Introducing a New Conceptual Framework of Food Security Integrating the Latest Understanding of the Phenomenon

Mark Gibson

Submitted in part fulfilment of the requirements of the Manchester Metropolitan University for the Degree of Doctor of Philosophy

Hollings Faculty: Department of Food and Tourism Management

Dec 2011

Disclaimer

No portion of this work has been submitted in support of an application for another degree or qualification in this University or any other institution of learning.

Acknowledgements

I would like to express my sincere thanks to the following for their valuable assistance and support in the completion of this thesis.

Dr. Tim Knowles

My director of Studies whose constant vigilance and support has kept me on track in this endeavour. I would especially like to acknowledge Tim's approachability and the fact that he always made time for me.

Dr. Emma Derbyshire

I would like to express my gratitude to Emma whose supervision, extensive knowledgebase base and patience has been a constant source of inspiration.

Professor Charles Brennan

I express my sincere thanks to Charles for his unwavering support and confidence in me. I also wish to express gratitude to Charles for his diplomacy and tact which has been the glue that has held this project together.

The University Library

For their continuous help and assistance and for providing a conducive environment in which to work.

Hannah, Kaur and Dalvina

I would especially like to extend my warmest gratitude to the three most important people in my life who constantly fill me with inspiration.

I would also like to thank Valentina Stojceska who helped me greatly in the early stages of this research and Dr. Elizabeth Ineson whose advice in the quantitative analysis stages was much appreciated.

Abstract

With little change in malnourished figures over the last 40 years there lacks consensus over conceptualising and dealing with the issues of food security. At the heart of the problem are the numerous issues that seemingly interact in complex ways that are difficult to elucidate. In an attempt to understand and clarify such issues conceptual modelling is increasingly used. However, despite some good progress there still remains serious concerns over the suitability of many present day models. Two of the major concerns regarding these models include their lack of overarching scope and the often seemingly ad-hoc or non-rigorous nature of the frameworks themselves; often replete with ill-defined and/or subjective conceptualisations.

With this in mind the aim of this research was to fill this knowledge gap with a new improved framework that addresses these issues. In the course of this research it was highlighted that one of the barriers to a full understanding of the subject was the way in which it was fragmented and ultimately reflected in separate models. As a result this research's approach concentrates on combining the hitherto separately dealt with multi-disciplinary issues into one holistic model. In doing so this work provides a new model of food security that sets itself apart from its contemporaries as being thoroughly comprehensive and overarching and one which also helps place the many hitherto disparate elements in better context. Moreover this new framework also stands apart in its rigorous methodological application which is both predominantly objective, intuitive and transparent.

In achieving this, this study comprised a literature review of current food security issues as well as social science modelling. This provided the tools used to evaluate 25 existing food security models of which 6 were looked at in detail with case study analysis. This resulted in one framework that was considered representative of the existing models. Separately two other models were created using two pilot studies; 7 focus groups; and an online global forum discussion. Collectively all three models were taken and evaluated using 6 specialist interviews and the resultant findings were incorporated into a single new framework.

In conclusion a review of the literature revealed a widespread lack of comprehension of the overarching perspective of food security issues in general. In addition however while there was also found to exist overwhelming support for the continued use of conceptual models in principle, there was also much agreement for the need to formalise the process. As a result this research produced an updated framework of food security that was seen by the specialists as an improvement on existing models. This new model was seen as easier to interpret whilst also displaying clear boundaries and relationships. Importantly too the new model also covered the whole spectrum of food security issues and by introducing a 3-part framework each with increasing levels of complexity, the model also has the capacity to appeal to novices and experts alike thus facilitating a more complete understanding of the phenomenon at all levels.

Contents

List of Figures

List of Tables

List of Abbreviations

APEC	Asia Pacific Economic Cooperation
ASEAN	Association of Southeast-Asian Nations
AU	African union
CGIAR	Consultative Group on International Agriculture Research
CIS	Commonwealth of Independent States A community of States
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CSD	Commission on Sustainable Development
CSSD	Consultative Sub-Committee on Surplus Disposal
DEFRA	UK Department for Environment, Food and Rural Affairs
DES	Dietary Energy Supply
DESA	Department of Economic and Social Affairs
EC	European Community
ECOSOC	UN Economic and Social Council
EU	European Union
FAC	Food Aid Convention
FAO	UN Food and Agriculture Organisation
FAOSTAT	FAO Statistical Databases
FIVIMS	Food Insecurity And Vulnerability Information And Mapping Systems
FPI	Food Price Index
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GIEWS	Global Information and Early Warning System on Food and Agriculture
GNI	Gross National Income
HDI	Human Development Index
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IMF	International Monetary Fund
IMR	Infant Mortality Rate
LDCs	least developed countries
LIFDC	Low-Income Food-Deficit Country
MDGs	Millennium Development Goals
MENA	Middle East and North Africa
NGO	Non-Governmental Organization
OCHA	Office for the Coordination of Humanitarian Affairs
ODA	Official Development Assistance
OECD	Organisation of Economic and Cooperative Development
OHCHR	Office of the United Nations High Commissioner for Human Rights

PPP	Purchasing Power Parity
SCN	United Nations System Standing Committee on Nutrition
SOFI	State of Food Insecurity
UN	United Nations
UNCCD	UN Convention to Combat Desertification
UNCTAD	UN Conference on Trade and Development
UNDG	United Nations Development Group
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	UN Educational, Scientific and Cultural Organization
UNFCCC	UN Framework Convention on Climate Change
UNFPA	United Nations Population Fund
UNHCHR	United Nations High Commissioner for Human Rights
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
UNU	United Nations University
USAID	US Agency for International Development
USDA	United States Department of Agriculture
WFP	World Food Programme
WFS	World Food Summit
WHO	World Health Organisation UN specialised agency
WRI	World Resources Institute
WTO	World Trade Organisation

Introduction

Every year globally over 10 million people die directly as a result of hunger and hunger related diseases (WFP 2011). This highlights the dilemma that sees close to one billion people underfed and suffering malnutrition while at the same time over 1.6 billion adults around the globe are overweight (WHO 2010). At a time when enough food is produced globally to feed the population comfortably the subject; unsurprisingly becomes emotive with many strong convictions and much blame as to the causes and lack of solutions. Over the last few decades some cite a lack of cohesive policymaking and issues of governance at both the national and global level, as being responsible for the general overall lack of progress (Devereux 2000; Devereux *et al.* 2004). Others allude to the complexity, misinterpretation and inherent lack of understanding in a subject that is as broad as it is complex. Yet others still wonder whether there is not a more fundamental issue at stake, regarding the basic conceptualisation of the key underlying concepts of the food security phenomenon itself (Devereux 2000; Radimer 2002; Scaramozzino 2006; Greenway 2008).

Whatever the original cause of this slow progress the current difficulty in food security understanding is being compounded by new modern driving forces. World population for instance is increasing by 80 million a year; biofuels compete directly with food (CFS 2008a); and other factors like high energy prices; globalisation; income growth; climate change; land and soil degradation; and urbanisation are all colluding to transform regional and global food production and consumption patterns (Schmidhuber 2003; Eswaran, Reich *et al.* 2006; Brown 2008; UNPP 2009). On top of these supply and demand pressures there are also difficulties of access. In this respect one of the more widely agreed barriers in a person's ability to acquire the food they require is poverty. So with over a billion people living in absolute poverty, equitable access to sufficient safe and nutritious food is of increasing growing social and political concern (FAO 2006). Other difficulties concerning food security too have been ascribed to among other things: a lack of political will; poor governance; a lack of institutional support and under-investment (FAO 2002; Rivera and Qamar 2003; Clapp 2009; G8 Summit 2009).

In an attempt to understand such complexity several key tools are employed; these include conceptual frameworks, construct models and concept maps. Properly defined such frameworks are very useful in consolidating understanding of a subject and developing theoretical linkages (Ericksen 2008; Novak and Cañas 2008). Indeed, it has been said that:

> "...until it is conceptualised as a multi-dimensional process... [food security indeed] cannot be effectively understood or addressed" (Misselhorn 2005).

Unfortunately however, if not considered carefully such frameworks can and do confuse readers and often lead to the over-simplification or the complication of inherent ideas (Ellis and Briggs 2001). All in all given the multiplicity and complexity of these issues it has been

suggested that more inter-disciplinary work in the field of conceptual analysis and current methodologies is needed (IPC Global Partners 2008; SCAR 2008). This is perhaps best summed up in the words of Riely and colleagues who argue that:

> "A well-defined conceptual framework … provides a broader context which is critical for successfully interpreting food security … particularly in the identification of factors (such as climate or food prices)…" (Riely, Nancy, Mock *et al.* 1999).

Therefore, the goals and objectives outlined in this research aim to provide a deeper understanding of the contentious issues of food security through the provision of a new conceptual model. In achieving this, this research aims to provide a useful framework that is objective and which also stands up under scrutiny. More than this though this new framework improves on existing models through a detailed analysis of the overarching nature of the food security concept as well as acknowledgment of the interaction of the many variables involved. However, it must also be noted that the aim of this research is not to determine the causality of food security but rather collate those potential influences of the phenomenon as determined by the literature and the primary research into one overarching framework. As a result, it is hoped this framework will become a valuable tool in an arsenal of existing data strategies that provide an effective means of communicating complex analysis to all food security stakeholders. After all, as Anderson and Cook (1999) state in their community food security (CFS) study, developing theoretical frameworks is not just an abstract exercise; a properly constructed and elucidated framework has direct consequences for social and policy action (Anderson and Cook 1999, IPC Global Partners 2008).

In the process this research generates new knowledge in three specific areas. Firstly, drawing on the modelling literature a practical, scientific methodology for constructing an appropriate and quality focused conceptual framework is created. Secondly, a set of guiding principles that aims to formally assess the quality dimensions of such models is drawn up. Lastly, new knowledge is also created in the outcome model itself which uniquely combines and reflects the latest holistic thinking on the subject.

A summary of this research's goals are elucidated in the aims and objectives.

Aims and Objectives

The aim of this research is to introduce a new conceptual model of food security that reflects the latest understanding of the phenomenon.

This is achieved through the following objectives:

1. To evaluate the breadth of the issues involved in the concept of food security;

2. To analyse the components of good social science modelling construction and to improve on existing procedures that add academic rigour through the formalisation of the methods involved;
3. To determine a set of dimensions of model quality and to evaluate existing food security frameworks' against these;
4. To analyse and integrate the latest thinking in food security into an updated model that reflects these advances;
5. To strengthen and validate the final framework through specialist interviews and appropriate methodologies.

