tapraid4/q78-tg/q78-tg/q7800316/q782034d16z | xppws | S=3 | 7/26/16 | Art: 584501

People, process and policy perspectives on food security

An exploration using systems archetypes

AQ: au

Amir Sharif

Brunel Business School, Brunel University London, Uxbridge, UK, and

Zahir Irani

AQ: 1

Brunel University

Received 27 January 2016
Revised 27 January 2016
Accepted 6 March 2016

Abstract

Purpose – This paper aims to identify a wider holistic view of the inter-relationships relating to food security from a people, process and policy. This is so that decision and policy makers can identify relevant alignments between disparate and conflicting priority elements in the field. Noting the complexity of inter-related challenges posed by food security, food supply chains and growing concerns over food waste, this paper also seeks to identify cross-cutting themes relative to shared energy and water security objectives also. The authors develop and adapt an existing food security framework to encapsulate the above culminating in a systems archetype that defines the intimate feed-forward.

Design/methodology/approach – As a viewpoint piece, there is no empirical work to report in this paper. An exploratory review of the literature has allowed for the extraction of food security concerns that need the attention of stakeholders across the enterprise to ensure robust food supply chains can be are created, maintained and sustained through a better understanding and usage of information, knowledge and data.

Findings – The authors present an adaptation of an existing food security framework to include dimensions of people, process and policy through the inclusion of a number of broad thematic areas including (among others): management best practices; sustainable business operations; consumption rights, behaviours and trading policies; lifecycle management; recovery and extraction; regulatory changes and policy reform; environmental and climate change impacts. The authors outline systems archetype based upon a combination of the Limits of Growth, Tragedy of the Commons and Attractiveness Principle archetypes can provide decision and policy makers to identify and explore a range of food security scenarios and potential outcomes.

Research limitations/implications – This paper is a position paper that provides strategic directions on the impact of people, process and policy aspects on the development of food security policies from the perspective of local and central government decision makers.

Practical implications – This paper provides a holistic worldview on key aspects of the global and national food security debate that seeks to assist decision and policy makers frame their decisions and policy interventions across dimensions of people, process and policy.

Social implications – Noting the impact of securing and maintain the production, supply, consumption, health benefits and waste recovery aspects of food this paper provides a perspective on the inter-relationships that exist within the topical area and the socially mediated inter-relationships which exist and should be considered when engaging with the food security and food supply chain topical area.

Originality/value – The paper raises awareness and highlights inherent inter-relationships within the food debate for the benefit of decision and policy makers present at the organisational level, specifically around people, process and policy.

AQ: 2

Keywords People, Food security, Food supply chains, Inter-relationships, Policy perspectives, Process perspectives

Paper type Viewpoint

Transforming Government: People, Process and Policy
Vol. 10 No. 3, 2016
p. 000

1750-6166
DOI 10.1108/TG-01-2016-0008

Introduction

Growing populations are putting increasing pressures on natural and man-made resources that are in turn creating competition for basic human needs, such as land, water and energy. We are also witnessing sovereign states increasingly leasing land and the natural resources of other sovereign countries to protect their own food supply chains, for example countries like Qatar have global land policies, and has leased over 40,000 ha in Kenya (Onyango and Gazzola (2011), along with setting up financial instruments, like in Vietnam where Qatar has set up an agriculture fund (Cotula and Vermeulen, 2009). However, in places like Australia where Qatar also has agricultural interests, alarm bells are starting to ring (Miller, 2011). The consequences of such national policy decisions are far reaching, at both ends, individual country(s) and on a global scale.

As the cost of extracting and transforming available natural resources increases in proportion to consumption demand, there is also added pressure to ensure resilience and consistency of supply to support societal demands in a sustainable fashion. This has a direct impact and consequence on levels of food consumption, health, wealthbeing and survivability, with the Food and Agriculture Organisation of the United Nations continuing to report that hunger remains an everyday challenge for almost 795 million people worldwide (FAO, IFAD and WFP, 2015).

