"Agribusiness Essential for Food Security: Empowering Youth and Enhancing Quality Products"

Proceedings of the
30th West Indies Agricultural Economics Conference
30th June – 6th July, 2013, Port of Spain, Trinidad

ISBN:	**978-976-634-013-1**
Main Title:	**Proceedings of the 30th West Indies Agricultural Economics Conference**
Publisher:	**The Caribbean Agro-Economic Society (CAES)**
	Department of Agricultural Economics and Extension
	The University of the West Indies
	St Augustine, Trinidad and Tobago
Printed in:	**St. Augustine, Trinidad and Tobago**
Website	www.caestt.com
E-mail	**info@caestt.com**
Publication Date:	

Prioritisation of Food Security by Decision makers in the Caribbean, A study of three Caribbean territories: Trinidad and Tobago, Belize and Barbados[1]

Shamin Renwick

Alma Jordan Library, The University of the West Indies,
St. Augustine, Trinidad and Tobago
E-mail: shamin.renwick@sta.uwi.edu

Abstract

The consequences of global food and nutrition insecurity, for example, high and fluctuating food prices would have had an impact on individual countries worldwide. This vulnerability in the Caribbean is, in fact, reflected in the recognition that none of the territories are able to produce all the food that is required to feed their populations and ensure that people lead healthy and productive lives. The extent of this exposure is reflected in the high food import bills of many Caribbean countries. Do policymakers and those who most closely influence them, in terms of their decision making for national food security, identify the impact of global food and nutrition insecurity as a main constraint to enhancing national food security in their countries? Is food security the highest priority of the various objectives of the agriculture sector? Using a qualitative approach to answer the above questions, policy makers, planners and key persons who influence policy makers in three diverse Caribbean countries (Trinidad and Tobago, Belize and Barbados) were interviewed and asked to complete an Analytical Hierarchy Process (AHP) questionnaire to rank their priorities. This paper presents some early results of the AHP analysis in an ongoing PhD study. In terms of the criteria weightings, sustainability of the food supply was judged to be far more significant than the level of external dependency. And whereas economic trade-based food security was scored as the most important objective of agriculture, supporting producers and local agribusiness was the second most important surpassing food self-sufficiency and sustainability of the environment, as well as, maximising employment in the agricultural sector and production for the export trade. These results have implications for the plans and policies designed to enhance the level of food security locally and regionally.

Keywords: Food Security; Food and Nutrition Security; Agriculture; Food Production; Agricultural Sector; Policy makers; Decision makers; Planners; Analytical Hierarchy Process; AHP; Multi-criteria Decision-Making; MCDM; Pairwise Comparison; Trinidad and Tobago; Belize; Barbados; Caribbean; West Indies

[1] This paper presents some of the results obtained in PhD study tentatively entitled "Planning for Food Security in Three Caribbean Territories, Trinidad and Tobago, Belize and Barbados: Decision Making and Information Use."

Introduction

In recent years, food security, how it is defined, interpreted, measured and managed varies widely from institution to institution, country to country and region to region depending on many factors, circumstances and the cause of the current crisis which brings "food security concerns" to the fore. Timmer (2012) commented that "although not common, on average there are three food crises per century."

Evolving definition of food security

The definition of food security has evolved over time. Schejtman (1988) claimed that the term "food security" had its origins in the 1972 –1974 food crisis when according to Timmer (2011), "Over those two years, real rice prices rose 206.3% and real wheat prices rose 118.2%, both setting historic highs". The World Bank (1986) stated that food security exists "when all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life."

Over time there has been consensus that food security at the national level is the ability of a country to feed its people in an economically feasible and environmentally sustainable manner. Today, however, it is accepted that food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and cultural customs (Food and Agriculture Organisation 2003; Pinstrup-Andersen 2009). This latter definition of "food security" subsumes the nutrition aspect.

Global concerns regarding food supply

Thomas Malthus, in 1798, was one of the first to raise the issue of a world food problem by theorising that over-population was a possible cause ("Thomas Robert Malthus," 2008). In 2011, 925 million of 7 billion people were considered undernourished (Mousseau and Bailey 2009)—with malnutrition stunting the growth of children (Crosby, Norman, and McNair 2012) including limiting their literacy levels (Crosby, Jayasinghe, and McNair 2013; Richardson 2013). There are varying schools of thought about the adequacy of the global food supply. One claim is that there is sufficient food produced worldwide but it is distribution which is the problem. Another dimension of the problem is that of wastage both in post-harvest losses and in "throw away food." It is expected that by 2050, over 9 billion people with 70% living in cities will exist (Food and Agriculture Organisation 2009; World Bank 2008).

Today, the quality and quantity of global food supply are impacted by many events and factors. For example, overall production is affected by climate change resulting in the negative impact of extreme weather in major food-producing countries; production of biofuels resulting in alternative demand for food crops; depletion of fisheries stocks; increasing demand for energy increases cost of production; overproduction resulting in soil degradation and desertification; other problems stemming from the "green revolution," ccompetition for land(land grabbing), decreasing water availability and quality (Evans 2009).

The quantity of food available is also affected by transportation issues, cost of fuel, cost and availability of inputs, availability and accessibility of incentives and trade practices and rules (which are sometime unfair). The quality of the available food is being influenced by the production of genetically modified food and other food safety issues, such as, bioterrorism. Depressed incomes resulting from the global financial crisis, high food prices and possible future volatility as well as political and ethnic instability can affect the accessibility of food. As the majority of the poor worldwide live on agricultural holdings, the welfare of small farmers is of importance in terms of impact of food security.