Structure of Research

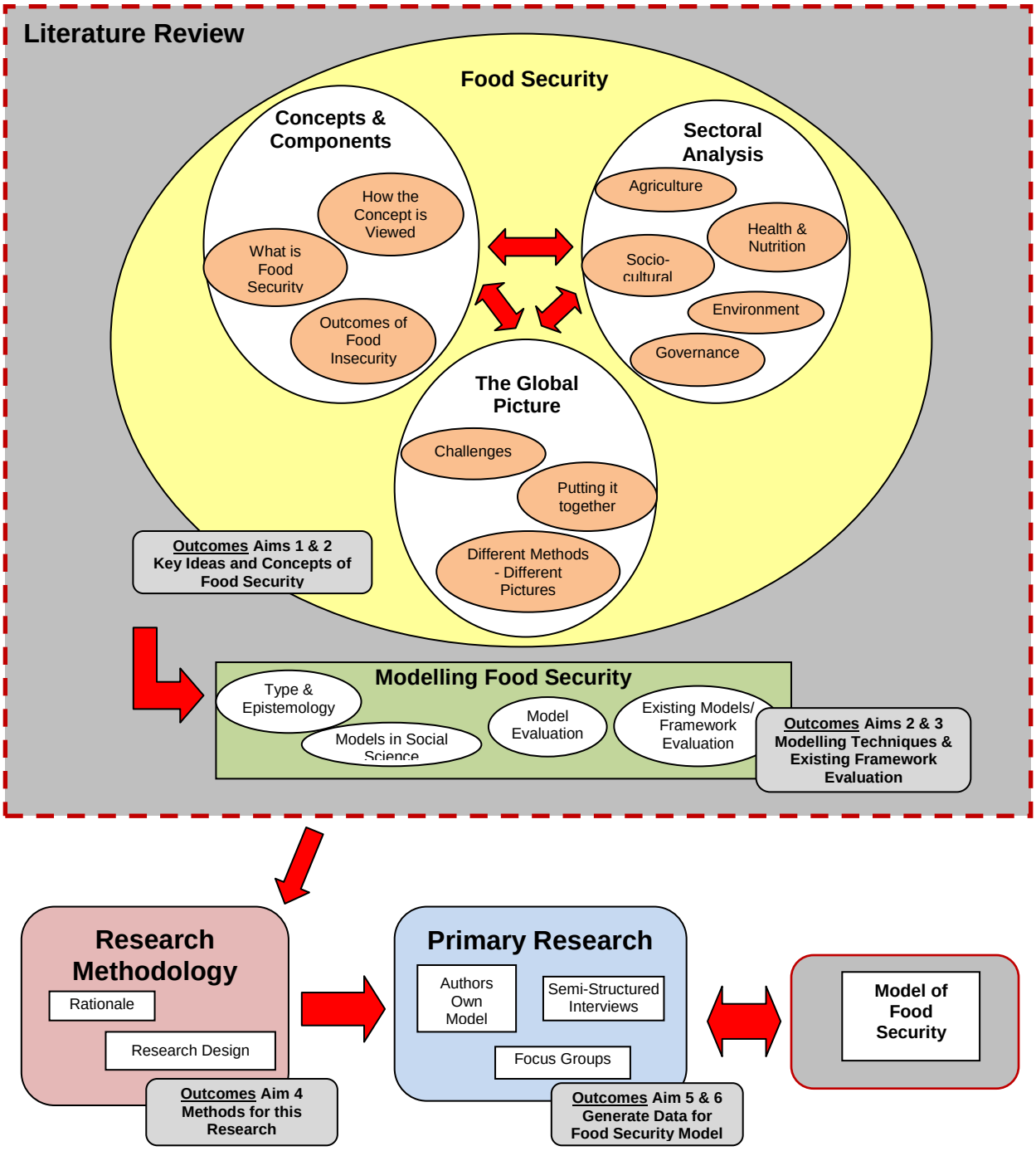


Figure 1.1 Structure of the Report

Literature Review

The review examines the notion of food security in some detail. In order to achieve this, this research draws on multiple diverse disciplines within the field from among others: economics, social history, politics, environmental issues and agronomics. As an aid to managing these disparate elements this section divides the issues of food security into three parts: the concepts and components of food security; a sectoral analysis; and finally an overall global picture as it exists today. After this there is a brief but thorough evaluation of the theoretical modelling literature. This allows for the later evaluation of existing frameworks that attempt to illustrate the food security phenomenon. This also provides the foundation upon which this study builds its methodological tools, which are used for the creation of the new model stated in the aims above.

1 Food Security

1.1 Concepts and Components of Food Security

To aid in understanding the difficulties of food security analysis it is worth elucidating some of the main components as identified by the literature. This helps frame the research and obtain a clearer picture of what and how the difficulties arise. This section is made up of three objectives, the first examines the nature of food security in general by identifying what it is and what it means to the various stakeholders. Secondly, a critical analysis of how the phenomenon is viewed by the various parties is introduced whilst thirdly, an analysis of the issues of poor food security and all its sequelae is illustrated. Ultimately a review of these concepts and components gives this research a foundation upon which the basics of a framework of understanding can be formulated.

1.1.1 Food Security What it is and Why it is Needed

Food security is about feeding people. Ensuring there is adequate food on a continual basis as well as ensuring there is a conducive environment that enables people to access food physically, economically and socially. While some suggest this is simply about hunger and malnutrition others argue for a broader more inclusive concept of food security that involves additional wider societal welfare issues such as poverty alleviation, education and health matters to name but a few (CFS 2008; SOFI 2009). In fact determining the breadth or scope of the food security concept itself is perhaps one of the more fundamental sticking issues (CFS 2008).

Even in spite of this fundamental disagreement however, it is generally agreed that progress on reducing the numbers and prevalence of the food insecure over the last three decades has been, and continues to be, painfully slow (WFP 2008). This is further demonstrated by the continuing persistent high incidence of undernutrition over more recent years. In 2009/10 for

instance there were an estimated 1.02 billion malnourished people in the world; an increase of 100 million over 2008 estimates (CFS 2008; SOFI 2009). Although these figures dropped to 925 million in 2010, according to the Food and Agriculture Organisation (FAO) this reduction was achieved more so through more favourable economic conditions rather than any real fundamental advancement in addressing the underlying issues (FAO 2010). This further raises questions as to how to achieve such gaols. Furthermore, this slow progress was also elucidated in the FAO's the State of Food Insecurity report (SOFI) when it was suggested in 2008 that:

> "Hunger has increased as the world has grown richer and produced more food than ever in the last decade." (SOFI 2008, pg 6).

On balance this quote succinctly sums up the ethical dilemma which if not tackled promptly could see malnourished numbers increase considerably over the ensuing years. This is borne out by the fact that if the population growth unfolds as estimated, this could effectively increase the current demand for food by as much as 70% to 2050 (SOFI 2008). The question then arises as to how populations intend to feed themselves; not just today but for generations to come. On this point, concern about issues of food security are not new. In the eighteenth century for instance, alarmed at what he saw as a dilemma between population increase and the earth's food availability, Thomas Malthus brought the debate to the public attention (Malthus 1798). Malthus' simple prediction was that the rate of food production, at the then current population growth rate, could not possibly keep pace with human reproduction (Malthus 1798). At the time, this was a provocative stance and one that was hotly debated (Chalmers 1852). It is also an issue that has not been properly resolved and one that continues to resurface repeatedly (Sulistyowati 2002).

In its simplest form then food security can be said to involve ensuring that all people are adequately fed on a continuing basis. Yet, as has been indicated, the breadth of the problem is difficult to elucidate; especially when the scope of the issues themselves are in question. Indeed this was even touched upon back in 1992, in Maxwell and Frankenberger's study (Maxwell and Frankenberger 1992). More recently too there is growing convergence of ideology whereby security of food is being viewed more as a constituent part of the broader concept of social welfare that includes: nutrition security; health care; poverty alleviation; as well as education and human rights among others (Ruxin 1996; IFAD 2009).

As a result this has left a gap in the holistic understanding of the phenomenon itself (Eswaran, Reich *et al.* 2006).

1.1.1.1 The Problem

This is not helped either by the fact that over recent years the world food situation continues to be redefined by new driving forces. Factors, often contradictory ones such as: income growth and increasing poverty; globalisation and localisation; subsistence farming to mass

production as well as intensification are all colluding to transform global food consumption and production patterns. This is further compounded by factors such as *inter-alia* climate change, natural resource limitations, sustainability, economic growth and urbanisation (Eswaran, Reich *et al.* 2006).

In understanding the phenomenon, food security analysis aims to assess and interpret these pressures, trends and emerging challenges. However, it has also been said that it is this very complexity that threatens to hinder progress. As such this complexity is both the cause of much misunderstanding and continues to act as a barrier to any real progress. In this way it is offered that today, many aspects of the food security concept is still poorly understood. The following recent quotes illustrate this point clearly.

The World Economic Forum in 2009 suggested that:

> "Malnutrition is poorly understood and has not benefited from expertise in communications and advocacy" (WEF 2009).

In Scaramozzino's report to the Food and Agriculture Organisation, Measuring Vulnerability to Food Insecurity, it was offered:

> "An analysis of the current literature on vulnerability make it apparent that there is …no consensus on …how to define and measure vulnerability" (Scaramozzino 2006, pg 3).

Others too clearly feel the same way:

> "What are the water and food challenges faced by the world? Why are they so poorly understood?" (Rijsberman, 2010, pg 15).

> "Food security and nutrition have not been given adequate attention [with regard to AIDS] despite broad agreement on their significance as an essential component of a comprehensive social protection package." (Greenway 2008, pg 1).

There are many more examples however the picture above suffices to illustrate the depth of the problem when it comes to understanding the concept of food security. Adding to the above problems of comprehension are subjectivity, misquotes and misrepresentation; oftentimes without recourse to fact (IPC Global Partners 2008; SCAR 2008). In this way the plethora of contradictory and confusing information available, often serves to confound and compound an already difficult phenomenon.

One of the methods that people, policy makers and interested stakeholders utilise in understanding this complexity is with the use of conceptual frameworks, often termed 'models'. These are discussed in detail in chapter 2. However, before this study can build on

this aspect it is incumbent to understand some of the core concepts of the food security phenomenon in a little more detail. By critically analysing the available literature food security issues can be explored and evaluated. In this endeavour this study specifically aims to understand the issues in relation to how they fit within the big picture, and ultimately, improve on the ways the issues are currently comprehended.

1.1.2 How the Concept is Understood

The concept of food security is understood by different people in different ways. It is also perceived as existing on different levels and temporal dimensions. All these aspects are important for a full understanding in this research and as such are examined here.

1.1.2.1 Definition

There have been many attempts over the years to define the phenomenon. However, with a continually changing concept encompassing numerous definitions and interpretations (Maxwell and Frankenberger 1992), there has been little progress on this front (McCalla and Revoredo 2001). Moreover, because the idea itself has drawn many to infer a multitude of diverse and often divergent meanings, there have been periodic attempts over the years to bring some cohesion to the debate (McCalla and Revoredo 2001). Of particular note in this endeavour are the efforts of Maxwell and Frankenberger who in 1992 collated over 190 unique definitions from the available literature (Maxwell and Frankenberger 1992). Their findings, aided by Smith and Pointing, offered that while numerous definitions shared many common threads many on the other hand seemed to attempt to re-define the concept based on their own needs (Maxwell and Frankenberger 1992). Accordingly, later analysis by McCalla and Revoredo (2001) concluded that it comes as no surprise that such attempts have created wary readers, leaving many with the notion that food security itself is fraught with confusion and subjectivity (McCalla and Revoredo 2001).