Naturally, this results in food as well as water, becoming a valued resource – leading to the principles that underpin food and water security which seek to balance the necessity to sustain life with patterns of lifestyle behaviour (consumption for consumptions sake). In addition to the challenges of growing and shifting populations outlined above, the latter changes to lifestyle and consumption in general is having an increasing impact upon health and wellbeing through changes to dietary intake as well as materials required to produce and deliver food (which includes water). This consumption behaviour shift (Terlau and Hirsch, 2015) is having a profound effect and has a tangential impact of course on not only food security itself but also associated policy facets encompassed by health, energy and environmental (climate change) policy. This increasing drain on natural resources also of course has a natural Malthusian limit, with direct consequences not only the rate of input and extraction but also on environmental products themselves (farmland, rivers, forests) – above and beyond what existing agricultural regulatory frameworks and directives can adequately cover (Porter *et al.*, 2014). Improving our understanding of those policy drivers which contribute to these factors might result in a reversal of the progress being reported through, for example, the Global Hunger Index (GHI), which reports that the state of hunger in developing countries as a group has improved since 1990, falling by 39 per cent, according to the 2014 GHI (IFPRI, 2014).

Further, such effects have a consequence upon climate change both through decreasing soil quality and capacity, as well as increasing demands to produce more food for consumption, which requires water and energy that emits growing levels of dangerous carbon dioxide (CO_2) from fossil fuels. This is notwithstanding developments around sophisticated carbon capture and storage (CCS) methods and technologies which allow CO_2 emissions from large source points to be captured, transported and stored in safe geological locations, rather than being emitted to the atmosphere (Gibbins and Chalmers, 2008). While CCS may represent a viable contribution to addressing CO_2 and greenhouse gas mitigation, as CCS costs reduce with

economies of scale and technological developments advance, the challenge still remains around reducing emissions overall with a greater adoption of more greener technologies embedded within supply chains (Cheng *et al.*, 2008; Green *et al.*, 2012; Sarkis *et al.*, 2011).

Food security and food waste as primary drivers

It is recognised nevertheless that while there may be advances and benefits in adopting and implementing green technology within food production and supply chains, a consequence of feeding populations still remains in terms of waste that is produced as a consequence of the non-consumption of food. Hence, this is also an associated risk and contingent factor to be considered. Although there are numerous definitions as to what constitutes waste in different legal jurisdictions (often grounded around environmental, hygiene, nutrition and food safety controls), there is a basic premise that waste can be produced all along the different stages in the food supply chain. These stages can range from the agricultural phase through to retail, consumer and then ultimately disposal phase (including before potential recycling). Parfitt *et al.* (2010) provide an even more comprehensive insight through examples of generic food supply chain waste through a total of eleven different stages.

Increasingly demand-driven consumer behaviours and habits are leading to a perpetual drain on the aforementioned natural and man-made resources at rapidly increasing rates. This thirst for more, often without consideration for any degree of sustainability is prompted by, among other things, a lack of awareness of the inter-related aspects on the confluence of food, water and energy (the so-called "nexus").

A lack of action by Governments, companies, society and the consumer will place a significant burden on the food system and environment as demand grows with population growth and increased wealth. Hence, if we consider that there are significant combined challenges posed by food security, the food-energy-water nexus, environmental climate change effects and the management of food waste, decision and policy makers need support and insight into how such grand challenges can be tackled not only at the global and national level but also at the regional and local level as well.

As a result, the authors propose a holistic framework to explore and identify inter-relationships across the people, process and policy dimensions of the above macro challenges, which is now presented.

Inter-relationships across the food security – food waste divide: a holistic framework

Building upon a previous view of the food security and food waste debate (Irani and Sharif, 2016), we now seek to extend and include additional elements of people, process and policy which we believe contribute to the wider food security debate. Hence, providing a basis for constructing and examining what and which drivers might be contributing to the development of future policies relating to food security at national and local levels. Table I shows a combined food supply chain (waste-focussed) as well as information chain (enterprise-focussed) delination of food security which is extended to include people, process and policy elements.

