predictors: (Constant), BID1, GEN, EDU, NRT, HSS, AAE, QFT,
b. Dependent Variable: OCM1

Appendix 14: Estimated compensation for sample of landowners

	A	B	C	D	E	F	G	H	I
1	Respondent ID	Bid data for contingent valuation of disturbance entitlements					Estimated disturbance compensation[a.]	Market value compensation for real (estate) property[b.]	Disturbance-integrated compensation[c.]
2		Bid sequence		Response (1st - 2nd)	Expected range of WTAC for disturbance	Upper bound of bid amount			
		1st bid	2nd bid						
3	07	1,500,000	2,000,000	No - No	WTA > 2,000,000	+Infinity	1,718,700	2,758,900.00	4,477,600.00
4	08	2,000,000	2,500,000	No - No	WTA > 2,500,000	+Infinity	1,718,700	3,883,603.00	5,602,303.00
5	09	3,250,000	3,000,000	Yes - No	3,000,000 < WTA ≤ 3,250,000	3,250,000	1,715,300	3,356,083.00	5,071,383.00
6	10	1,000,000	1,500,000	No - No	WTA > 1,500,000	+Infinity	1,718,700	5,395,303.00	7,114,003.00
7	11	750,000	1,250,000	No - Yes	750,000 < WTA ≤ 1,250,000	1,250,000	1,178,500	1,690,530.00	2,869,030.00
8	12	1,500,000	2,000,000	No - No	WTA > 2000000	+Infinity	1,718,700	282,905.00	2,001,605.00
9	13	1,750,000	1,500,000	Yes - No	1,500,000 < WTA ≤ 1,750,000	1,750,000	1,503,800	6,298,435.00	7,802,235.00
10	14	2,750,000	2,500,000	Yes - Yes	WTA ≤ 2,500,000	2,500,000	1,688,300	3,276,832.00	4,965,132.00
11	15	3,500,000	3,250,000	Yes - No	3,250,000 < WTA ≤ 3,500,000	3,500,000	1,717,100	3,965,575.00	5,682,675.00
12	16	2,000,000	1,750,000	Yes - No	1,750,000 < WTA ≤ 2,000,000	2,000,000	1,600,000	1,833,844.00	3,433,844.00
13	17	2,250,000	2,750,000	No - No	WTA > 2,750,000	+Infinity	1,718,700	2,616,975.00	4,335,675.00
14	18	2,750,000	3,250,000	No - No	WTA > 3,250,000	+Infinity	1,718,700	1,984,668.00	3,703,368.00
15	19	1,000,000	1,500,000	No - No	WTA > 1,500,000	+Infinity	1,718,700	9,906,704.00	11,625,404.00
16	20	750,000	500,000	Yes - No	500,000 < WTA ≤ 750,000	750,000	734,080	438,663.00	1,172,743.00
17	21	1,500,000	2,000,000	No - No	WTA > 2,000,000	+Infinity	1,718,700	4,114,281.38	5,832,981.38
18	22	3,000,000	3,500,000	No - No	WTA > 3,500,000	+Infinity	1,718,700	7,999,624.97	9,718,324.97
19	23	1,750,000	2,250,000	No - No	WTA > 2,250,000	+Infinity	1,718,700	7,640,651.52	9,359,351.52
20	24	3,250,000	3,000,000	Yes - Yes	WTA ≤ 3,000,000	3,250,000	1,711,600	18,860,487.71	20,572,087.71
21	25	1,250,000	1,000,000	Yes - No	1,000,000 < WTA ≤ 1,250,000	1,250,000	1,178,500	1,637,289.50	2,815,789.50
22	26	2,500,000	3,000,000	No - No	WTA > 3,000,000	+Infinity	1,718,700	9,363,308.94	11,082,008.94
23	27	1,250,000	1,000,000	Yes - No	1,000,000 < WTA ≤ 1,250,000	1,250,000	1,178,500	4,660,443.00	5,838,943.00
24	28	2,750,000	3,250,000	No - Yes	2,750,000 < WTA ≤ 3,250,000	3,250,000	1,715,300	2,027,567.00	3,742,867.00
25	29	2,500,000	2,250,000	Yes - Yes	WTA ≤ 2,250,000	2,250,000	1,657,300	1,331,753.00	2,989,053.00
26	30	750,000	1,250,000	No - Yes	750,000 < WTA ≤ 1,250,000	1,250,000	1,178,500	2,873,590.00	4,052,090.00
27	31	3,000,000	2,750,000	Yes - Yes	WTA ≤ 2,750,000	2,750,000	1,704,000	3,483,565.00	5,187,565.00
28	32	2,250,000	2,000,000	Yes - Yes	WTA ≤ 2,000,000	2,000,000	1,600,000	1,122,627.00	2,722,627.00
29	33	1,500,000	1,250,000	Yes - Yes	WTA ≤ 1,250,000	1,250,000	1,178,500	7,250,260.00	8,428,760.00
30	34	2,000,000	1,750,000	Yes - Yes	WTA ≤ 1,750,000	1,750,000	1,503,800	6,102,758.00	7,606,558.00
31	35	2,750,000	2,500,000	Yes - Yes	WTA ≤ 2,500,000	2,500,000	1,688,300	292,993.00	1,981,293.00
32	36	750,000	1,250,000	No - Yes	WTA ≤ 1,250,000	1,250,000	1,178,500	3,626,902.00	4,805,402.00
33	37	2,500,000	2,250,000	Yes - Yes	WTA ≤ 2,250,000	2,250,000	1,657,300	194,604.00	1,851,904.00
34	38	3,000,000	2,750,000	Yes - Yes	WTA ≤ 2,750,000	2,750,000	1,704,000	4,840,298.00	6,544,298.00
35	39	1,750,000	2,250,000	No - Yes	1,750,000 < WTA ≤ 2,250,000	2,250,000	1,657,300	3,242,663.90	4,899,963.90
36	40	2,000,000	1,750,000	Yes - No	1,750,000 < WTA ≤ 2,000,000	2,000,000	1,600,000	7,281,731.80	8,881,731.80
37	41	3,000,000	2,750,000	Yes - No	2,750,000 < WTA ≤ 3,000,000	3,000,000	1,711,600	2,661,087.00	4,372,687.00
38	42	1,250,000	1,750,000	No - No	WTA > 1,750,000	+Infinity	1,718,700	3,821,447.10	5,540,147.10