This view is further backed by the Food and Agriculture Organisation (FAO) when in 2003 they remarked on the use of such definitions, suggesting that indeed many people have applied varying and at times contrasting meanings to the concept. With this in mind it would seem that the notion of a broadly acceptable definition has duality of purpose. On the one hand the few widely accepted definitions might be quoted verbatim in support of an argument; while on the other they are equally quoted to refute similar arguments. However talking of the general concept and despite such inconsistencies, Siddiqur Osmani offers that there is in fact. a growing convergence of ideology over recent years (Osmani 2002).

Of the many available definitions themselves perhaps the two most widely recognised; although not with universal agreement, are those of the United nations and the United States.

FAO Definition

The FAO definition is based on the 1996 United Nations World Food Summit which was further elaborated in 2001. Currently the FAO suggest that:

> "Food security [is] a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO 1996, para 1; SOFI 2001, pg 49).

This definition is widely quoted and although not explicit, the definition itself implicitly renders nutrition as a component of overall food security. Advocates of this version of food security include: the World Food Program (WFP), the World Bank, European Union as well as IFAD and many others (EU 2006; IFAD 2009; EU 2010).

US Definitions

The United States on the other hand use multiple definitions. Both the US Department of Agriculture (USDA) and the US Agency for International Development (USAID) provide definitions depending on its expected usage. As a guide, the USDA generally focuses on national food security issues while USAID mainly operates with an international remit.

USDA Definition - The most recent USDA definition is based on Anderson's 1990 Life Sciences Research Office which offered:

> "Access by all people at all times to enough food for an active, healthy life. Food security includes at a minimum: (1) the ready availability of nutritionally adequate and safe foods, and (2) an assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies)" (Andersen 1990, pp. 1575-1576; USDA 2009).

USAID Definition - the current USAID's definition is based on the USAID Policy Determination #19 from 1992:

> "When all people at all times have both physical and economic access to sufficient food to meet their dietary needs in order to lead a productive and healthy life." (USAID 1992, pg 2; USAID 2010).

PL 480 – Food For Peace - known officially as the Agricultural Trade Development and Assistance Act of 1990, Public Law 480 (PL 480) defines food security more flexibly. As in the USAID's definition, PL 480's is also based on Policy Determination #19 yet is necessarily flexible in their view to allow a range of policy responses.

> "Access by all people at all times to sufficient food and nutrition for a healthy and productive life." (USAID 1995, pg 20).

With all these differing definitions an interesting comment by the FAO in 2003 suggested that there was a prevalence in some quarters to give food security too narrow a definition suggesting that on the one hand people have used the idea to represent:

> "…little more than a proxy for chronic poverty…" (FAO 2003, pg 34),

whilst at the same time others, they suggest, apply meanings that represent:

> "…an all-encompassing definition, which ensures that the concept is morally unimpeachable and politically acceptable, but unrealistically broad." (FAO 2003, pg 34).

In spite of these differing views it can be seen that while there are obvious differences there are also glaring similarities. The similarities can be summed up as issues of: access to food; availability of food; stability of supplies; and utilisation of food. These are considered the four-pillars, or dimensions of food security. Unfortunately too many existing frameworks that claim to represent food security ignore one or more of these dimensions and choose instead to narrowly focus on just one part of the whole (as can be seen in section 2.5).

1.1.2.2 Four Pillars

Building on these dimensions and as an aid to analysing food security, the Food and Agriculture Organisation (FAO) and others have developed a very simple model representing these ideas as shown in figure 1.1, (CFS 2000; Devereux, Baulch *et al.* 2004). Whilst perhaps too simplistic in itself, it is sufficiently descriptive to act as a means of organising data;as such, this basic template is adopted as a guide throughout this research.

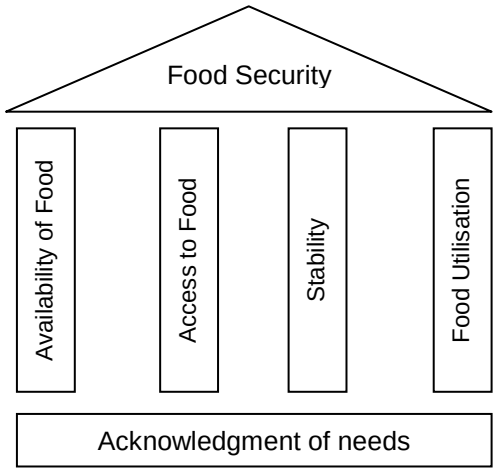


Figure 1.1 The FAO 4-Pillar Model of Food Security.

Source: (FAO 2008).

In the meantime however, a quick understanding of these dimensions aids in contextualising this information.

Availability

This aspect deals with the availability of food, particularly with reference to quantity and quality. Availability however, also implies more than just production. Inherent in this construct it has been suggested that consistency and variety are also important considerations, while the United States Agency for International Development also insist that

reasonable proximity is also a necessary requirement (Riely, Mock *et al.* 1999; CFS 2007; FANTA2 2010; USAID 2010).

Access

After much work in the field of access particularly in the works of people like Amatyr Sen (1981) there appears to be more general agreement on this dimension of the food security concept. Access, it has been noted by many, infers a package of entitlements that people have command over in order to satisfy their food and nutritional requirements (Riely, Mock *et al.* 1999; FAO 2006; Maunder 2006; CFS 2007; FANTA2 2010; USAID 2010). Such entitlements might be direct: income, barter and exchange; or indirect via social arrangements like family or community entitlements.

Utilisation

Utilisation is interpreted as the biological maximisation of food within the body. The ability of the body to absorb foods' nutrients is related to both the physical health of the individual and the quality and safety of the food itself. Importantly too here, and there appears to be general consensus on this point, is that the major institutions all agree on the importance of the non-food inputs of food security such as: health care, water and sanitation among other things (Riely, Mock *et al.* 1999; FAO 2006; Maunder 2006; CFS 2007; FANTA2 2010; USAID 2010).

Stability/Vulnerability

Risk and stability, the literature indicates, are fast becoming entrenched in the notion of food security. As a risk management tool it succinctly implies that food security can be lost as well as gained (USAID 2007). In this way, stability refers to anything that impacts negatively on the various dimensions of food security; availability, access or utilisation of food (Riely, Mock *et al.* 1999; FAO 2006; Maunder 2006; CFS 2007; FANTA2 2010; USAID 2010).

Thus, looking at food security through this multi-dimensionality, it at once helps to articulate the basic notions of the concept.

However, along with these four dimensions, there are two other ways in which food security manifests that helps with an overarching understanding; these are the differing levels and the temporal dimensions.

1.1.2.3 Different Levels

To further understand the phenomenon it is necessary to realise that food security is not heterogeneous and as a result is found to work on different levels. Figure 1.2 highlights the three main levels, that of the individual, the household and the national. What is important to note here is that achieving food security on one level does not necessarily mean that food security is present in the others (FIVMS 2008). That is to say a country might enjoy overall

food security while many of its citizenry do not and vice-versa This notion then, that food security can exist independently on any or all of these levels further compounds the difficulties in achieving a full understanding of the concept. This brings into the debate an increased number of variables that need to be considered as well as how they might interact at the different levels.

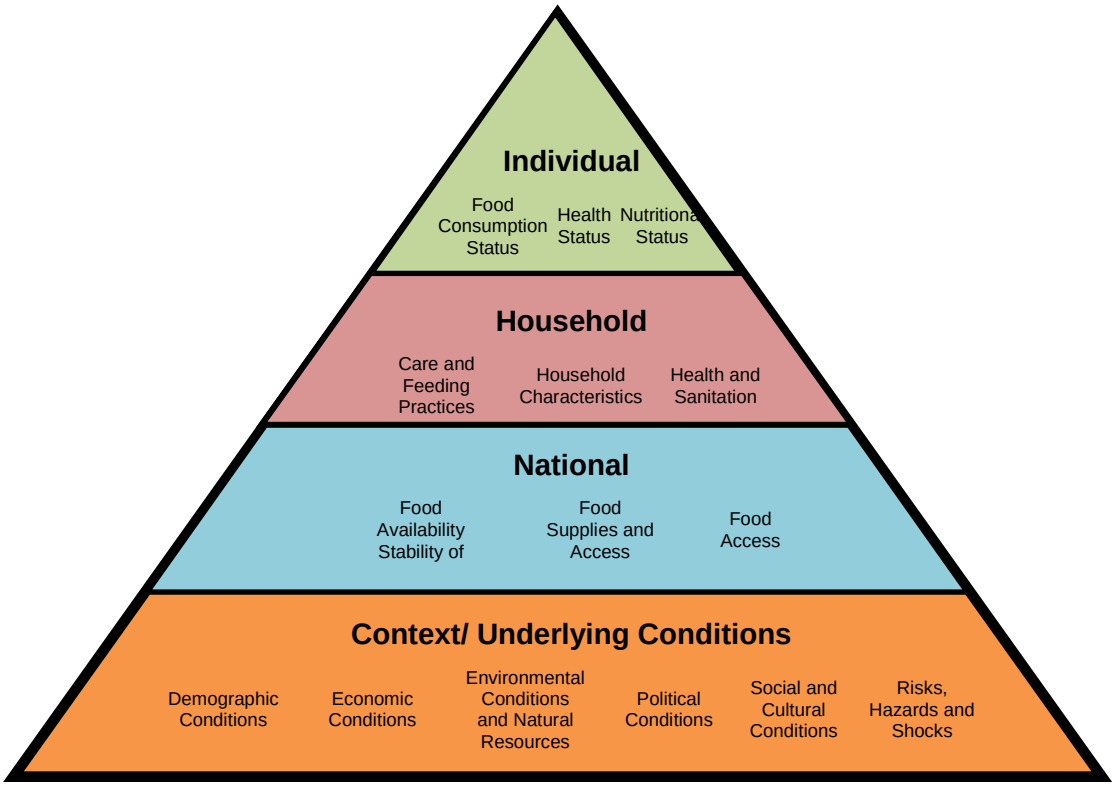


Figure 1.2 The Different Levels of Food Security

Source: Based on (CFS 1998; FIVMS 2008).

1.1.2.4 Temporal Dimensions

As well as the different levels of food security, the concept also exists within different temporal dimensions. This can be thought of as the time dimension of food security. This came about largely in response to the World Bank's influential 1986 report, in which it was ascertained that food security could be thought of as existing in terms of: chronic (continuous), temporary (transitory) and/or seasonal (or cyclical) time dimensions (World Bank 1986; IFAD 2009). As a result, by determining adequate policy response to emergent or continuous time defined food crises, knowledge of the underlying triggers and perceived resultant longevity of the problem is needed. Thus by classifying food security in this way helps to ensure precision targeting of resources.

Chronic (Continuous) food insecurity exists when individuals or households are persistently unable to meet their food requirements over a long or protracted period. It is often driven by endemic poverty or can exist in situations where people are unable grow or produce enough food for themselves. In such situations the question is then raised as to how

long before such conditions result in reduced nutritional status of individual's (World Bank 1986; IFAD 2009).