T1

To explore the interactions and competing demands across these three facets, we propose using a combination of different systems archetypes (SAs), in the vein of Coyle (2000) who suggests using systems approaches to identify the value gained by quantifying qualitative problems. These representations of dynamical system behaviour

Table I. Positioning points of waste and information in the food supply chain mapped to people, process and policy

Waste phase	Waste driver	Enterprise/ organisation level	Information/ technological level	People	Process	Policy
Economic	Mergers and Acquisitions	Economic	Financial data and metrics	Purchasing power and price indices	Sustainable business operations (Circular Economy)	Economic policy reform and loss/gains in subsidy
	Poor demand management		Consumption trends and KPIs			
	Immature markets Supply reduces price		Market pricing	Management of natural resources and best practice behaviour		
Farming	Poor practice Appearance–quality	Agriculture	Crop and soil sensing Farm machinery efficiency		Agri-technologies and Agri-business process modelling	Safeguarding environmental products and resources
	Unfit for human consumption		Inventory and Production levels and controls			
Processing	Inefficient operations management	Manufacturing		Education, Awareness and Skills development		Regulatory changes and standards (forward and reverse supply chains)
Storage	Ineffective operations management	Logistics				
	Lack of infrastructure		Asset identification/ warehousing			
Transportation	Poor logistics infrastructure	Haulage, shipping or flight	Transportation tracking and monitoring	Supplier–consumer relationship management		
	Weak levels of investment	Government	Traffic and flow management		Innovations in Transportation, Packaging processes and technology	Alignment of conflicting Governmental priorities
	Bad packaging	Suppliers	Packaging technologies			
Consumption	Purchasing habits Purchasing incentives	Retail	Consumer trends Sales and marketing targets	Consumption behaviours Retail Promotions	Distribution and sales cycle	Food waste behaviours, Consumer rights, Trading standards, Health policies
Premature harvesting due to bad weather	Bad weather	N/A	Climate/weather monitoring and remote sensing (GIS)	Accessibility/availability to natural resources	Changes in farming practices to adapt to climate change	Impact upon Climate Change Mitigation, adaptation and alternative energy sources and resource extraction/infusion techniques
Lack of disposal options	Disposal is cheaper than recycling	Environmental	Reverse Logistics metrics (recovery and recycling)	Awareness of the product and service design lifecycles	Lifecycle management	
Embedded energy	Total energy consumption	Cyclical	Energy indices		Recovery and extraction	
Systems Archetype representation →				*Tragedy of the commons*	*Limits to Growth*	*Attractiveness Principle*

Source: Adapted from Irani and Sharif, 2016

are essentially diagrammatic causal loops, sometimes known also as causal loop diagrams (CLD), which allow researchers and practitioners to model and explain interactions between disparate viewpoints and factors (Senge *et al.*, 1994). Essentially, the approach is to model causes and related effects, with feedback and feed-forward loops identifying either reinforcing, growth or divergent dynamic behaviour.

There have been many studies exploring representing food security and environmental systems using systems dynamics and so-called archetypes in recent years (Armendaritz *et al.*, 2015; Jarvie, 2013; Keegan and Nguyen, 2011; Setianto *et al.*, 2013; Sun and Bosch, 2013). However, there is a paucity of uptake and application of systems dynamics and SAs in the policy making arena due to either policy resistance, the risks of experimentation, need to achieve consensus across a wide range of diverse stakeholders, overconfidence in existing policies and the comfort in taking an internal (endogenous) perspective (Ghaffarzadegan *et al.*, 2011).

Noting these points and using the "small systems models" approach of the latter, we propose that viewing food security and food waste in terms of people, process and policy aspects contributes to the modelling and understanding of these complex issues.

People – tragedy of the commons

In this archetype/worldview, a key consideration lies with identifying the "commons" or the underlying resource which in this case is access to food, water and energy. This archetype also includes an identification of incentives and reinforcing processes held by a few (individuals) in contrast with those held by the collective (organisations/markets). In this context, the People column in Table I suggests a broad mix of incentives aimed at developing individual capacity and capability (such as education, training and awareness-focussed), all the way through to economic incentives (such as improvements to consumer purchasing power, consumption behaviours and general accessibility to food resources). This could also be reframed as seeking a balance between food consumption needs and agribusiness demands (maximising profits). Hence, the CLD in
F1 Figure 1 is seeking to balance and mitigate growing food demands against the needs of food producers to remain profitable. Both elements however hit a resource limit in terms of natural resource availability and overall sustainability of this system.

