Kwamina Ewur Banson

A SYSTEMS THINKING APPROACH TO ADDRESS THE COMPLEXITY OF AGRIBUSINESS FOR SUSTAINABLE DEVELOPMENT IN AFRICA: A CASE STUDY IN GHANA

Thesis submitted to the University of Adelaide in fulfilment of the requirements for the degree of Doctor of Philosophy

School of Business, Systems Design and Complexity Management

Faculty of the Professions

University of Adelaide

July 2016

Dedicated to Mr Albert Kojo Banson, Sandra Banson and the late Cecilia Tornyedzi

Contents

List of Tables

List of Figures

List of Abbreviations

AAGDS	Accelerated Agricultural Growth and Development Strategy
AGRA	Alliance for a Green Revolution in Africa
BBN	Bayesian belief network
CAADP	Comprehensive African Agricultural Development Plan
CBBR	Cat Ba Biosphere Reserve
CLD	causal loop diagrams
CPT	Conditional Probability Table
CSA	Community Supported Agriculture
ECOWAP	Economic Community of West African States Agricultural Policy
ELLab	Evolutionary Learning Laboratory
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FASDEP	Food and Agriculture Sector Development Policy
GDP	Gross Domestic Product
IFAD	International Fund for Agricultural Development
MESTI	Ministry of Environment, Science, Technology and Innovation
MOFA	Ministry of Food and Agriculture
NEPAD	New Partnership for Africa's Development
NGO	non-government organisations
NTFP	non-timber forest products
PSIA	poverty and social impact analysis
R&D	research and development
SCP	structure, conduct and performance
RQs	research questions
US	United States

Abstract

African countries have comparative advantages in the production and export of primary commodities; however, they face many sustainability challenges in the agricultural sector. Since the democratisation of many African countries—notably Ghana—a number of interventions, costing billions of dollars, have been implemented to overcome the challenges facing the agricultural industry, but with little success. The agricultural industry is characterised by complex challenges such as famine, food insecurity, poor soil and quality standards, political instability, inappropriate agricultural practices, and the depletion of natural resources. These challenges have worsened the plight of African farmers. The increasingly complex nature of the agricultural industry in Africa has led to an urgent need for the use of a systemic rather than traditional approach to solve agricultural problems.

Capacity building using a systems thinking approach and the concept of an Evolutionary Learning Laboratory during a series of stakeholder workshops in Ghana, has had a remarkable effect on the ability of the agricultural industry to evolve, improve and increase its efficacy. Causal Loop and Bayesian Belief Network (BBN) modelling were used to develop systems models to determine the components and interactions between the policy and the social, environmental and economic dimensions of the industry. Insights were made into potential system behaviours and leverage points for the systemic interventions required for sustainable agricultural development.

The results reveal that the behaviour over time of agricultural productivity is declining, although new agricultural lands are being exploited, leading to environmental degradation. System archetypes as diagnostic tools have contributed to understanding the cause of a fix 'now', which gives rise to a much bigger problem to fix 'later'. The results illustrate how the structure, conduct and performance elements of the agricultural industry interact together to influence the survival and growth of the sector. The study identifies that stakeholders adopt several strategies to survive and compete, leading to overexploitation of the ecosystem.

Results from the BBN models indicate that the implementation of systemically determined interventions, policies and strategies could result in the chance of raising 'agricultural productivity' as high as 92.2% from 57.5%, and it might be plausible to reduce poverty levels from 44.9% to 10.0%. This would also lead to a significant increase in farmers' yields and profits. These BBNs are used for scenario testing to determine the potential outcomes of different systemic interventions by observing what happens to the system as a whole when a particular intervention/strategy or combination of interventions/strategies is implemented—that is, before any time or money is invested in implementation.

This approach provides clarity on dealing with complex sustainability challenges and should gradually replace the reductionist approach (e.g., short-term quick fixes and treating the symptoms) in dealing with challenges and developing policies. The systems models will help governments to anticipate the long-term consequences of their decisions and actions, as well as help to avoid significant unintended consequences of policies and strategies such as ‘silo mentality’ and ‘organisational myopia’.