Temporal (Transitory) food insecurity on the other hand describes a temporary decrease in available food due to one or more factors including but not exclusively: production shortfalls or crop failures; flooding and drought; price changes; loss of income; war or pest and infestation (World Bank 1986; McHarry, Scott *et al.* 2002) These short-term shocks, briefly push the level of food consumption below requirements and hunger may result; regardless of whether it has an underlying chronic insecurity problem or not (FAO 2003; IFAD 2009). Another aspect of temporal dimension is that of seasonality (cyclical).

- **Cyclical Food Insecurity** although usually defined in terms of chronic or temporary, food security does have another dimension to it; cyclical. This can occur in existing chronic or temporary situations and corresponds to cyclical patterns of inadequate availability and access. This might be connected to fluctuations in the cropping patterns or the harvest calendar, climate, seasonal employment opportunities or perhaps the prevalence of seasonal diseases such as flu. This is an important aspect that must also be considered when dealing with possible solutions or interventions (IFAD 2009).

From this brief explanation it can be seen that individuals and households are generally accepted as being food secure if they are protected against both types of food insecurity as well as throughout all temporal dimensions (IFAD 2009).

Having explored the various dimensions of the concept, any new framework benefits from an understanding of how different people view the concept.

1.1.2.5 Different Approaches

As touched upon food security is a multifaceted phenomenon involving many variables which can and often do originate from a number of possible causes. While it is often suggested that the main protagonists are well known and equally well documented difficulties arise as a result of the many differing perceived solutions (Hoddinott 1999; Cohen 2006; SCAR 2008; G8 Summit 2009). It has been offered too that, confounding any consensus towards understanding the whole subject and its solutions, is the insular approach within which the various aspects of food security are studied in isolation (SCAR 2008; G8 Summit 2009). For example, agronomists might concentrate efforts in understanding productivity, land use improvements or perhaps soil management; economists on the other hand might look at investment and balance of payments; while humanitarians and Non–Governmental Organisations (NGO) might concentrate on the food aid and developmental issues of the food security phenomenon (Darcy and Hofmann 2003).

On top of this there are also the non-food issues surrounding the concept. Access to clean safe water and things such as health care and shelter can be just as important in some situations, to help develop security of food (ActionAid 2003; Barrett and Maxwell 2006). That is not to suggest that these singular focal points are not beneficial, indeed such targeted research is a must however, very few stakeholders beyond the immediate large multi-lateral institutions like the UN, USAID, CARE *etcetera* consider the phenomenon from its overarching perspective (Darcy and Hofmann 2003; IPC 2007).

1.1.2.6 Food Security: An Outline

The above section sought to introduce some of the main elements of the food security phenomenon. From this it can be seen that fundamentally it is about feeding people. Yet from this cursory examination too, it can also be seen that it is much more complicated than that. With this in mind it can be seen that difficulties in comprehending the subject are not only confounded by intricate complexity inherent in a phenomenon of this breadth; understanding is further complicated by insufficient consideration of the subject as a whole. In light of this, what is needed, according to the International Food Security Phase Classification (IPC) project, is an overarching consideration of food security, involving a more inter-disciplinary approach encompassing among many others: economics, environmental science, policy and politics (Darcy and Hofmann 2003; IPC 2007).

This research aims to do just that and in the process, provide the foundation upon which a more comprehensive model of food security can be created. So the next question that must be addressed if this research is to uncover the broad underpinnings of the concept is, that of the issues of food security itself. That is to say, to identify what the main drivers are. This is achieved through a sectoral analysis across such fields as: agricultural; science and technology; socio-cultural; health; the environment; and governance. This adds further understanding by placing what has been uncovered so far in context of food security's natural environment. It also needs to be borne in mind too that the size of this thesis allows for only a cursory examination these fields. As a result many important issues are only touched upon in brief. Having saif that, these issues are no less important and indeed contribute valuable insight in the overall final framework.

1.2 Issues of Food Insecurity: A Sectoral Analysis

1.2.1 Agriculture, Forestry and Fisheries

While agriculture is linked to food security in the most obvious of ways, there are also other links which are not always or immediately evident. Understanding what these are and just how they fit in with the food security concept is one part of the big picture.

Production

As this research unfolds it will be seen that the world currently produces enough food for its populace, yet it is also recognised that meeting future increased demand (which is expected to be as much as 70% by 2050), is also going to be a big challenge (SOFI 2008, 2009). With this increase in demand, as well as the changing patterns of food consumption, the extent that current agriculture can continue to provide sufficient food is of concern at the highest levels (SOFI 2009). Not surprising too, given the pervasiveness of disagreement among food security stakeholders there are fundamental differences in the way people view the solutions to these challenges (ibid). Perhaps the biggest area of divergence, concerns the agricultural development paradigm itself (DFID 2004). On the one hand, some see the prevalent Western market-oriented farming model of, consolidation and the subsequent intensification of production practices as paramount to feeding a growing population, while on the other, there is a growing vocal opposition that supports fundamental change (La Via Campesina 2011). This latter position involves a backlash of the so called socially and environmentally damaging practices of monopoly and monoculture, in favour of a more 'food sovereign' approach, that puts the smallholder farmer back in the controlling seat (La Via Campesina 2011). Furthermore while some see more smallholdings as a proactive way for farmers to ensure local productivity others also see the benefit of allowing the sovereign state rather than globalised market forces to determine local food security policy (La Via Campesina 2011).

This fundamental dichotomy of local versus global governance has enormous implications for any understanding of food security especially as this places more emphasis on local or national variables of risk and stability (DFID 2004). Such polarised views also impact on any conceptual model although, not perhaps, to the same degree as ultimately the same variables apply both locally and globally (SOFI 2009).

Also of particular interest in the food security and agrarian debate will be the direction of the ongoing agricultural policy reforms of the World Trade Organisation (WTO), the EU's Common Agricultural Policy (CAP) and the like (UOR 2009). Such policies designed to reduce farm support and restrict import and export tariffs, impacts on global food trade and ergo food security (UOR 2009). Such developments also affect a developing country's ability to trade on a level playing field whilst earning valuable foreign reserves needed for a healthy balance of payments account (ibid).

As a result of these considerations and whichever policy directions are taken there may be consequences which are not always clear. For instance, while improvements in smallholder farms might increase productivity, employment and incomes at the national level, such production increases generally lead to lower food prices (Zhang, Rockmore *et al.* 2007). While this might seem like good news for the individual, on the export front, this is not so good as reduced exports leads to reduced national income. Moreover, a familiar response to

low prices often see farmers raising production to compensate (ibid). This ultimately has the effect of further depressing food prices and encourages long periods of low prices, which is often followed by swings in the other direction (Zhang, Rockmore *et al.* 2007). Consequently, the cost-benefits of different policies need to be considered *vis-à-vis* the food security agenda. These cost-benefits will also need to take into account the policy trade-offs that aim to tackle multiple objectives if present and future food security is not to suffer (Zhang, Rockmore *et al.* 2007: UOR 2009).

Macro-economics aside, others also point out that such policy trade-offs also need to be considered against other less tangible but no less important variables such as the health of the land and sustainability *etcetera* (FAO 2011; GFS 2011). This takes the research into considerations of agriculture.

Modern Agricultural Practices

When it comes to food security, there is a direct link between the management of farmlands and the productivity and health of the natural resource base (FAO 2011; GFS 2011). Agriculture incorporates a wide variety of specialities and techniques, and different farming practices have different impacts *vis-à-vis* soil management, sustainability and ultimately food security (ibid). Furthermore, these different systems vary between farms and regions and are dependent on local resources and other considerations such as: geography, climate; policy; economic and social pressures (FAO 2011). Consequently, issues of sustainability and the health of the natural environment are wrapped up in local custom and cultural environments as well as the previously mentioned economic and policy constraints (ibid). Not surprising then, that the proper management of ecosystems, biodiversity, soils and groundwater for example become increasingly important within the present food security debate, as well as in any future production challenges (FAO 2011).

However, while such ideological aims might represent best practice, in reality not everything is properly managed nor is there universal agreement as to the best methods of achieving a present or future sustainable food production system (UOR 2009). For instance, despite the multitude of farming practices worldwide, there is a propensity for increasing intensification, extensification, concentration and specialisation of agriculture (ibid). This is effectively placing more pressure on increased inputs (FAO 2011). That is to say, while the benefits of the industrialisation of agriculture are evident in the progress of food security, the failings concern the large quantities of fertiliser, insecticides, fungicides and herbicides that are used to improve crop yields. Moreover, high input/output agriculture is expensive and out of reach to all, but the few well to do farmers in the developing world (ibid). For some, the concern is evident in the widespread instances of soil degradation, as well as in the contamination of the water table, which ultimately combine to jeopordise continuing productivity and sustainability (UOR 2009).

Other food security concerns within the agricultural sector refer to both agroforestry as well as fisheries.

Agroforestry

Agroforestry (forest farming) is the practice of combining woodland with crops and/or livestock and often concentrates on specialty crops by mixing forestry with agriculture (Britannica 2009). In this scenario, the biodiversity and ecological systems both benefit from the inherent symbiotic relationship between farmer and the environment (Britannica 2009; UOR 2009). This is particularly well suited to the farming of: mushrooms; nuts; honey; herbs; fruits such as blueberries; elderberries; raspberries and blackberries; edible flowers and sap products like maple syrup and birch sap wine *etcetera*. A well managed agroforestry system then, can provide valuable income and security of food, not just for the immediate farm workers but for the local region too (UOR 2009). As a result, the carefully maintained ecosystem in which the forest resides is of paramount importance and any aberrant or excessive misuse of this natural resource, is likely to have a disproportionate effect on its future viability and sustainability (UOR 2009).

Fisheries and Aquaculture

This is also true of the fisheries sector, which contributes significantly to people's diets, providing the main source of animal protein (upto 15 to 20 %) for nearly one billion people worldwide (FAO 2011). On top of this, in 1996 fish and fisheries alone accounted for an estimated 30 million people's incomes worldwide; 95 percent of which were in the developing regions (FAO 2011). Unfortunately, according to the FAO, increasing over fishing, over the last few decades, has adversely affected overall global marine food security (ibid). In response some enterprising nations and entrepreneurs are turning to aquaculture (or aqua farming), as a means of maintaining the important dietary needs and incomes of this group. In fact according to the FAO, aquaculture is the fastest growing food-producing sector, accounting for nearly 50 percent of the world's fish consumption (FAO 2011). Although having said that, the sector is in relative infancy, and the extent to which aqua-farming comes to benefit the overall notion of global food security is as yet unknown.

Also within the agricultural sector, an understanding of the extent of future food security also involves some comprehension of sustainability issues.

1.2.1.1 Sustainable Agriculture

In the past few decades there has been a determined move towards the improved sustainability of agriculture (GFS 2011). This is partly because the green revolution has hitherto allowed more food to be grown today than at any other time in history, yet in spite of this, critics have argued, this progress has been at the expense of the environment (GFS 2011). Many reasons have been cited for this, ranging from the intensive application of fossil

based technologies such as fertilisers, mechanisation and transport, to the mismanagement of land and water resources; and from profligacy or wastage to simple inefficiencies (FAO 2007; Nellemann 2009; UNESCO 2009; GFS 2011).