Justification

In the Caribbean, some consider food

security to be second only to national security (Brathwaite 2012). The high dependency on food from markets external to the region:

> Seven of our countries in CARICOM have a per capita food-importation bill of over US$500, on an annual basis, when the global average in developing countries is just US$66 per capita. It means that we are importing more than 10 times of the average citizen in developing countries ("Reducing That High Food Import Bill," 2013).

as well as the high incidences of chronic non-communicable nutrition-related diseases ("CARICOM SG makes call for addressing high food import bill," 2011), among other indicators, are usually used to highlight the alarming level of national food insecurity in most Caribbean countries. Over the years, most plans for treating with problems of food security have been aimed at increasing agricultural production (even at the level of backyard gardening) and some social intervention at the level of inadequate access to food. However, the basis for decision making is unclear as a high level of food security has not been attainable and, possibly, has been deteriorating (CARICOM Secretariat 2012). Decisions made at the national/regional level are crucial in enhancing the level of national/regional food security. Fundamental to making such decisions is the prioritisation applied by decision makers regarding the issues involved.

Objective

This paper proposes to investigate the prioritisation of food security by decision makers using a multi-criteria decision-making (MCDM) analysis method called the Analytic Hierarchy Process (AHP).

Delimitation of the Study

This study is limited to aspects of the overall food availability and food access at the national level. The three Caribbean Community (CARICOM)[2] countries included in the study were Trinidad and Tobago, Belize and Barbados. They were chosen based on their diverse natures regarding food security. Table 1 lists the various characteristics of the three selected countries.

The reason for this selection was to have a sample representation of CARICOM countries based on varying economy, climate, natural resource base, agricultural production, trade patterns and population characteristics as well as culture, language, literacy levels and history. This would allow one to look at the results for similarities or differences with regard to food security which could be representative of the Caribbean due to the varied nature of the countries which constitute CARICOM.

Methodology

This study required a qualitative approach to answering the research questions as quantitative methods would not have been the most appropriate to solicit the type of responses required.

Due to the complexity of the concept of food security and concerns which if treated too simply many aspects may not be dealt with adequately, an appropriate methodology was sought for analysis. In reviewing methodologies which treat with the analysis of multidimensional issues, multi-criteria decision making (MCDM) analysis was identified. The Analytic Hierarchy Process (AHP), developed by Thomas L Saaty[3] in the 1980s, is one of a number of MCDM tools that have been widely used for analysing decision-making processes (Saaty & Vargas, 2001). The most utilised purposes of the AHP are:

[2] CARICOM countries are: Antigua & Barbuda, Barbados, Belize, Commonwealth of the Bahamas, Commonwealth of Dominica, Co-operative Republic of Guyana, Federation of St. Kitts & Nevis, Grenada, Jamaica, Montserrat, Republic of Haiti, Republic of Suriname, Republic of Trinidad & Tobago, St. Lucia, St. Vincent & the Grenadines.

[3] Distinguished University Professor at the University of Pittsburgh

1. Choosing the best item from a number of alternatives
2. Ranking a number of alternatives
3. Prioritising a number of alternatives by giving their relative importance

AHP is a theory of measurement that uses pairwise comparisons when applied to complex problems and "relies on the judgments of experts to derive priority scales"to assist in ranking decision priorities (Saaty 2008). "AHP uses objective mathematics to process the inescapable subjective and personal preferences of an individual or a group in making a decision" (Saaty and Vargas 2001).

The steps involved in an AHP analysis (Saaty, 2008) are:

1. Decompose the issue, select the goal, criteria and alternatives. Build a hierarchical structure- with a main goal at the top and subsequent levels of criteria and the alternatives at the lowest level.
2. Do the pairwise comparisons of the criterion to set priorities. Experts are asked to assign weights to indicate the level of importance and how much more important one aspect of the pair is to the other aspect according to the scale in table 2.
3. Synthesise the results. Utilising matrices the judgements of the pairwise comparisons are scored to derive the weightings/priorities. Ranking and relative importance are obtained when these weighting/priorities are normalised. Idealised priorities, done when the overall relative score derived for each option is calculated, are done when the highest rank is represented as 100% and the other alternatives are shown as a proportionate value.
4. Group priorities are calculated based on the geometric mean.
5. Consistency ratios are calculated to reflect the consistency of the expert's judgement.

Sample

The study population being investigated comprised decision makers in the area of national food security and those who most influence them. This includes the following:

- Policy makers: Ministers, Permanent Secretaries, Director of Planning/Senior Research Officer/Senior Economist in the Ministries of Agriculture/Food Production and possibly Environment, Health, Trade, Planning, Social Development
- Planners and Technocrats in the Ministry of Agriculture/Food Production (persons who provide policy makers with briefs and support for decision making)
- Persons who influence policy makers: Directors of International and Regional Agencies; Food and Agriculture Academics; Heads of Relevant Associations, Boards, Non–Governmental Organisations (NGOs)

The sampling method was, therefore, stratified purposive as the study population was small and contained subgroups which facilitated comparisons (Creswell 2007). Purposive sampling allows for selecting a small number of cases "that will yield the best information about a particular phenomenon" (Bickman and Rog 2009) and have a range of characteristics relevant to the study (Gorman and Clayton 1997). As AHP is onerous it is usually carried out on a small number of persons, who are considered experts in the area of study.

The AHP questionnaire was completed by 21 persons. The breakdown by country and category of these persons is detailed in table 3. As seen in table 3, there were 7 persons from each country (which could also be categorised as 5 policy makers, 8 planners/technocrats and 8 influencers) completed the AHP questionnaire.