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name for any other degree or diploma in any university or other tertiary institution without prior approval of the University of Adelaide and, where applicable, any partner institution responsible for the joint award of this degree. I give consent to this copy of my thesis, when deposited in the University Library, being made available for loan and photocopying, subject to the provisions of the *Copyright Act 1968*. The author acknowledges that copyright of published works contained within this thesis resides with the copyright holder(s) of those works. I also give permission for the digital version of my thesis to be made available on the web via the University's digital research repository, the Library Search and also through web search engines, unless permission has been granted by the University to restrict access for a period of time.

I hereby certify that this thesis is submitted in the form of a series of published papers of which I am the main author. I have included as part of the thesis a written statement from each co-author, and endorsed by the Faculty Assistant Dean (Research Training), attesting to my contribution towards the multi-authored publications.

Signed: Date:9th September 2016

(Kwamina Ewur Banson)

Acknowledgements

Thank God, the Father of our Lord Jesus Christ and of us all, for giving me the gift of life and the ability to complete my PhD successfully, during which He thought me a wonderful example of how to live a life of faith. I wish to, first and foremost, give praise and glory to Almighty God for granting me favour for scholarship and bringing me to a successful end in this PhD program. I thank the Australian Agency for International Development (AusAID) and the Business School at the University of Adelaide for granting me a scholarship award and funding for this study. I also express my sincere gratitude to both of my supervisors, Dr. Nam Cao Nguyen and Prof. Ockie Bosch, for their kindness, day-to-day guidance, and support and encouragement for this research and other matters. I am privileged and glad to have shared the technical knowledge and wide experiences of these two professionals as their student. In a related message, I would like to extend my sincere thanks to the Biotechnology and Nuclear Agriculture Research Institute (BNARI) of the Ghana Atomic Energy Commission (GAEC) for granting me study leave with pay, and also for their support during my data collection in Ghana.

I would like to express great gratitude to all of the agricultural experts and relevant stakeholders from Africa for their time, willingness and contributions to this study. My humble appreciation goes to Prof. Dr Josephine Nketsia-Tabiri, former director of BNARI, GAEC for the assistance rendered during data collection, and to members of Ministry of Food and Agriculture for technical advice in making the data collection possible.

I wish to express my sincere thanks to my parents, Mr Albert Kojo Banson and Mrs Sandra Banson, as well as my sisters, uncles and grandmother, for their continual encouragement, love and prayers. Finally, I am greatly indebted to my wife, Irene Baaba Banson, my lovely sons, Nana Baa Banson and Kojo Atta Banson, and my daughters, Christina Kuukwa Banson and Anastasia Nana Ekua Banson, for all of their love, moral support, understanding and great encouragement. I would love, in a special way, to thank my best friend, Mr Hastings, for his encouragement, inspiration and, above all, for keeping in touch. God bless you!

Finally, appreciation is extended to the staff of the ‘Business School, Marketing and Management’ for their support throughout my Doctoral studies. God bless you all!

List of Publications by the Candidate

Published/under review Journal Papers (these papers form the main body of the PhD Thesis)