Interestingly, one major area that would reap great dividends in the sustainability of food security is that of food wastage in general and human profligacy in particular (Nellemann 2009; WRI 2010).

Crop/ Food Wastage

According to a recent UNEP GRID-Arendal report, there is an incredible amount of food waste and very little effort focused on salvaging it (Nellemann 2009). Indeed, it has been calculated that food lost in the field between planting and harvest time, can be as much as between 20-40% depending on the region, crop and wastage type (pest or pathogens *etcetera*) (Nellemann 2009). On the post-harvest side too, FAO estimates fruit wastage to be anywhere from 25% to 50% (FAO 1989), while others note, that up to 37% of post-harvested rice in the developing world might also be lost (World Resources 1999). Moreover, in terms of grains in general as much as 25% of the total croppage is said to be lost due to post harvest handling, storage and infestation (Latham 1997). On the marine front too discarded fish also account for about 23-30% of the total landed catch (Nellemann 2009). While finally, losses from the retail sector as well as domestic wastage has been said to be as much as 25-50 % of the total economic value (Nellemann 2009; WRI 2010). Such losses are widespread, they exist at all levels of the food chain, and collectively represent an enormous lost potential.

There is also concerns regarding a relatively new phenomenon, and one that is not immediately obviously an issue of sustainability, that of land grabbing (RTFN 2010).

Foreign versus Domestic Land Priorities

According to the Right to Food Network (RTFN), foreign investment in local land, commonly known as ‘land grabbing’ is one of the most disturbing practices of recent years (RTFN 2010). This involves the purchase or leasing of land by foreign interests for the purpose of growing crops for their domestic markets. One concern is that, such lands would then be subject to intensive agriculture creating further competition for local natural resources of water and other inputs (RTFN 2010). Moreover there are questions raised as to exactly who benefits most out of such transactions and whether or not local food security is at risk (ibid). Although not a new phenomenon, in recent years, land grabbing has been on the increase and while the extent of the practice is not fully known, the FAO have suggested that, perhaps as much as twenty million hectares have been acquired by foreign interests over the last few years in Africa alone (RTFN 2010). Such practices it has been said, runs

contrary to the spirit of sustainability and how this evolves is one the RTFN promises to watch with interest.

Despite the above ongoing concerns, one positive development in the increased public awareness of sustainability issues is the growing awareness and accountability within the food system itself (Ericksen 2008).

Food Systems

The recent past has witnessed many changes in the food supply chain (Ericksen 2008). At each level, technological advances, globalisation and politicisation are shaping the food system, yet just as importantly, it is also becoming increasingly accountable at the social level (Ericksen 2008). This accountability is the culmination of both public and institutional pressure in respect of sustainability, natural resources and an increased sense of fair trade (SOFI 2005; Ericksen 2008).

This accountability too is also encouraging people to take a closer look at the food chain on the whole. From this it can be seen that global trends in food production have been identified as being characterised by the intensification of agriculture as well as containing larger farm sizes whilst also increasing the fragmentation and marginalisation of smallholders (Ericksen 2008). Erickson also points towards the large move toward 'value-added' foods in the processing sectors and comments on the concentration of corporate businesses up and down the supply chain (ibid).

By evaluating such relationships, Ericksen explicitly highlights the growing symbiosis that exists between current food systems and environmental factors (Ericksen 2008). In doing so she also closes the circle that sees food security, environmentalism and sustainability becoming inextricably linked and increasingly difficult to separate from wider societal issues (Nellemann 2009; WRI 2010).

Another issue important to the direction of current and future food security issues, and one that was touched upon earlier, involves the progress and direction of agricultural development paradigms themselves.

1.2.1.2 Agriculture Development Paradigms

Over time agricultural paradigms have shifted considerably. At times, the agricultural sector has been treated as little more than a global allotment with little or no regard to its developmental potential in the wider economy (McCalla 2007). At others, it has been noted that by investing in rural education and industry, more labour could be drawn out of agriculture into 'more effective' or prosperous industries. While further shifts have recognised that poverty was predominantly a rural problem and one that could be addressed

through social and economic investment (ibid). Finally though, after a long period of reflection, agricultural development paradigms arrived at the current prevailing development paradigm, which recognises that the agricultural sector has a valuable and proactive role to play in the overall strategy of both the economic and social development of regions and countries (McCalla 2007). In this, suggests McCalla (2007), the agricultural sector:

> "...becomes much more complex, more interdependent with the rest of the economy and charged with meeting multiple goals. [Where] Increasing food production is no longer a goal in itself." (McCalla 2007, pg 16).

A cautionary note too, according to McCalla suggests that despite progress, it is a debate that is not yet reconciled by the wider community and as such, agriculture's role in future development strategies is not yet decided with any degree of certainty. In this way, the chosen development paradigm determines to a large extent, the interaction of many of the variables of food security (McCalla 2007).

Having explored and evaluated the role of food security within the wider agricultural sector the following section reviews food security issues *vis-à-vis* science and technology.

1.2.2 Science and Technology

Scientific and technological advancement has taken place on many levels and touches on many facets of the food debate. On the investment front a new economic development paradigm ensured that focus was shifted away from sole goal of supply to consideration of the need to increase poorer countries ability to fend for themselves. This new economic growth model argued for investment in developing countries. It was argued that such investment especially in agriculture would provide one of the most effective and efficient means of improving incomes and reducing people's vulnerability to food insecurity (Zhang, Rockmore *et al.* 2007).

Leading this investment were the combined green revolution technologies which single handedly had more to do with the advancement of agriculture in the past half century than anything else (Gardner 2002).

1.2.2.1 Green Revolution

Variously described as beginning between 1945-1960, the green revolution was effective in spreading existing technologies, particularly agro-technologies and mechanisation into many areas previously untouched by modernisation (Borlaug 2000). Financial incentives and policy spurred on this rapid uptake of science, as well as the promise of new hybrid varieties that would increase yields and require less inputs. At the same time land and soil management was improved and collectively, this green revolution, enhanced productivity which in turn effectively led to further changes in economies, population levels and the

distribution of equity (Borlaug 2000; Khush 2001; Evenson and Gollin 2003; Troyer 2004; Wu and Butz 2004).

Although having achieved much in the way of improved food security, the green revolution has also been widely criticised, particularly on the environmental side (Darmawan, kyuma *et al.* 2006). Perhaps the two main criticisms are the environmental consequences and the loss of biodiversity (ibid). In the first charge, fossil fuel dependant agriculture's use of increased chemical inputs, has been said to have caused many negative environmental consequences including continuing soil infertility, degradation and improper maintenance (Muir 2009). Further, pesticide and fertiliser run-off too, can cause among other things eutrophication of ponds and rivers as well as disrupting the delicate ecosystem balance (McLaughlin, Hiba *et al.* 2000; GEO 2007; Muir 2009). The second major charge of the green revolution is that of the loss of biodiversity (Muir 2009). Advances in hybridisation and genetic engineering have resulted in fewer crop varieties being sown today with some suggesting ththeis loss to existing biodiversity to be as much as 90% (GEO 2007). This overreliance it has been argued, places the ecosystem, and more importantly, the food system in a fragile and precarious situation, raising important considerations of relying on too few crop varieties (Zhi Ping Song, Bao Rong Lu *et al.* 2004; GEO 2007).

1.2.2.2 Biotechnology and the Bio-Sciences

Contrary to some views, biotechnology is not new (Wissemann 2007). Discovering that juices could be fermented into wine, milk into cheese or crops into beer; alongside the realisation that animal or crop breeders could introduce, or indeed breed out, desirable or undesirable traits have been around for millennia (Peters 1993). However, more recently the field of biotechnology has quickly opened up with improvements in microbiology, germ theory, hybridisation techniques and importantly genetic engineering (Wissemann 2007). Today this genetic research and genetically modified crops (GMO)'s offer huge potential in the quest for food security over the next 40 years or so (ibid). Yet despite such advances, just how much benefit these advances will provide is up for question (Fári and Kralovánszky 2006; Schneider and Schneider 2010). The difficulty here is that while there is much evidence in support the possible benefits of this technology, there is a trust issue in the term "possible" benefits (ibid). That is to say, many of the benefits claimed are in dispute and there appears to be several ways of interpreting the results of much of this scientific evidence (ibid). On top of this there is also widespread public suspicion of the unknown with frequent talk of "Frankenfoods" (Fári and Kralovánszky 2006; Schneider and Schneider 2010). Just how the benefits are to be implemented and how the fears of the public are to be appeased is an ongoing debate, and one that continues to be divisive. Furthermore just how this affects future food security is yet to be seen, yet it is an important consideration and one that must be factored into any overall understanding of the phenomenon (Fári and Kralovánszky 2006; Schneider and Schneider 2010).

With regards to food security and its many socio-cultural variables there are a wide variety of aspects that need to be considered from poverty to population growth and more.

1.2.3 Socio-Cultural

More and more of late food security is seemingly bound up with the 'rights' of individuals (FAO 2000; FAO 2006). A rights based approach to food is part of a larger, social revolution, involving institutions and governments alike. In this context, human social development addresses the 'whole' person and involves not only food security, but also entitlements to equitable economic opportunities; access to education, to health care and reasonable social safety nets as well. Thus in this way wider social considerations, or social capital, as it is sometimes referred to, just like the sustainability issues discussed above, are further entrenching themselves in the enlarged package that is food security. Or transversely as the FAO point out, food security issues are becoming part of the larger package of social capital (FAO 2006). This inextrcably linking of food security, with human social development capital however, does perhaps, complicate an already difficult concept (Weingärtner 2004; FAO 2006). Such ideas it has been suggested, no matter how well intentioned, are in danger of being further complicated by difficulties in defining standards and goals, especially it seems, as financial indicators and not social indicators (MDG's not withstanding) continue to define progress in this area (FAO 2000; Weingärtner 2004; FAO 2006). That said, such aspirations are not to be dismissed as around the globe already, over 40 governments have judicially enshrined the right to food for their citizens in their national constitutions (FAO 2000).

Perhaps one of the major drivers of current food security concerns, is that of population, with continued growth spurring much discussion in this area (UNPP 2009).

1.2.3.1 Population Pressures: Growth, Capacity & Sustainability

Concern with the effects of unchecked population growth is not new (Freen 1996). For a long time though, population numbers remained persistently low (Figure 1.3) with the period from about 200 AD until about 1000 AD seeing annual growth rate equivalent to about 0.04% (Johnson 1997). However, after having reached the first global billion in about 1800 A.D., population numbers to the twenty first century have grown at an exponential rate, reaching over 6.7 billion within the last few years (Zhang 2008).