Decomposition of the issue being studied

In order to determine the prioritisation placed on food security in terms of the agricultural sector, objectives of the agricultural sector were identified as:

1. Ensuring a desired level of economic trade-based food security, i.e., food must be available and accessible no matter what the circumstances
2. Ensuring a desired level of food self-sufficiency and sustainability of the environment, i.e., maximise domestic food production without endangering the environment as a matter of priority
3. Ensuring a desired level of export trade and or other economic activity (growing food to support tourism or agro processing for export)
4. Ensuring support for producers and local agribusiness
5. Maximising employment in agriculture as a welfare strategy (keeping the unskilled unemployed in some kind of work activity)

For the purposes of this study the criteria by which the food supply can be evaluated were stability, dependency, equity, sufficiency and sustainability (Ali-Renwick, 1992). They were derived from the following variables which influence food availability and access of the food supply at the national level:

1. The degree of stability (refers to the fluctuations in levels of aggregate supply as well as fluctuations in prices over time)
2. The degree of external dependency (relates to the external vulnerability of the food supply)
3. The degree of sufficiency (includes the level to which food supply, from both domestic production and imports, satisfies the existing demand for nutrients including micronutrients)
4. The degree of sustainability (refers to maintenance of the food supply over the long-term, taking care to achieve equity, stability, some degree of autonomy and sufficiency without depleting renewable and non-renewable resources to such an extent as to make the supply unsustainable in the long run.)
5. The degree of equity (reflects a value judgement based on a human right to safe food and evidence of malnutrition [whether from inadequate or excess calories]).

The five criteria which describe the food supply can be measured by a number of indicators (Ali-Renwick 1992).

Figure 1 illustrates the hierarchy developed for the analysis of the problem treated with in this study. Each level of the hierarchy was limited to 5 items as beyond this the number of pairwise combinations may become too onerous increasing the possibility of judgements being inconsistent.[4]

The hierarchy structure for the problem being analysed involves the goal of achieving a desired level of national food security. The second level consists of the criteria by which the food supply can be evaluated. The third level contains the alternative objectives of the agricultural sector.

Methods

Data gathering was done by interview utilising an AHP questionnaire. The questionnaire posed the pairwise comparisons for the interviewee to indicate on a scale how much more important one item is relative to the other (table 2). In this study, the question asked of the interviewees was how do you rank the importance of A over B not what do you think the should be the importance of A over B.

Results

Based on the AHP analysis[5] of the pairwise comparisons, the priority weightings for the food supply criteria by category of persons are listed in table 4 and illustrated in figure 2.

As illustrated in table 4 and figure 2, both planners/technocrats and influencers ranked sustainability as the most important criteria,

[4] Five factors require 10 comparisons, 6 factors would need 15 comparisons while 7 factors would need 21 paired comparisons (Rucker, 2008).

[5] AHP software utilised in this analysis was developed in 2013 by Devin Escallier, MSc Computer Science student/Supervisor: Dr. Wayne Goodridge of the Department of Computing and Information Technology, Faculty of Science and Technology, The University of the West Indies, St. Augustine, Trinidad and Tobago.

though policy makers ranked sufficiency highest. Note that the highest ranked criteria in both cases were substantially more important than the other criteria. Influencers felt that equity was the least important criterion but for both policy makers and planners/technocrats, dependency was the least important. Policy makers appear to be the most consistent in their judgements.

The priority weighting for the criteria of the food supply by country are listed in table 5 and illustrated in figure 3. As shown in table 5 and figure 3, in order of importance, the criteria were ranked in all three countries as follows: (1) sustainability; (2) sufficiency; (3) stability; (4) equity and (5) dependency.[6] Though having a consistency ratio more than 10%, persons in Belize appear to be the most consistent of the countries.

The priority weightings of the objectives of agriculture by categories of persons are listed in table 6 and illustrated in figure 4.

Policy makers and planners/technocrats ranked food security as the most important objective but influencers ranked food-self sufficiency and sustainability of the environment as the most significant. All three categories thought that supporting the farmer as producer and local agribusiness as the next most important objective. Being self sufficient and ensuring sustainability of the environment was the third most important objective. Using agriculture to provide employment for unskilled workers as a welfare instrument was the fourth most important objective. The least important objective was conducting agriculture for export trade or to support tourism or agro processing.

Across countries, economic trade-based food security was considered the most important objective of agriculture. However, though food self sufficiency and sustainability of the environment was considered the next most important objective by persons in Trinidad and Tobago as well as Barbados, those in Belize felt that supporting the farmer as producer and local agribusiness the second most important objective. Doing agriculture to provide employment and as a welfare tool was the fourth most important objective for all and export trade and other economic activity the least important objective.

Figure 6 illustrates the overall priorities for the objectives of agriculture for each of the criteria of the food supply. This bar chart shows the degree of importance of the various objectives of agriculture in terms of the criteria used to evaluate the food supply. Food security, producer/local agribusiness and food self-sufficiency and the environment ranked substantially more important than equity and trade and other economic activity.

The overall priority weightings for the criteria of the food supply as well as the alternatives are stated in table 8. Overall weightings for the criteria, ranked in order of importance with the most significant first, are: (1) sustainability; (2) sufficiency; (3) stability; (4) equity and (5) dependency (table 8). The consistency ratios for the criteria indicate that the experts were most consistent in weighing sustainability, sufficiency and stability. There was some inconsistency in determining the weights of equity and dependency.

In terms of the objectives of agriculture, they were ranked as (1) economic trade-based food security; (2) farmer as producer/local agribusiness; (3) food self-sufficiency and the sustainability of the environment; (4) maximising employment in the agriculture sector as welfare and (5) the export trade and other economic activity.