Notes: **a.** Estimated using equation 17
b. Extracted from Appendix 10
c. Summation of columns G and H for each case. (Compensation is quoted in Rwanda Francs, Frw)
d. Validation cases for model of disturbance compensation are in shades of grey colour.

Appendix 15: Results of paired sample test of significance

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Disturbance-Integrated compensation	5796762.06	36	3631788.47	605298.08
	Market value compensation	4225526.50	36	3578545.06	596424.18

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Disturbance-Integrated compensation & Market value compensation	36	0.998	0.000

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
DICM - Market value compensation	1571235.56	244123.82	40687.30	1488635.94	1653835.17	38.617	35	0.000

Appendix 16: Mathematical notes on the design of disturbance-integrated compensation method

This appendix is a mathematical guide explaining the design of DICM for land expropriation as well as its link with analytical framework of this research.

A simple equation for determining disturbance-integrated compensation for land expropriation is expressed as:

$$Total\ compensation = MV + disturbance \quad \text{(i)}$$

$$T_c = MV_k + WTAC_d \quad \text{(ii)}$$

Where T_c = Total compensation for land expropriation; MV_k = Market value; and $WTAC_d$ = contingent value of disturbance entitlements.

Market value " MV_k "compensation for real estate (property) of a specific "*kth*" landowner is expressed as the sum of the land value " V_L ", value of building " V_L ", value of farm crops " V_C ", and value of other assets" V_O " (if any).

$$MV_k = V_L + V_B + V_C + V_O \quad \text{(iii)}$$

So that, $T_c = (V_L + V_B + V_C + V_O) + WTAC_d$ (iv)

In the absence of other assets, the equation (iv) is reduced to:

$$T_c = (V_L + V_B + V_C) + WTAC_d \quad \text{(v)}$$

Turning attention to disturbance compensation which is expressed as willingness to accept compensation for disturbance "$WTAC_d$", a numerical integration of logistic cumulative (bid) function containing value determinants of each disturbance entitlement will be determined.