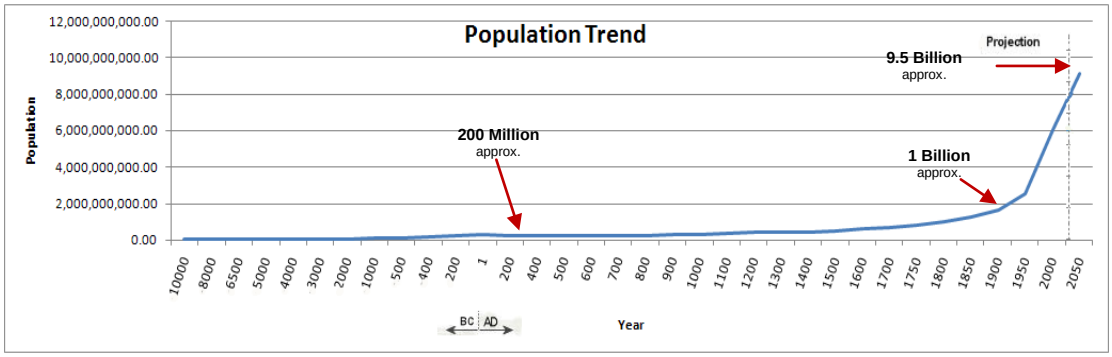


Figure 1.3 Population Trends: Historical and Projected

Source: Based on mean averages of past trends as offered by (UN 1973; McEvedy and Jones 1974; Thomlinson 1975; Biraben 1980; Haub 2002; USCB 2008; Zhang 2008) and future figure based on UN medium Variant projections (UNPP 2009).

However, despite the slowing down of these growth rates the global population is still increasing by about 80 million people a year and is expected to reach 9 billion by the year 2050 (UNPP 2009). This growth reflects a growing fear that population is, or is soon to be, living beyond its current means and is suggestive too, that humankind is possibly inflicting irreversible environmental damage on the planet (GEO 2007; PAP 2008).

On this point, and going back to Thomas Malthus' 18th century observations, he remarked on the fundamental limits to which the earth could sustain populations (Malthus 1798). He postulated back then, that the earth's resources would only support a specific number of people and as a result the growth of overall population was tied to the growth of the food supply (Malthus 1798). These paths he further argued, were following completely different growth trajectories whereby the exponential growth of the world population could only be supported by the arithmetic growth of the food supply. Beyond this, he speculated, the inability of the earth to provide, would naturally (via famine and poverty) keep the growing population in check (ibid). In his thinking, famine, conflict and poverty were necessary counter balances to unchecked population growth. Despite such sentiments however, many have opined that his theories completely ignored the ability of man to influence food production beyond the arithmetic growth he speculated (Merritt-Hawkes 1928). Thus far, the Malthusian spectre of continual and widespread global famine has not materialised and indeed, today the world continues to produce enough food for everyone. However, that is not to say the situation will prevail in the future; hence the ongoing Malthusian debate.

An associated idea involves the carrying capacity of the earth. This notion occupies itself, rather than with the notion of food production keeping up with population, but with the limitation of the earth to provide for its people. In contrast to the top-down approach offered by Malthus, the carrying capacity approaches the same subject; total numbers that the earth can support, but from the bottom-up approach. While few doubt the premise on which this theory is built, for many what is hotly debated are the perceived limiting factors within the

equation itself (Roughgarden 1979; GEO 2007; PAP 2008). As such, population pressures and the idea of a sustainable limit are highly contentious debates often open to opinion and subjective interpretation (Ehrich and Ehrlich 1990; Johnson 2000). However, it can be confidently asserted that, despite universal agreement on limiting factors, there is growing agreement that continuing on the present course without consideration to the future is not feasible (GEO 2007; PAP 2008). This view was iterated in 1992, in a declaration re-affirmed at the Rio Earth summit by the Union of Concerned Scientists when they declared:

> "Human beings and the natural world are on a collision course… The earth is finite. Its ability to absorb wastes and destructive effluent is finite. Its ability to provide food and energy is finite. Its ability to provide for growing numbers of people is finite. And we are fast approaching many of the earth's limits." (UCS 1992, pg 1).

Such limits then need to be considered in the overall picture of food security. Questions it seems, are being asked as to whether humanity aims to feed an ever growing population, irrespective of growth rates or whether part of the food security solution involves population checks and balances (GEO 2007; PAP 2008).

Population aside, further insight into a greater understanding of the phenomenon of food security can be gained with a look at the vulnerable groups in society, as well as some of the burdens of social conflict.

1.2.3.2 Vulnerable groups

In the social sphere women and children are of particular importance, not only do women play a key role in the family unit but often in the developing world, it is the women who are responsible for purchasing, or the growing of, the food the family requires (SOFI 2006). With respect to food security and children in particular, it is also the women who are the primary health givers (Freedom from Hunger 2010). As such they represent an important but vulnerable group in many underdeveloped societies (SD 2001; Freedom from Hunger 2010). There is much literature that suggests cultural values persist to keep women subservient, oftentimes lacking equal access to most things from food, health care, education and support (UNICEF 2007; Dewan 2008). The challenge for policy makers is that this gender subordination, ensures that women persistently make up the majority; more than 60 percent, of the global poor and of the chronically hungry (SOFI 2006). How women are treated and empowered then, will determine to a great extent the food security of future generations and is paramount in the overall picture (ibid).

1.2.3.3 War and Conflict and Famine

Conflicts and crises such as civil wars and military coups too factor largely in the food security debate (Hartmannshenn 2004). Such incidents can lead to displacement, forced migration and widespread population exodus. This results in loss of livelihoods and farmland for subsistence farmers and results, all too often according to Hartmannshenn, in hunger and

malnutrition (Hartmannshenn 2004). This is not always as a direct result either of such conflicts, as Hartmannshenn himself attests (Hartmannshenn 2004). He suggests that if conflict itself is not the cause, the tying up of valuable government resources like health care, or a breakdown in the social infrastructure, can displace important social safety nets in times when they are most needed (ibid). Hartmannshenn also suggests that food security is not necessarily seen solely as a consequence of civil unrest but also, at times, an instigator of it (Hartmannshenn 2004). Hartmannshenn (2004) is not alone in this opinion either, others too, have long cited food shortages and shifting economic patterns as responsible for much conflict as one party struggles to gain economic advantage over another (Rasler and Thompson 1983; Freedom from Hunger 2010).

1.2.3.4 Poverty

Poverty is another closely associated variable of food security, indeed drawing on the FAO's definition wealth is a good marker of an individual's access to food. Globally there are 1.2 billion people currently living on less than £1-a-day (World Bank 2008). However, while this is seen by some as an absolute measure of poverty, others see this as a relative measure. An alternative, better measure, it has been suggested, would take into account the regional cost of living indices (World Bank 2008). Whichever measures are chosen, the poor, particularly the rural poor, collectively make up three quarters of all poor people in developing countries and it is often these people who most likely to be affected by problems of access to food (World Bank 2008).

1.2.3.5 Dietary Preferences

Also of concern in the socio-cultural sphere are the changing dietary habits of individuals and how this might be placing enormous pressure on existing food supplies. Indeed, there is much literature regarding income growth and dietary changes (Halweil 2003; Nierenberg 2003; Brown 2005; Dyer 2006; Pingali 2006). At the core of such ideas is Engel's Law, this law suggests that as incomes rise, so the demand for basic staples falls off rapidly. This is because people use their increased purchasing power to exercise choice by increasing their consumption and diversifying their diets (Eifert, Galvez *et al.* 2002). This suggests, and which is supported by the literature, that previous diets consisting mainly of starchy staples like grain or rice, upon income growth are displaced in favour of more diverse diets based on meat, milk, and eggs (Halweil 2003; Nierenberg 2003; Brown 2005; Dyer 2006; Pingali 2006). This trend too is forecast to continue (ibid) and this has implications not only for food production as a whole, but just as importantly for the individual food chains involved (von Braun 1995; Brown 2005; Dyer 2006; Kumar, Birthal *et al.* 2007). Putting this in context Dyer (2006), notes that to feed the increasing meat based diets (currently 14 billion poultry and five billion hoofed animals that the world consumes every year), it takes a little over a third of all available grain supplies. In this respect increased meat consumption, even by a

small fraction, places a heavy burden on the cereal or grain supplies of the world (Dyer 2006)

1.2.4 Health and Nutrition

In terms of food security, health and nutritional issues undoubtedly factor heavily (IFAD 2009; WFP 2008). In this way, food security is often seen as a constituent component of a broader concept that is nutrition security. This view fits in with the ever widening goals of the food security concept and is one that aims to ensure that households have sufficient access to health care as well as improved nutritional knowledge (IFAD 2009). Macro- along with micro nutrients are the principal ingredients of the human diet and, as has been shown, good nutrition is the cornerstone of good health and development (ibid). Malnutrition however, can and does occur with regular frequency. Malnutrition though, contrary to popular belief also involves overnutrition as well as undernutrition (IFAD 2009; WFP 2008; WHO 2010). Moreover malnutrition is not just a condition of developing countries, more and more these days the prevalence of both under and over-nutrition are being seen in the same areas and regions within the same countries, irrespective of developmental stage (ibid). This has a lot to do with the previously mentioned dietary changes based on increasing personal wealth, but it is also a consequence of increasing urbanisation and a general reduction in physical activity levels (ibid).

Thus, from this it can be seen that health and nutrition, and in all its various drivers, whether through disease, famine, malnutrition, poverty or conflict *etcetera* must be explored if the full picture of food security is to be told.

1.2.4.1 Famine and Hunger

With regards to famine, food insecurity leads to malnourishment and hunger and if prolonged can lead to starvation, famine and even death (Ó Gráda 2009). However before examining the extent of malnourishment and hunger around the world it is worth noting the development, or changing concept of famine itself. The rationale for this is provided by Ó Gráda as he suggests that the underlying causes and frequency of famines are changing in such drastic ways, as to ultimately influence the wider food security debate (Ó Gráda 2009). Further need to examine such issues, in respect of the overall phenomenon is given by Devereux (2000) when he offered:

> "…our understanding of famine in more of a muddle at the end of the 20th Century than at the beginning." (Devereux 2000, pg 16).

The first point of clarification is that as with the terms 'food security' and 'hunger', famine too shares problems of conceptualisation (Watkins and Menken 1985). Loosely defined O'Grada states that famine:

> "… represents the upper end of the continuum whose average is hunger"

(Ó Gráda 2009, pg 210).

As a result the word 'famine' can also be a highly emotive term and is one that O'Gráda (2009) suggests, ought to be used with caution. Malthus's view in this area for example was very clear and for many years highly influential when he offered:

> "Famine seems to be the last, the most dreadful resource of nature. The power of population is so superior to the power in the earth to produce subsistence…that premature death must in some shape or other visit the human race…But should [that] fail…gigantic inevitable famine stalks in the rear, and with one mighty blow levels the population with the food of the world." (Malthus 1798, pg 54).

From this and other examples, Watkins, Ó Gráda and others suggest that the emotive connotations of the word tends to sensationalise such ideas and makes it more difficult to portray an objective viewpoint, let alone adequately conceptualise the phenomenon itself (Watkins and Menken 1985; Ó Gráda 2009). As such, and referring to the need to adequately conceptualise concepts, such as famine and hunger (section 2.3), Wand *et al.*, (1999) cautions against using loose or poorly defined terminology in any scientific study.