Table 9 illustrates the final synthesis results in terms of normal priorities and idealised priorities. The normal priorities clearly show the ranking 1—5 of the alternatives. The idealised priorities show that if the highest, economic trade-based food security is 100%, supporting:

- the producer/local agribusiness is 75.31% as important
- food self-sufficiency and sustainability of the environment is 68.71% as important
- maximising employment in agriculture as welfare is 36.51% as important

[6] (1) is the most important and (5) is the least important.

- trade and other economic activity is 33.50% as important.

Discussion and Conclusion

Consistency of judgements

In terms of consistency of the expert judgement, it was illustrated that the experts were not always clear in their thinking and this was reflected in their judgements. However, though some of the ratios were above 10%, only two sets of judgements rated above 20%- that of the planners/technocrats weightings (22.6%) and persons in Trinidad and Tobago weightings (22.2%) in terms of the criteria of the food supply. Values above 10% are considered inconsistent, however "Saaty concedes that values just above 10% may have to be accepted sometimes", though values of 90% are unacceptable (Coyle, 2004). AHP questionnaires are onerous and time-consuming, this may have caused some inconsistencies rather than actual inconsistency in judgement.

Limitations of this AHP study

Access to the relevant persons was limited by accessibility, availability, time and cost of conducting the research. This was especially so for high level policy makers, with whom it was extremely difficult to arrange for the kind of detailed interviews needed for an AHP questionnaire and, therefore, those interviewed were selected based on availability within the time the study was conducted.

Interpretation of results

Results showed that despite the diversity of the three countries, the criterion of sustainability of the food supply was rated the most significant at both the category of persons and country levels. That it was substantially more so than the criteria of equity and dependency, which were the less important criteria, was a valuable discovery. This may be because, much of the discussion about food security in the Caribbean focuses on reducing the high food import bill and access to food by the poor. As a result, policies and plans to treat with food security focus on these aspects. This begs the question has the more politically and emotionally-appealing criterion, such as reducing external dependency (i.e., reducing the food import bill) given prominence despite sustainability of the food supply has in reality been the thinking of the decision makers?

Maybe consideration of the importance of sustainability of the food supply is as a result of an increasing awareness of the growing negative impact of global food and nutrition insecurity (as outlined earlier, for example, the possible effects of climate change, global economic instability and strife etc.).

Also, the policy makers rated sufficiency of the food supply of highest importance as opposed to the planners/technocrats and influencers. That policy makers are more concerned about the fact that people should be getting sufficient food to be healthy and productive is an imperative and laudable goal.

Economic trade-based food security was ranked the most important objective of the agricultural sector. This finding reveals that across countries and categories of persons, the main objective of the agricultural sector was that food must be provided whether by domestic production or by imports.

The next most important objective was supporting farmers as producers and local agribusiness. This implies that there is a consciousness that policies and issues affecting this group must be championed. They must be assisted as they are fundamental to domestic food supply.

Food self-sufficiency and sustainability of the environment was the third most important objective, actually, ranking higher than maximising employment (as a welfare strategy) in the agricultural sector. The latter would, of course, assist with equity and sufficiency of the food supply. So this prioritisation regarding this objective is equivalent to priorities of the criteria (where

equity was one of the less important criterion) and, one may even say it provides some measure of validation of the results. Domestic food production for trade and other economic activity was the least most important objective of agriculture across the countries.

Recommendations

These findings reveal that food security is the most significant objective of decision makers in the agricultural sector but enhancing the level of food security may require plans and policies which are long-term, sustainable, and supportive of producers rather than focus on the immediate call for reducing the food import bill.

One major impact of global food and nutrition insecurity concerns as outlined earlier is that, in times of crisis or conflict, essential food may not be available for purchase on the world market or be unable to reach the country, so having economic trade-based food security the main objective of agriculture may not be prudent. This may call for a reconsideration of the current strategies, plans and policies.

This study investigating the priories placed on the importance of how criteria and objectives related to food security are considered shows that there is merit in using a methodology like MCDM analysis, one not traditionally used for this purpose in the Caribbean, to look at an issue and find a unique perspective. An understanding of which may allow for new and creative approaches to making a difference to the level of food insecurity in the Caribbean.

Acknowledgements

I would like to thank my supervisor, Dr. David Dolly, as well as advisory committee members: Dr. Govind Seepersad and Dr. Marisa Wilson for their guidance. I, also, sincerely thank Devin Escallier and Dr. Wayne Goodridge, M.Sc. student and thesis supervisor, respectively, for use of the AHP software they developed and allowing me to use it. I acknowledge the UWI Campus Research and Publication Fund for their support. My gratitude is extended to the 21 persons who so willingly and patiently completed the AHP questionnaires.

.

References

Ali-Renwick, S. 1992. "Food Security in Trinidad and Tobago: Data Requirements and Policy Implications." MPhil. Thesis. The University of the West Indies, St. Augustine, Trinidad and Tobago.

Bickman, L., and D.J. Rog, eds. 2009. *The Sage Handbook of Applied Social Research Methods* (2nd ed.). Los Angeles, CA: Sage.

Brathwaite, C. (Former Interim Director of the School of Agriculture, FSA, UWI, St. Augustine). 2012. Interview by author, April 13, St. Augustine, Trinidad and Tobago.

CARICOM Secretariat. 2012. Coordinated Efforts Needed To Tackle High Food Import Bill. Accessed June 20, 2013, from http://www.caricom.org/jsp/pressreleases/press_releases_2012/pres279_12.jsp.