The first step is to calibrate a logit model of disturbance compensation using the vector format:

$$Logit_{WTA} = f\left(\overrightarrow{DC}, \overrightarrow{OC}, \overrightarrow{RC}, \overrightarrow{RM}, \overrightarrow{LV}, \overrightarrow{LC}, \overrightarrow{PD}, \beta_0\right) \quad \text{(vi)}$$

Where; $Logit_{WTA}$ = outcome vector which is the natural logarithm of odds (likelihood) for accepting a bid amount in CV surveys, *f(....)* implies *"function of"*, $\overrightarrow{DC}$ = bid amounts for disturbance compensation; $\overrightarrow{OC}$ = characteristics; $\overrightarrow{RC}$ = relocation cost; $\overrightarrow{RM}$ = removal cost; $\overrightarrow{LV}$ = loss of livelihood; $\overrightarrow{LC}$ = loss of income; $\overrightarrow{PD}$ = psychological damages; and β_0 = Constant term for unobservable aspects of $WTAC_d$. Except for the constant term " β_0 ", all other vectors in the logit regression model are characterized by specific variables (See Table 9 of the Thesis).

Equation (vi) is further expressed in terms of its constituent variables as:

$$Log_e\left[\Pr ob(Yes)/1 - \Pr ob(Yes)\right] = \beta_0 + \beta_i \bullet (BID) + \beta_1 \bullet (Z_1) + \beta_2 \bullet (Z_2) + \beta_3 \bullet (Z_3) + ... + \beta_n \bullet (Z_n) \quad \text{(vii)}$$

The LHS of equation (vii) is the outcome vector which is the natural logarithm of odds (likelihood) for accepting a bid amount in contingent valuation surveys. Equation (vii) is the calibrated version of a logit model for accepting disturbance compensation. The sample mean values of variables Z_1 to Z_n are multiplied by their individual coefficients and summed up to further reduce equation (vii) to the format below:

$$Log_e\left[\Pr ob(Yes)/1 - \Pr ob(Yes)\right] = \beta_0 + \beta_i \bullet (BID) + \sum\left(\beta_j \bullet (Z_j)\right) \quad \text{(viii)}$$

The probability of rejecting a bid amount as compensation for disturbance is expressed using the exponential equation:

$$\hat{p}_k = 1 - \frac{1}{1 - e^{-x}} \tag{ix}$$

Where $\hat{p}_k$ = probability of rejecting bid amount, e = 2.718281828, and x = the logit model for acceptance of a bid amount expressed above as equation (viii). Equation (viii) is simplified to pave the way for its substitution in equation (ix). Therefore, the pooled constant "α" is computed by adding "$\sum(\beta_j \cdot (Z_j))$" and "$\beta_0$". That is:

$$\alpha = \beta_0 + \sum(\beta_j \bullet (Z_j)) \tag{x}$$

Therefore, the logit model expressing the willingness of an expropriated landowner to accept a bid amount is reduced to:

$$Log_e[\Pr ob(Yes)/1 - \Pr ob(Yes)] = \alpha + \beta_i \bullet (BID) \tag{xi}$$

Substituting equation (xi) into equation (ix) produces equation (xii) below:

$$\hat{p}_k = 1 - \{1/[1 + \exp-(\alpha + \beta_i(BID_k))]\} \tag{xii}$$

The logic behind equation (xii) is that the likelihood of rejecting a bid amount as compensation decreases as the bid amount is increased. Within the context of this research, the bid function for disturbance compensation in Figure 8 has been illustrated for a better understanding of this logic.