1.2.4.2 From Natural to Man-made

The second issue regarding the nature of famines and, one that is perhaps more important, concerns the changing face of the phenomenon's causality. Over the years it would seem, famine has variously been ascribed to the whims of Gods or acts of nature (Mehta 1929; Hutchinson 1998), more recently however, this view is changing and the changes are being increasingly linked to outcomes of poor political governance, unfavourable economic conditions, conflict and other adverse social consequences (Hutchinson 1998; Ó Gráda 2009). The paradox of such changes suggests Johnson (2000), is that while there are undoubtedly fewer famines today than at any time in history, those that do occur tend to be more devastating in their impact on human lives. This is supported by evidence in table 11.1 (Appendix A: Famines of the 20th Century), which clearly shows that the worst famines of the 20th century are indeed often exacerbated by conflict or poor governance or both. Although having said that, there is some agreement that through proper political and international expediency some of the worst effects of modern famines (not in all cases though) can be markedly offset (Johnson 2000; Ó Gráda 2009).

This shift in modern day famine and hunger's causality, places more emphasis on the wider range of political, economic and social consequences of governance (Johnson 2000; Ó Gráda 2009). Thus the changing face of modern famines, has implications not only for solutions predicated on these changing dynamics, but also for any models that aim to portray the concept of food security.

One last note regarding famine concerns the erroneous perception, that death from famine and starvation is commonplace (Hionidou 2002). This is important in the fundamental

understanding of the overarching food security concept, as it relates to wider issues of public health, water and sanitation. At its very core is the fact that, while famine is the most severe form of malnourishment, this does not tell us how the individual is affected or how it ultimately leads to death. In actual fact, famine rarely directly causes death, more often it is the work of opportunistic diseases (DeRose and Millman 1998); the following sections help clarify.

1.2.4.3 Hunger Manifest

It has been calculated that the average person needs between 2,100-2,400 kilocalories per day to lead a normal, healthy and active life and any continual or sudden and prolonged reduction in this intake can have severe physiological consequences (WFP 2008). The severest form of malnutrition can lead to death, yet research indicates that up until quite recently, death from hunger or famine was, and still remains to some degree, a large area of contention (Mokyr and Grada 2002). In the past, this interaction between hunger, malnutrition and death was not well understood and as such many historic studies invariably attributed these 'apparent' hunger related deaths simply to the catchall of hunger and starvation (Hionidou 2002).

However, it was soon realised that actual starvation, or atrophy, was not, nor has ever been the main cause of famine or hunger mortality (Mokyr and Grada 2002). This led many to look for alternative or coincidental factors, that might have interacted with reduced nutritional levels, to exacerbate causes of death. Over time findings from several studies indicated that reduced immunity from malnutrition, could indeed lead to susceptibility of the individual to opportunistic diseases such as: diarrhoea, dysentery, respiratory infections (including tuberculosis and pneumonia), starvation, dropsy (oedema), and to a lesser extent fever, (influenza) as well as to other opportunistic diseases such as cholera (Mokyr and Grada 2002).

Initially, such was the contention of this synergistic relationship that it attracted both proponents and critics in equal measure (Mokyr and Grada 2002). The critics argued strongly against the notion and queried the lethality of such infections. Some even questioned the fundamental underlying assertion of the proposed relationship itself (Hionidou 2002; Mokyr and Grada 2002). On the other hand proponents, convinced by the mounting evidence, advocated the improvement of non-food elements such as water, health care, shelter and sanitation *etcetera* as paramount to overall health and food security (Mokyr and Grada 2002). Over time however, the general consensus now prevails that when it comes to death from famine and hunger, despite persistent critics, the body of evidence suggests many people accept, even if they do not fully understand, that malnutrition and infectious disease often interact to compound the worst effects of hunger and famine (Watkins and Menken 1985; Smith, Obeid *et al.* 2000; Mokyr and Grada 2002).

So while famines, according to the WFP, still tend to be 'headline grabbing news', much more widespread is the fact that the worst incidences of food insecurity (and by extension-mortality) are reflected in the more frequently occurring everyday chronic and often slow onset incidents of hunger and malnourishment around the world (WFP 2008). This brings into the debate not only the expanded notion of non-food elements mentioned above but also the utilisation, the quality and the bioavailability of the food itself which is ultimately reflected in the ongoing nutritional status of individuals at risk.

1.2.4.4 Malnutrition and Nutritional Disorders

In conceptualising malnutrition, it is important to note that malnutrition encompasses both over- and under- nutrition as well as maladies of poor nutrition (WFP 2010). In short it is bad or 'mal'- nutrition (WFP 2010). With this in mind and placing hunger in context, the UN's Standing Committee on Nutrition (SCN) the World Health Organisation (WHO) and others, suggest that malnutrition is one of the most serious public health problems worldwide today (DFID 2009; WFP 2010; WHO/EMRO 2010). Moreover, while undernutrition has generally been accepted as the most pervasive form of malnutrition in developing countries over the years. Indeed figure 1.4 clearly shows that overnutrition (obesity and overweight) are nowadays comparable diseases to undernutrition (WHO 2010). Some have linked this to the nutrition transition, that sees income growth spurring dietary changes that include: greater choice, more consumption and increasingly nutritionally poorer diets. Indeed, what was once seen as an exclusively Western problem is now fast becoming a global health epidemic and one that is forecast to increase (WHO 2010).

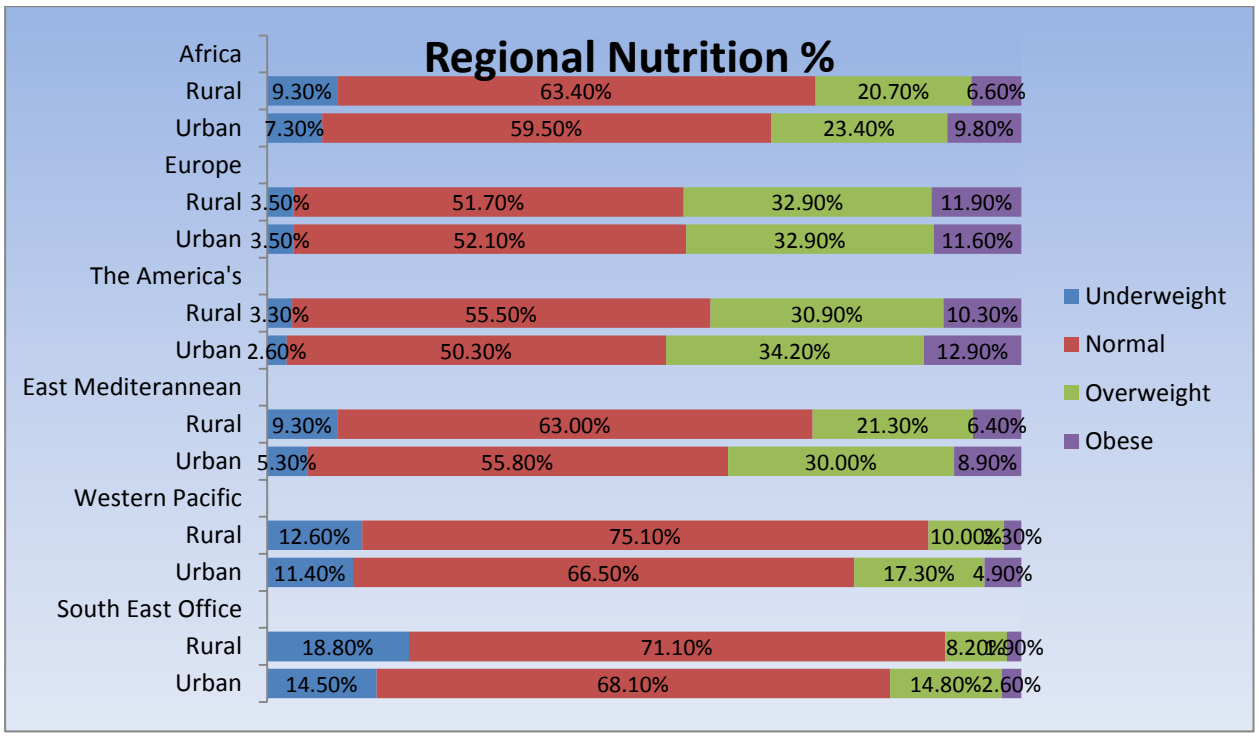


Figure 1.4 Regional Nutrition: Prevalence of Underweight and Overweight 2002/3

Source: (Moore, Hall *et al.* 2010)

In light of this, malnutrition can be viewed as existing anywhere on a plane with undernutrition at one end and overnutrition at the other and with all its sequelae inbetween. In this respect, the WHO recognise the need for addressing all forms of poor nutrition, whether under, over or mal- nutrition (WHO 2010).

1.2.4.5 Terminology and Nomenclature

As an aside and regarding the use of these words, one problem that is recognised as adding a layer of difficulty in the overall understanding food security, is the inappropriate and interchangeable use of nomenclature. Hunger, for instance is a word frequently used interchangeably with malnutrition and undernutrition, while malnutrition, often excludes overnutrition. More importantly too, according to MacAuslan (2009), as with famine; hunger is an emotive word that even both the FAO and WHO use in subtly different ways. This suggests MacAuslan perpetuates confusion over properly conceptualising loosely defined and often mis-used terminology (MacAuslan 2009).

That said and leaving overnutrition to one side, this research concentrates on food insecurity. Bearing this in mind, and to gain a better understanding of the concept, this research identifies two main types of malnutrition prevalent in the world today; protein-energy malnutrition (PEM) and micronutrient deficiencies. These are looked at here as part of a brief overview before the prevalence of each is examined in the global picture outlined in chapter 1.3.

Protein-Energy Malnutrition (PEM)

PEM is now considered to be the most pervasive form of hunger worldwide and results from a combined lack of protein and calories (WFP 2010). Complicating this situation is the widespread prevalence of predominantly vegetarian based diets (WHO 2010). The problem it seems, is that while it is accepted that traditional vegetarian diets do contain adequate protein, unbalanced vegetarian diets that subsist to a large extent on tuber or grain, may be at greater risk of protein deficiency (DeRose and Millman 1998; WHO 2010). Despite this, and whether from animal or vegetable origin, any prolonged energy and protein deficiencies lead to reduced physical activity, reduced appetite and general apathy (DeRose and Millman 1998).

The two main types of protein-energy malnutrition include: Kwashiorkor – a virulent form of malnutrition. This greatly affects children and is characterised by oedema, anorexia and painful ulcerating dermatosis. Secondly Marasmus,another form of PEM, is often manifest through extensive tissue and muscle wasting (WFP 2010).

Micronutrient Deficiencies

The second widespread deficiency is a lack of vitamins (avitaminosis) and minerals, which can and does result even if both caloric and protein needs are met (WHO 2010). Today, three

major micronutrient deficiencies persist: Iron; Iodine; and Vitamin A. That said, other important micronutrient deficiencies are still widespread, although perhaps to a lesser degree and include: niacin; thiamine; and vitamins C and D which can lead to diseases of pellagra, beriberi, scurvy and rickets respectively. However, although often less prevalent, in certain populations they can represent significant health problems (WHO 2010).