CARICOM SG makes call for addressing high food import bill. (2011, October 14). *Dominica News Online*. Retrieved from http://dominicanewsonline.com/news/homepage/news/agriculture/caricom-sg-makes-call-for-addressing-high-food-import-bill.

Central Intelligence Agency. CIA. 2013. The World Factbook. Accessed June 9, 2013, from https://www.cia.gov/library/publications /the-world-factbook/index.html.

Coyle, G. 2004. "The Analytical Hierarchy Theory (AHP)." *Practical Strategies: Structured Tools and Techniques*, edited by G. Coyle. UK: Pearson Education.

Creswell, J. W. 2007. *Qualitative Inquiry and Research Design: Choosing Among Five Approaches* (2nd ed.). Thousand Oaks, CA: Sage.

Crosby, L., K. Norman, and D. McNair. 2012. "A High Price to Pay." Accessed from http://www.savethechildren.org.uk/resourc

es/online-library/high-price-pay.

Crosby, L., D. Jayasinghe., and D. McNair. 2013. "Food for Thought: Tackling Child Nutrition to Unlock Potential and Boost Prosperity." Accessed from http://www.savethechildren.org/atf/cf/%7B9def2ebe-10ae-432c-9bd0-df91d2eba74a%7D/FOOD_FOR_THOUGHT.PDF.

Evans, A. 2009. "The Feeding of Nine Billion: Global Food Security for the 21st Century." Accessed April 11, 2009, from http://globaldashboard.org/wp-content/uploads/2009/Chatham_House_Feeding_Nine_Billion.pdf.

Food and Agriculture Organisation. 2003. Trade Reforms and Food Security: Conceptualizing the Linkages. Accessed June 9, 2013, from ftp://ftp.fao.org/docrep/fao/005/y4671e/y4671e00.pdf.

Food and Agriculture Organisation. 2009. "How to Feed the World in 2050." Rome, Italy: FAO.

Gorman, G. E., & Clayton, P. (1997). *Qualitative Research for the Information Professional: A Practical Handbook*. London: Library Association Publishing.

Mousseau, F., and M. Bailey. 2009. "A Billion Hungry People: Governments and aid agencies must rise to the challenge." *Oxfam Briefing Paper* Accessed April 12, 2009. http://www.oxfam.org/sites/ www.oxfam.org/files/bp127-billion-hungry-people-0901.pdf.

Pinstrup-Andersen, P. 2009. "Food security: definition and measurement." *Food Security, 1*(2009), 5-7. doi: 10.1007/s12571 -008-0002-y.

Reducing That High Food Import Bill. 2013. *Guyana Chronicle Online*. March 1.

Richardson, H. 2013. Authors Back "Malnutrition Hits Literacy" study. *BBC News: Education and Family, 2013*(June 20). http://www.bbc.co.uk/news/education-22656793.

Rucker, R. 2008. AHP Survey Technique - Draft 08-12. Accessed June 20, 2013, from http://www.milagrosoft.com/AHPSurveyTechniques.pdf.

Saaty, T.L. 2008. "Decision Making with the Analytic Hierarchy Process." *International Journal of Services Sciences* **1(1):** 83-98. doi: 10.1504/IJSSCI.2008.017590.

Saaty, T. L., and L.G. Vargas. 2001. "How to make a decision." *Models, Methods, Concepts & Applications of the Analytic Hierarchy Process*, 1-25.

Schejtman, A. 1988. "Food Security: Trends and Impacts of the Crisis." *Cepal Review* **36:** 141-160.

Thomas Robert Malthus. 2008. In D. R. Henderson (Ed.), *The Concise Encyclopedia of Economics*: LIbrary of Economics and Liberty.

Timmer, C.P. 2011. Tuesday February 22, 2011. Failed Policies Lead to Food Shortages: the World Needs More Investment in Agricultural Research and Infrastructure, *The Wall Street Journal*. Retrieved from http://online.wsj.com/article/SB10001424052748704476604576157611079551494.html.

Timmer, C.P. 2012. "Behavioural Dimensions of Food Security." *Proceedings of the National Academy of Sciences of the United States of America* **109(31):** 12315-12320. http://www.pnas.org/content/109/31/12315.full.pdf+html.

World Bank. 1986. *Poverty and Hunger: Issues and Options for Food Security in Developing Countries*. Washington, D.C.: World Bank.

World Bank. 2008. World Development Report 2008. Washington, DC: World Bank.

Table 1: Characteristics of selected countries

Characteristics	Country		
	Trinidad and Tobago	Belize	Barbados
Land size(km^2)	5,128	22,966	430
Arable land (%total land)	251.3 (km^2) (4.9%)	757.9 (km^2) (3.3%)	120.0 (km^2) (27.9%)
Population	1,225,225	334,297	288,275
Pop density (pop per km^2)	239	14.6	670.4
Labour force (agri) (%pop)	46,559 (3.8%)	34,098 (10.2%)	28,826 (10.0%)
Main Econ activity	Oil / Gas	Tourism	Tourism
GDP (USD)	27.1 b**	2.9 b	7.1 b
Agri GDP	0.3%	10.2%	3.1%
Food Import Bill (USD)*	364 million	44 million	128 million

Source: Data from CIA (2013)
*2010
**billion

Table 2: Example scale of comparisons

Intensity of importance on an absolute scale	Description
1	Equal importance
3	Moderate importance of one factor over another
5	Strong or essential importance
7	Very strong importance
9	Extreme importance
2, 4, 6, 8	Intermediate values
Reciprocals	Values for inverse comparison

Source: Adapted from Saaty (2008)