Process – limits to growth

This next archetype focusses on the time relationship between growth and deceleration – typically due to external factors outside of the stakeholders control. As such, the Process column in Table I identifies a range of "growth engines" in terms of agribusiness-specific processes (including the introduction of technology, innovations in transportation and packaging, best practice adoption, lifecycle management and the
F2 like). As in the previous case, the CLD in Figure 2 identifies a balance subject to a limiting condition which slows the effect of the overall outcomes. In this case, we propose that growth is limited not principally due to the availability of supporting food supply resources, but in terms of a confluence of reducing food, water and energy resources subject to the just-in-time demands of consumers (for example, the loss of seasonal demand cycles in preference for year-long unseasonal supply). In other words, no matter how effective or efficient production and supply might be, the consumption demand will limit further sector growth as supply struggles to keep up. This almost

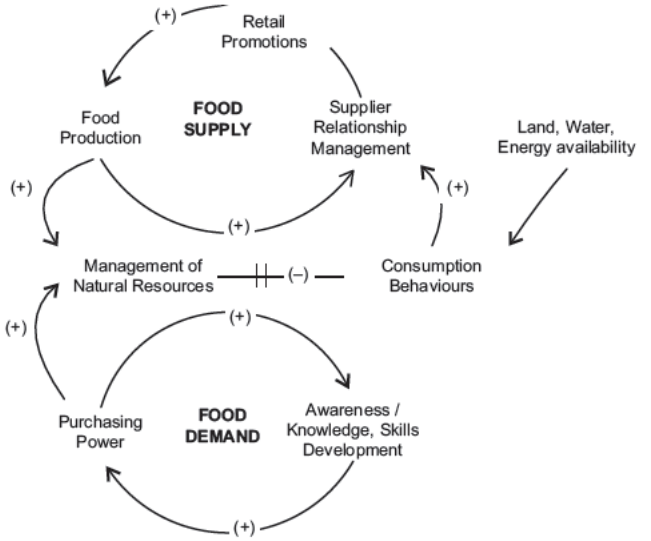

Figure 1.
SA for the "people" dimension

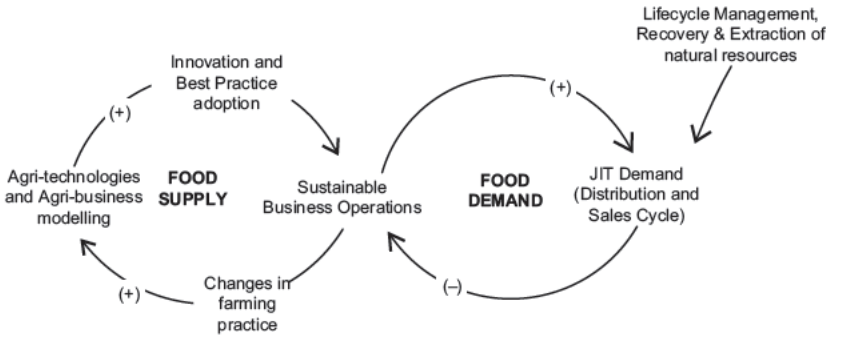

Figure 2.
SA for the "process" dimension

suggests this scenario could revert to the "Success to the Successful" archetype where competing activities share and then deplete scarce resources.

Policy – attractiveness principle

Finally, policy interventions as identified in Table I can be represented by a derivative of the Limits to Growth archetype known as the Attractiveness Principle. In this instance however, there are respective slowing actions/limits which impact upon the outcomes desired. Hence, the "attractiveness" implied in the CLD shown in Figure 3 is in terms of highlighting the dilemma of addressing which limit should be handled and dealt with first and which merits most attention. The range of potential food security and related food waste policies which are available to policy makers and which highlighted in Table I, therefore signify an additional (endogenous) balancing act which underpins the complexity of tackling food security overall.