1. **Banson, KE,** Nguyen, NC, Bosch, OJH & Nguyen, TV 2015, 'A systems thinking approach to address the complexity of agribusiness for sustainable development in Africa: a case study in Ghana', *Systems Research and Behavioral Science*, vol. 32, no. 6, pp. 672–688. doi:10.1002/sres.2270.
2. **Banson, KE,** Nguyen, NC & Bosch, OJH 2016, 'A systems thinking approach to the structure, conduct and performance of the agricultural sector in Africa: a case study—Ghana', *Systems Research and Behavioral Science*, (under review: 1st round of comments from peer reviewers received; revised manuscript has been submitted)
3. **Banson, KE,** Nguyen, NC & Bosch, OJH 2016, 'Using system archetypes to identify drivers and barriers for sustainable agriculture in Africa: a case study in Ghana', *Systems Research and Behavioral Science*, vol. 33, no. 1, pp. 79–99. doi:10.1002/sres.2300.
4. **Banson, KE,** Nguyen, NC & Bosch, OJH 2015, 'Systemic management to address the challenges facing the performance of agriculture in Africa: case study in Ghana', *Systems Research and Behavioral Science*. vol. 33, no. 4, pp. 544–574. doi:10.1002/sres.2372.
5. **Banson, KE,** Nguyen, NC & Bosch, OJ 2015, 'A systems thinking approach: "the greater push model" for growth and sustainability in Africa: evidence from Ghana', *International Journal of Markets and Business Systems*, vol. 1, no. 4, pp. 289–313.

Peer-Reviewed Conference Publications

1. **Banson, KE,** Nguyen, NC & Bosch, OJH 2015, '"The greater push" for growth and sustainability in Africa: evidence from Ghana', proceedings of the 59th Annual Meeting of the International Society for Systems Sciences, 2–7 August, Berlin, Germany.
2. **Banson, KE,** Nguyen, NC & Bosch, OJH 2015, 'Systemic structure, conduct and performance of the agricultural industry in Africa: evidence from Ghana', proceedings of the 59th Annual Meeting of the International Society for Systems Sciences, 2–7 August, Berlin, Germany, http://journals.isss.org/index.php/proceedings59th/article/viewFile/2480/859.

3. **Banson, KE,** Nguyen, NC & Bosch, OJH 2014, 'Systemic intervention to tackle the constraints and challenges facing stakeholders and the performance of the agricultural sector in Ghana', paper presented at the 9th Annual System of Systems Engineering Conference, 9–13 June, Adelaide, SA.
4. **Banson, KE,** Nguyen, NC, Bosch, OJH & Nguyen, TV 2013, 'A systems thinking approach to address the complexity of agribusiness for sustainable development in Africa', proceedings of the 57th Annual Meeting of the International Society for Systems Sciences, HaiPhong, Vietnam, http://journals.isss.org/index.php/proceedings57th/article/view/2119.
5. **Bosch, OJH,** Nguyen, NC, Ha, TM & Banson, KE 2015, 'Using a systemic approach to improve the quality of life for women in small-scale agriculture: empirical evidence from Southeast Asia and Sub-Saharan Africa', proceedings of the Business Systems Laboratory 3rd International Symposium 'Advances in Business Management. Towards Systemic Approach'. January 21-23, 2015, Perugia

List of Additional Publications

1. **Banson, KE,** Bosch, OJH & Nguyen, NC 2015, 'A systemic intervention to access resource impact on the quality of life among women farmers in developing countries: evidence from Ghana', *Academia Journal of Agricultural Research*, vol. 3, no. 2, pp. 15–22. doi:10.15413/ajar.2015.0108.
2. Nguyen, NC, Bosch, OJH, Ong, FY, Seah, JS, Succu, A, Nguyen, TV & **Banson, KE** 2015, 'A systemic approach to understand smartphone usage in Singapore', *Systems Research and Behavioral Science*, vol. 33, no. 3, pp. 360–380. doi:10.1002/sres.2348.
3. Nguyen, NC, Bosch, OJ, **Banson, KE,** Ting, OLJ, Xuan, JG, Hui, MS & Lim, Z 2015, 'A systems thinking approach to address the complex issue of plastic surgery in South Korea', *International Journal of Markets and Business Systems*, vol. 1, no. 2, pp. 108–135.
4. Nguyen, NC, **Banson, KE,** Bosch, OJ, Nguyen, T, Tan, L, Goh, G, Lim, O & Jupary, Z 2016, 'The economic importance of social graciousness index: a systemic approach to Singapore case', *International Journal of Markets and Business Systems* (In press).