Table 3: Breakdown of sample by country and category of persons

Category	Country			
	Trinidad and Tobago	Belize	Barbados	Total
Policy makers	1	2	2	5
Planners/Technocrats	3	3	2	8
Influencers	3	2	3	8
Total	7	7	7	21

Table 4: Priority weighting for the criteria of the food supply by category of persons

Criterion	Policy Makers	Planners/Tech.	Influencers
Stability	12.95	21.41	16.34
Dependency	6.66	8.06	18.21
Equity	14.47	13.55	13.23
Sufficiency	33.30	18.14	14.99
Sustainability	32.63	38.83	37.22
Consistency Ratio	0.0040	0.0226	0.0193

Table 5: Priority weightings for the criteria of the food supply by country

Criterion	Country		
	Trinidad and Tobago	Belize	Barbados
Stability	16.12	16.02	20.27
Dependency	13.54	9.19	9. 91
Equity	15.43	15.59	10.82
Sufficiency	21.76	14.38	23.96
Sustainability	33.15	44.82	35.04
Consistency Ratio	0.0222	0.0155	0.0170

Table 6: Priority weightings for the objectives of agriculture by category of persons

	Policy makers	Planners/Tech	Influencers
Food Security	35.63	37.03	24.94
Food Self-Suff./Environ. Sust.	18.97	18.56	27.94
Trade/Economic Activity	8.31	10.77	11.69
Producer/Agribusiness	24.27	21.09	26.14
Employment/Welfare	9.28	12.55	12.81

Table 7: Priority weightings for the objectives of agriculture by country

Objective	Country		
	Trinidad and Tobago	Belize	Barbados
Food Security	34.14	30.06	28.98
Food Self-suff/Environ. Sust.	28.24	11.85	28.54
Trade/Economic Activity	6.94	13.36	11.94
Producer/Agribusiness	21.26	28.88	19.99
Employment/Welfare	9.42	15.85	10.55

Table 8: Overall priority preference matrix

	Stability	Dependency	Equity	Sufficiency	Sustainability	Priorities
Criteria Weights	17.48	10.79	14.04	19.95	37.73	
Consistency Ratio	0.0066	0.0114	0.0151	0.0079	0.0045	
Food Security	30.74	28.12	36.5	37.69	28.6	31.84
Food Self-Suff./Environ.	21.40	21.86	16.53	22.40	23.82	21.88
Trade/Econ. Activity	9.44	11.20	10.21	10.46	11.37	10.67
Producer/Agribusiness	27.66	27.60	20.51	19.19	25.07	23.98
Employment/Welfare	10.76	11.22	16.25	10.27	11.14	11.63

Table 9: Final synthesis results

Objectives of Agriculture	Normal Priorities	Idealised Priorities	Ranking
Food Security	31.84	100.00	1
Food Self-Sufficiency/Environ.	21.88	68.71	3
Trade/Economic Activity	10.67	33.50	5
Producer/Agribusiness	23.98	75.31	2
Employment/Welfare	11.63	36.51	4