F3

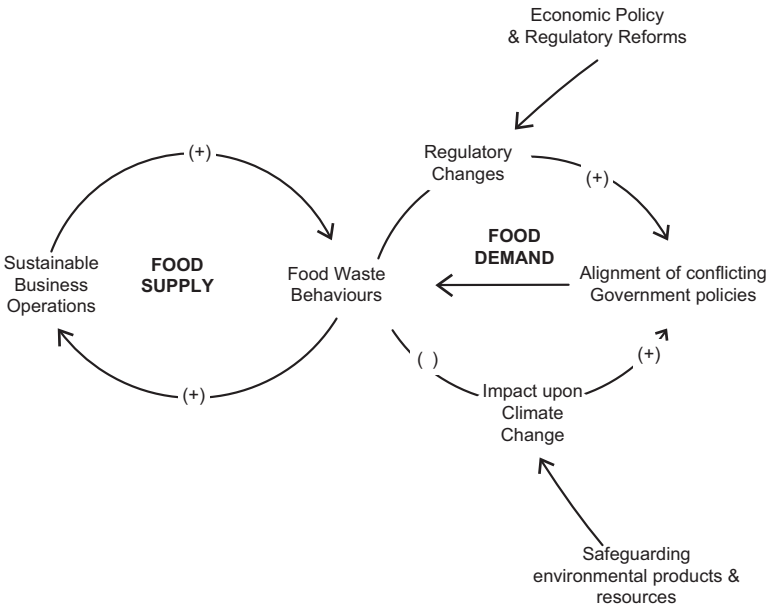

Figure 3.
SA for the "policy" dimension

For example, is economic policy and subsidy reform more important than safeguarding environmental products and resources? Are regulatory standards (such as food waste management, recycling and energy recovery) more critical than the impacts upon climate change and the use of alternative energy sources and resource extraction/infusion technologies? These are difficult and challenging decisions, which in our view can only be understood if policy options are mapped and visualised together in such a pairwise manner to stimulate opportunities to manage anticipated and unanticipated outcomes.

Conclusions

This paper has posed the challenges presented by food security in terms of extending previous research highlighting the enterprise and information aspects of food security and food waste strategies. The authors believe that the inherent complexity of inter-relationships involved in this topic, suggests a need to adopt a holistic view through adopting a SA perspective to bring people, process and policy aspects together.

The "Tragedy of the Commons" archetype was used to represent the People dimension of food security and food waste, highlighting the balance between food supply and demand and the effect that consumption behaviours have on the availability of natural resources (land, water and energy). The "Limits to Growth" archetype was used for the Process dimension, to represent the importance of managing food waste, recycling and recovery as an input to the distribution of food products (innovation and best practices in support of sustainable business operations notwithstanding). Finally, the "Attractiveness Principle" archetype was chosen to represent the policy making dimension of food security. This was to show the need to evaluate competing food policy decisions in terms of seeking to meet a shared goal of changing food waste behaviours

(while safeguarding environmental products and resources, and allowing for changes to economic policies and regulatory reforms).

The resulting proposed archetypes have attempted to map and visually highlight suggested causal inter-relationships which both decision and policy makers should engage with. This is also noting the bipartisan approach taken in the literature and published reports by global bodies such as the FAO, WFP and others, to increase global awareness and action towards safeguarding food, water and energy resources. Although we believe this work contributes to the existing literature, we suggest that the significance of food security and food waste topics at the present moment requires an increase in additional and ongoing research to fully understand all aspects of the combined nexus. Hence, it is imperative for researchers to combine their work and compare, contrast – and where possible to even integrate – local/regional models of food supply and demand together to understand and tackle the global challenges that food security presents.

References

Armendaritz, V., Armenia, S., Atzori, A.S. and Romano, A. (2015), "Analyzing food supply and distribution system using complex systems methodologies", *Proceeding of the 9th International European Forum on System Dynamics and Innovation in Food Networks, International Center for Food Chain and Network Research, University of Bonn, Innsbruck Igls, 9-13 February*, Vol. 511, pp. 36-59.

Cheng, J.H., Yeh, C.H. and Tu, C.W. (2008), "Trust and knowledge sharing in green supply chains", *Supply Chain Management: An International Journal*, Vol. 13 No. 4, pp. 283-295.

Cotula, L. and Vermeulen, S. (2009), "Deal or no deal: the outlook for agricultural land investment in Africa", *International Affairs*, Vol. 85 No. 6, pp. 1233-1247.

Coyle, G. (2000), "Qualitative and quantitative modeling in system dynamics: some research questions", *System Dynamics Review*, Vol. 16 No. 3, pp. 225-244.