In consonance with the economic principle of consumer surplus, the area under the bid function of disturbance compensation is used as a proxy for disturbance compensation. This area can be determined using numerical integration of equation (xii) as follows:

$$E(WTA_k) = \int_L^U 1 - \left(\frac{1}{1 + \exp-(\alpha + \beta_i(BID_k))} \right) dBID \tag{xiii}$$

Where $E(WTA_k)$ = Expected WTA for a kth (specific) landowner, L = lower bound of integral calculus, which is set at zero; and U = upper bound of integral calculus, which is set with reference to the double-bounded dichotomous bidding of WTAC for disturbance. The general solution to the integral in equation (xiii) is expressed as:

$$E(WTA_k) = \left[-\frac{1}{\beta_i} \{\log_e[1 + \exp-(\alpha + \beta_i(BID_k))] + \alpha\} \right]_L^U \tag{xiv}$$

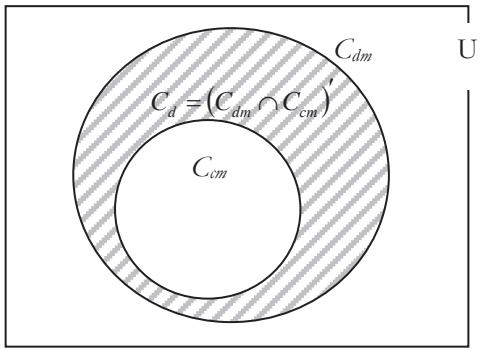
$E(WTA_k)$ in equations (xiii) and (xiv) implies the same thing as $WTAC_d$ in equations (i), (iv), and (v) respectively. So that:

$$T_c = (V_L + V_B + V_C) + E(WTA_k) \tag{xv}$$

$$\therefore T_c = MV_k + \left[-\frac{1}{\beta_i} \{\log_e[1 + \exp-(\alpha + \beta_i(BID_k))] + \alpha\} \right]_L^U \tag{xvi}$$

Under the DICM, total compensation for land expropriation equals the sum of market value and disturbance compensation estimated from integral calculus of a recursive equation of a landowner's WTAC for disturbance entitlement which has been elicited from double-bounded dichotomous bidding.

Equation (xvi) relates to the analytical framework for the design of DICM for land expropriation as follows:



Analytical framework in Venn diagram

In the universal set *"U"* of compensation for land expropriation, equation (iii) in this appendix equals to the set C_{cm}. That is:

$$MV_k = C_{cm} \quad \text{(xvii)}$$

Or $$V_L + V_B + (V_C + V_O) = ln, bg, oi \quad \text{(xviii)}$$

Therefore, $$C_{cm} = V_L + V_B + (V_C + V_O) \quad \text{(xix)}$$

where it is recalled that *ln* is market value of land, *bg* is market value of building, and *oi* is market value of other improvements (including farm crops) on land.

Furthermore, equation (xiv) is equalled to the set C_d. That is:

$$E(WTA_k) = C_d \quad \text{(xx)}$$

Or $$E(WTA_k) = (C_{dm} \cap C_{cm})' \quad \text{(xxi)}$$

So that $$\left[-\frac{1}{\beta_i}\left\{\log_e\left[1+\exp-\left(\alpha+\beta_i\left(BID_k\right)\right)\right]+\alpha\right\}\right]_L^U = f(rm, re, lv, in, pc, uc) \quad \text{(xxii)}$$

Implying that disturbance compensation on the LHS of equation (xxi) is a function of removal costs *"rm"*, relocation and incidental costs *"re"*, loss of livelihood *"lv"*, loss of income *"in"*, psychological damages *"pc"* and other unique circumstances of expropriated party *"uc"*.

Therefore, $$C_d = \left[-\frac{1}{\beta_i}\left\{\log_e\left[1+\exp-\left(\alpha+\beta_i\left(BID_k\right)\right)\right]+\alpha\right\}\right]_L^U \quad \text{(xxiii)}$$

If $$C_{dm} = C_{cm} \cup (C_{dm} \cap C_{cm})' \quad \text{(xxiv)}$$

Then $$C_{cm} \cup (C_{dm} \cap C_{cm})' = MV_k + E(WTA_k) \quad \text{(xxv)}$$

Therefore, disturbance integrated compensation equals $C_{cm} \cup (C_{dm} \cap C_{cm})'$ which has been mathematically expressed in equation (xvi).