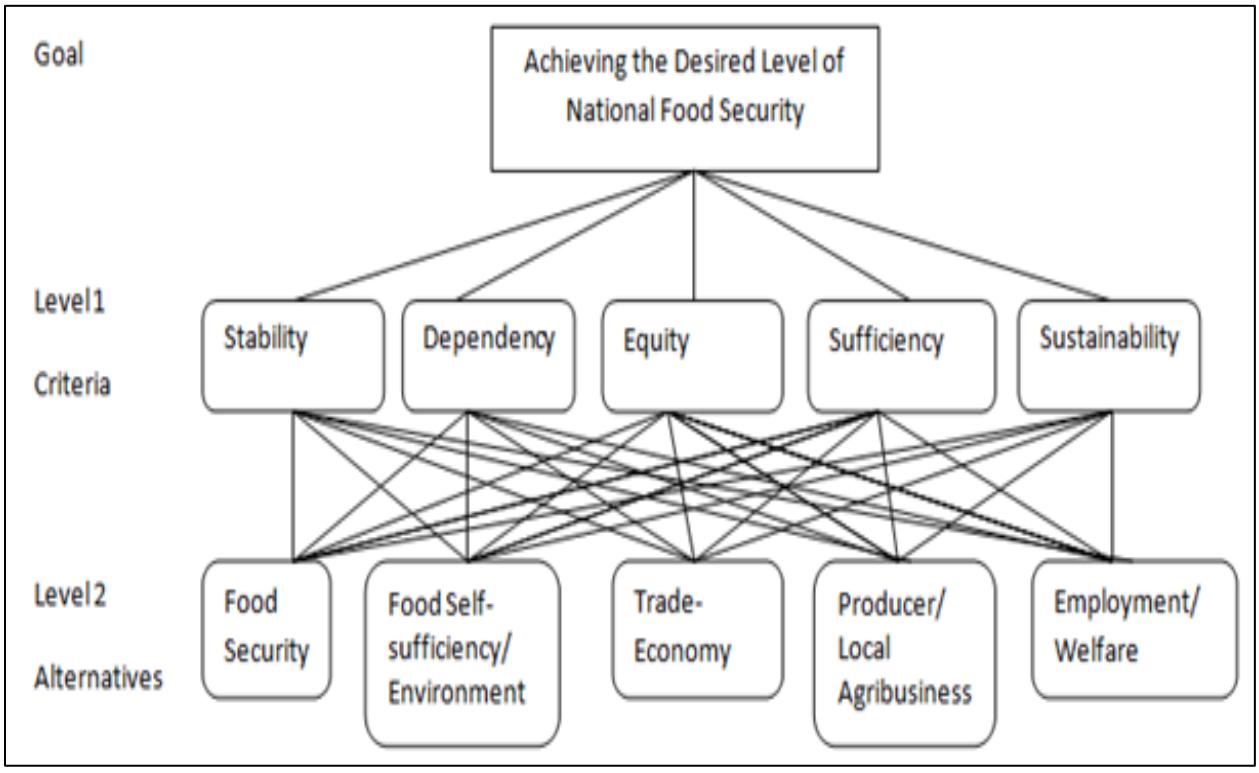

Figure 1: Hierarchy structure

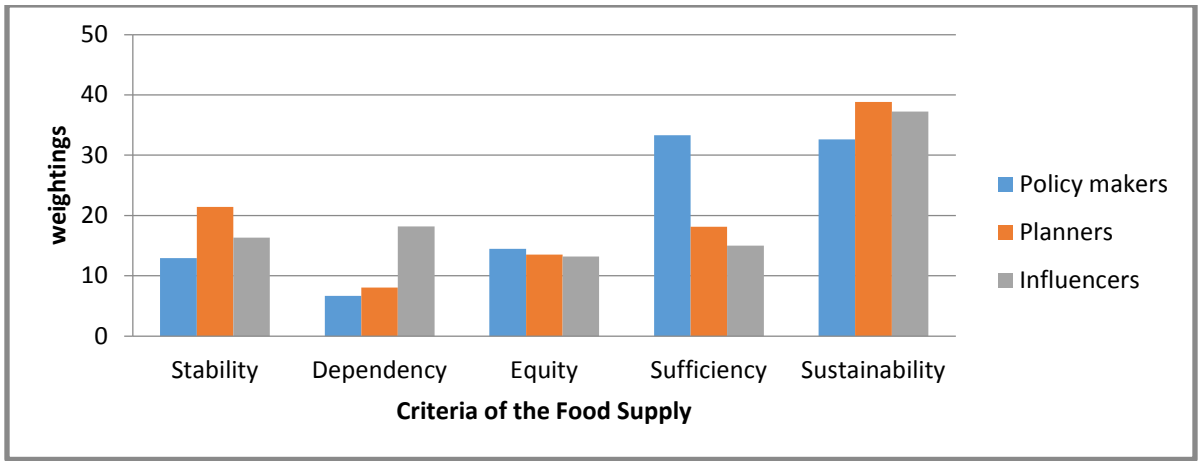

Figure 2: Priority weightings for the criteria of the food supply by category of persons