FAO, IFAD and WFP (2015), "The state of food insecurity in the world 2015", *Meeting the 2015 International Hunger Targets: Taking Stock of Uneven Progress*, FAO, Rome.

Ghaffarzadegan, N., Lyneis, J. and Richardson, G.P. (2011), "How small system dynamics models can help the public policy process", *Systems Dynamics Review*, Vol. 27 No. 1, pp. 22-44.

Gibbins, J. and Chalmers, H. (2008), "Carbon capture and storage", *Energy Policy*, Vol. 36 No. 12, pp. 4317-4322.

Green, K.W. Jr, Zelbst, P.J., Meacham, J. and Bhadauria, V.S. (2012), "Green supply chain management practices: impact on performance", *Supply Chain Management: An International Journal*, Vol. 17 No. 3, pp. 290-305.

IFPRI (2014), *Global Hunger Index: The Challenge of Hidden Hunger*, International Food Policy Research Institute, Bonn, Washington, DC and Dublin.

Irani, Z. and Sharif, A.M. (2016), "Sustainable food security futures: perspectives on food waste and information across the food supply chain", *Journal of Enterprise Information Management*, Vol. 29 No. 2, pp. 3-12.

Jarvie, L. (2013), "The need to identify system archetypes and leverage points for the protection of aquifers in the water-energy nexus", *Proceeding 57th Annual Meeting of the International Society for the Systems Sciences (ISSS 2013), Hai Phong City, Curran Associates, New York, NY*, pp. 536-555.

Keegan, M. and Nguyen, N. (2011), "Systems thinking, rural development and food security: key leverage points for Australia's regional development and population policy", *Migration Australia*, Vol. 1 No. 1, pp. 50-64.

Miller, R. (2011), "Qatar land grab angers bush", *The Victoria Age*, 19 June.

Onyango, V. and Gazzola, P. (2011), "Regional spatial planning as a tool for addressing land injustices and mitigating land clashes: the case of Kenya", *International Development Planning Review*, Vol. 33 No. 2, pp. 147-168.

Parfitt, J., Barthel, M. and Macnaughton, S. (2010), "Food waste within food supply chains: quantification and potential for change to 2050", *Philosophical Transactions: Biological Sciences*, Vol. 365 No. 1554, pp. 3065-3081.

Porter, J.R., Xie, L., Challinor, A.J., Cochrane, K., Howden, S.M., Iqbal, M.M., Lobell, D.B. and Travasso, M.I. (2014), "Food security and food production systems", in Field, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R. and White, L.L. (Eds), *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, MA, New York, NY, pp. 485-533.

Sarkis, J., Zhu, Q. and Lai, K-H. (2011), "An organizational theoretic review of green supply chain management literature", *International Journal of Production Economics*, Vol. 130 No. 1, pp. 1-15.

Senge, P., Kleiner, A., Roberts, C., Ross, R.B. and Smith, B.J. (1994), *The Fifth Discipline Fieldbook*, Doubleday, New York, NY.

Setianto, N.A., Cameron, D.C. and Gaughan, J.B. (2013), "Identifying archetypes of an enhanced system dynamic causal loop diagram in pursuit of strategies to improve smallholder beef farming in Java, Indonesia", *Proceding 57th Annual Meeting of the International Society for the Systems Sciences*, *Curran Associates, New York, NY*, *14-19 July*, pp. 555-573.

Sun, D. and Bosch, O. (2013), "Systems approaches towards understanding the barriers to innovation adoption in the Australian beef industry", *Proceeding 57th Annual Meeting of the International Society for the Systems Sciences (ISSS 2013)*, *Curran Associates, New York, NY*, *14-19 July*, pp. 493-515.

Terlau, W. and Hirsch, D. (2015), "Sustainable consumption and the attitude-behaviour-gap phenomenon - causes and measurements towards a sustainable development", *Proceeding the 9th International European Forum on System Dynamics and Innovation in Food Networks, International Center for Food Chain and Network Research*, University of Bonn, *Innsbruck Igls*, *9-13 February*, pp. 199-215.

Further reading

Banson, K., Nguyen, N.C., Bosch, O.J.H. and Nguyen, T.V. (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.

Corresponding author
Zahir Irani can be contacted at: zahir.irani@brunel.ac.uk