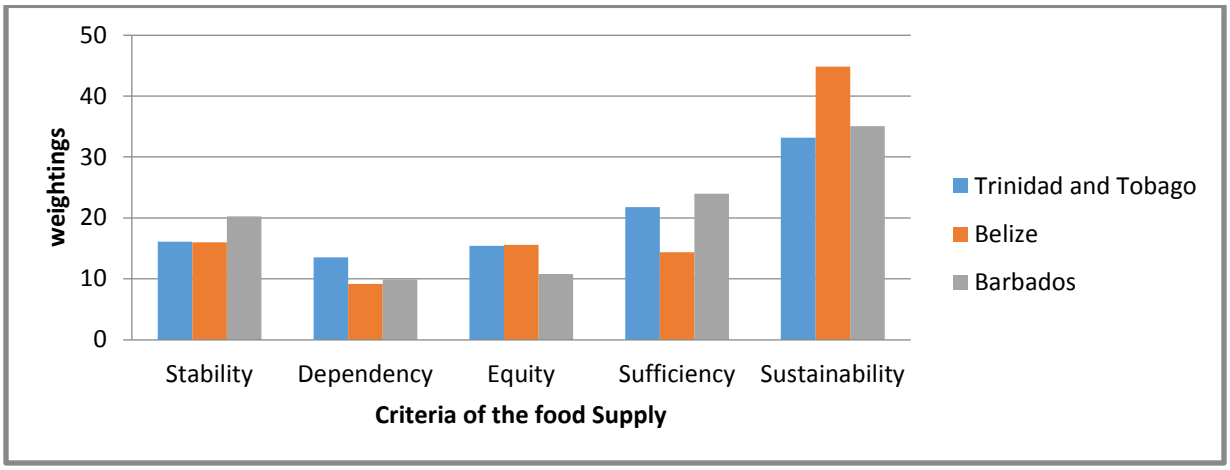

Figure 3: Priority weightings for the criteria of the food supply by country

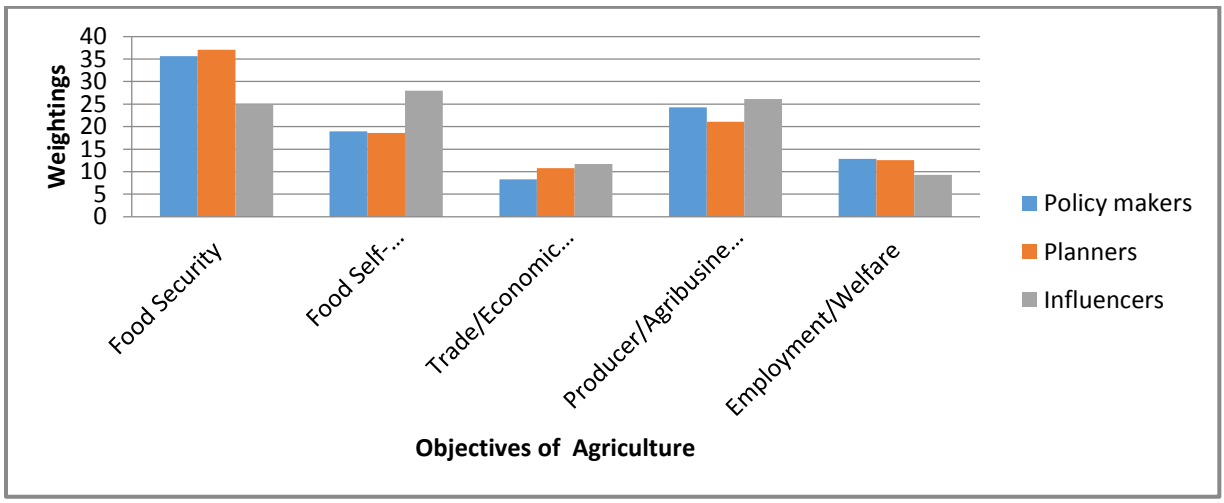

Figure 4: Priority weightings for the objectives of agriculture by category of persons

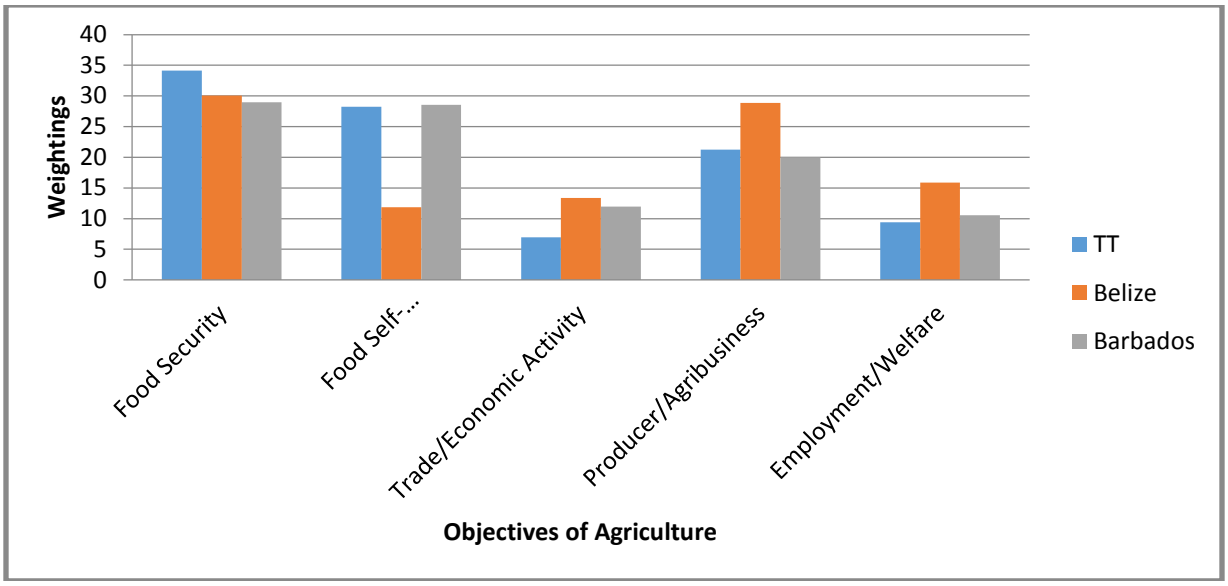

Figure 5: Priority weightings for the objectives of agriculture by country

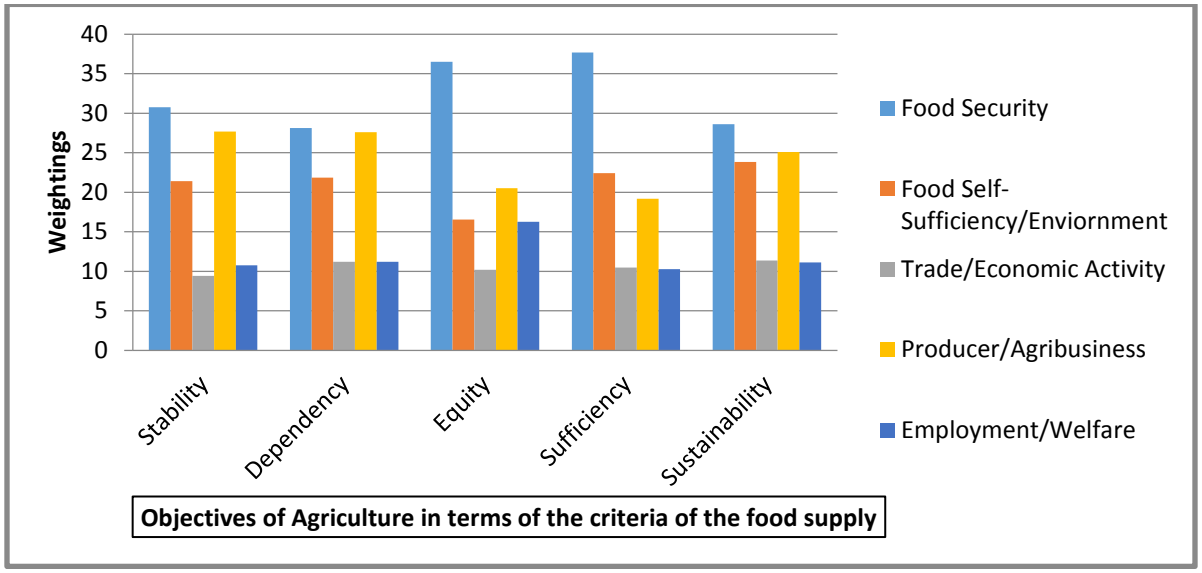

Figure 6: Overall priority weightings for the objectives of agriculture in terms of the food supply