1.2.5 Environment and Natural Resources

This research has already touched upon some of the environmental issues and sustainability with regards to agriculture in particular in section 1.2.1.1 yet it is worth broadening the discussion here to include the growing propensity for environmental accounting. Even up until the early 1990's it seems, there was a feeling among the general public that natural resources were in relative abundance (GFS 2011). Farmers could happily intensify farming in the knowledge that resources could adequately cope and be replenished fairly easily. Nowadays however, such misconceptions are no longer prevalent and there is a global awareness of the increasing need to account for, and preserve, the natural environment (ibid). Serious resource degradation is occurring in all the major biomes: lithosphere, hydrosphere, atmosphere and biospheres (GFS 2011). So much so in fact, that it has been said that over-exploitation and the deterioration of the environment have become one of the major challenges of the 21st century (Zhang 2008).

This situation goes to the heart of the food security concept and there are many debates concerning the sustainability of the food supply versus the population demands. Major soil degradation has occurred and continues to occur around the world and although more and more people are devising ways of continuing to maintain productivity while introducing new land management practices, some suggest the measures are perhaps insufficient (GFS 2011). For many, the worst effects of ongoing: soil erosion, overgrazing, irrigation, salinisation, waterlogging, land use changes and deforestation have wider societal consequences than mere measures of productivity. For these people, such practices pose great risks to the biodiversity of the existing planet, but more importantly, degrade future generations' enjoyment of the natural environment (GFS 2011). The same is true of the growing scarcity of water supplies where non-renewable fossil aquifers are being depleted at alarming rates. Climate change too, continues to affect current cropping practices, with changing weather patterns and more frequent occurrences of floods and droughts (GFS 2011).

Environmental Accounting

In response to such crises there is a growing convergence of opinion for the need to account for humanitys' interactions with the environment (FAO 1995; von Braun 1995; Cohen 2006; ESA 2007). One such method, popularly uptaken by governmental institutions and non-governmental bodies alike, is the idea of environmental accounting (ibid). This idea proposes to account for natural resource usage in the same way that national accounts account for say, Gross Domestic Product (GDP). Others however, prefer a less monetary oriented approach

and have chosen to adopt a system of 'footprinting' (Cohen 2006). This particular method views resource usage in more cross-comparable terms., As an example, it is offered that it takes about 6kg of grain to produce 1kg of beef off-the-bone,, or alternatively 99% of the water footprint of toothpaste is taken up by running the tap as we brush our teeth (FAO 1995; von Braun 1995; Cohen 2006; ESA 2007).

Another aspect of environmental sustainability is the notion of biofuels. For some people, this is a revolutionary answer to the over-reliance on fossil-based fuels while for others, this is not an issue so much of the environment; rather it taps into the debate about food security (Cohen 2006: ESA 2007). This is evidenced, as some suggest, by that fact that basic commodities are slowly but surely converging on the price of oil (ESA 2007). In sum, whatever one's viewpoint, the balance of opinions suggest that food security and the environment are closely interlinked in many ways. Albeit, as has been seen, with a good measure of divergence of opinion as to just how interlinked or separate these many issues actually are.

Lastly before this research goes on to explore the current food security picture on the global scale this next section evaluates the role of government and governance in the issue of food for all.

1.2.6 Governance, Politics and Economics

When it comes to global governance of food security issues there are a number of stakeholders beyond the national government. These include non-governmental organisations such as charities, private voluntary organisations (PVO'S) and civil society organisations (CSO) among others. However, perhaps among the best known international agencies are those belonging to the United Nations family; the world food programme (WFP), the FAO, UNICEF, WHO, CFS and the Office for the Co-ordination of Humanitarian Affairs (OCHA) among others. Between them, food security or aspects of food security, are analysed discussed and policies are predicated on their findings (Karunakara 2010). The difficulty here is one of co-ordination, for while the UN for instance, foster productive relations with many outside bodies, many such bodies see the UN as an impotent force. For others, it has been suggested that they simply feel they could do a better job outside of the UN's influence (Karunakara 2010). As a result of this situation, many bodies and institutions have been created over the years (ibid). This has left a legacy of disparate institutions and oftentimes duplicated effort whose worst outcome was witnessed in the recent humanitarian emergency in Haiti in 2010 (Karunakara 2010). In this emergency it has been estimated, that as many as 12,000 NGO's were present shortly after the earthquake struck, despite such numbers, the carefully planned, un-coordinated response, has been accused of failing spectacularly (Karunakara 2010). This has been blamed by some, in part on NGO's that claimed responsibility for areas like health or sanitation for instance,

but then failed in their duties (Karunakara 2010). Whether through “capacity or know-how” this situation effectively left thousands of people's needs unmet; adding rather than alleviating the worst effects of the initial emergency itself (ibid). This left many unanswered questions within the sphere of governance about who is responsible and how we should co-ordinate such efforts in the future.

Humanitarian work too is not the only issue that falls under the remit of food security and global governance. Also within this large catchall questions are raised with regards to the notions of:

- freedom and democracy - that aim to bring about the means by which individual’s can acquire the foods they need, of;
- globalisation - where markets respond to stimuli that maintain equilibrium in supply and demand;
- social safety nets - that prevent setbacks becoming disasters or emergencies; as well as economic and;
- social development – that aims to raise the standards of well being and promote solid foundations of food security.

All this and more is predicated on political expediency, capability and most of all, it has been said, political will (Marzeda-Mlynarska and Curie-Sklodowska 2009; RTFN 2009). Indeed, some have suggested the issue of food security has become so wide, as to be too difficult to formulate policy, while others vehemently deny thi,s suggesting instead that the means are already there and that what is lacking is simply the international political will itself (Marzeda-Mlynarska and Curie-Sklodowska 2009; RTFN 2009).

With all this in mind and in keeping with the first aim of this research; to analyse the extent of the issues involved in food security, the next section seeks to bring all of this information together to give a picture of the food insecure throughout the world.

1.3 Putting it all Together: The Global Picture

Unfortunately even before any global picture can be offered there are certain challenges and possible areas of confusion that need clarifying. Moreover, it is important that such issues are addressed, as such misunderstandings continue to contribute to the confusion of the subject (Devereux 2000; Radimer 2002; Scaramozzino 2006; Greenway 2008).

1.3.1 Challenges

The three main challenges to gathering an overarching picture of the people suffering food insecurity are examined in the following section. First and foremost the biggest challenge lies with the indicators used to identify those suffering. The second area of potential confusion pertains to the need to represent much data geo-spatially; this involves the arbitrary use of boundaries and classifications. The third area is concerned with the use of

data and the potential long time-lag between data-sets. There is one further point that also needs clarifying and that is the different methodological approaches that are used in calculating the same phenomenon. This is dealt with separately in section 1.3.3 as it relates specifically to one metric in particular; the prevalence of undernourishment.

1.3.1.1 Food Security Indicators

Perhaps one of the biggest problems with determining, and by extension understanding, those who are food insecure, lay with the measures themselves (Cohen *et al.* 2008). Firstly, it is important to point out that there does not exist a single measure of food security. Although some inroads however, have been made using composite measures, such as the Integrated Food Security and Humanitarian Phase Classification System (IPC) (IPC 2007) and the International food Policy Research Institute's Global Hunger Index (GHI), there still exists much debate as to the use of appropriate indices and suitable methodologies within these indices. As such these metrics are still in their early days and are currently not yet widely adopted (ibid).

Instead, food security is measured by proxy. By measuring the variables closely associated with food security and its outcome, it is hoped a reasonable picture emerges. Ultimately however, with no single measure of food security, quantifying the food insecure becomes increasingly much more difficult. That is because while the various agencies and multilateral bodies use a selection of proxy indicators once again, as in many other aspects of the phenomenon, there is still only loose agreement over just which broad indicators to use (Hoddinott 1999; Hoddinott, Cohen *et al.* 2008).

Broadly speaking there are anywhere between 25 and 450 associated indices from which to choose (Riely and Mock 1995; Hoddinott 1999; Hoddinott, Cohen *et al.* 2008). Used for national purposes, this number might suit a variety of purposes however, at a cross border level this number becomes confusing and unworkable (Hoddinott, Cohen *et al.* 2008). In view of this there has been a recent move to rationalise cross-border proxy indices (Hoddinott, Cohen *et al.* 2008). As a result, consultation between several main agencies, the Committee on Food Security (CFS) in 2001 endorsed a suite of seven indicators to directly monitor food security, table 1.1.

Table 1.1: Indicators endorsed by the Committee on Food Security

Core Food Security Indicators
1. Average dietary energy supply per person (DES)
2. Cereals, roots and tubers as a Percentage of DES
3. Percentage of population undernourished
4. Life expectancy at birth
5. Under 5 mortality rate
6. Proportion of children under 5 underweight
7. Percentage of adults whose body mass index (BMI) <18.5

Source: (CFS 2001; FIVMS 2008).

Further indicators were also recommended for monitoring underlying conditions of vulnerability to food security see table 1.2. These were re-affirmed once again in 2008 by the Food Insecurity and Vulnerability Information Mapping Service (FIVIMS).

Table 1.2: Proposed Indicators for Monitoring Underlying Conditions for Inclusion in Future CFS Assessment Documents

Economic conditions	• GNP per capita • Growth rate per capita in GNP • GNP per capita at Purchasing Power Parity
Risks, hazards, shocks	• Number of countries facing food emergencies
Food availability	• Volume of production, use, trade, and stock changes • for selected food commodities, by group and by country • Ratio of Five Major Grain Exporters' Supplies to Requirements • Food production index
Food access	• Gini-index of income distribution • People living below national poverty line • People living on less than $1 per day
Stability of food supplies and access	• Cereal production changes in China, India and CIS • Cereal Production changes in LIFDCs • Cereal Production changes in LIFDSs less China and India • Export Price Movements for Wheat, Maize and Rice • Variability of food prices • Index of variability of food production

Source: (CFS 2001; FIVMS 2008).

Thus despite consensus or agreement between the multiple measures, it is hoped that by standardising a smaller, more manageable number of indicators a reasonable picture of those affected by food insecurity can be drawn (ibid).

Another potential area of confusion relates to the way data are assimilated. This is not so much an issue when comparing data on an intra-institutional basis but is a major consideration when comparing inter-institutional reports *etcetera*. This is important not only in the wider food security debate, but is central to this research as a global picture cannot be reliably gained without its due consideration. The following illustrates.

1.3.1.2 Boundaries, Classifications and Geo-Spatial Demarcation

Within the context of food security there is much need for data to be presented geo-spatially. As such there are often clear needs to demarcate certain geographic boundaries. This is important, as different institutions report information on varying geographic, economic or trading regions, as well as certain conceptual boundaries such as 'developed' and 'developing' countries. The difficulty with this is, not everyone signs up to the same boundaries, or even to the same criteria within each boundary (Devereux 2000; Devereux *et al.* 2004). Unfortunately this makes comparing data from different bodies difficult at best and confusing at worst (ibid).

The need for such demarcation is not itself in question however, the problem lies in standardisation (UNSD 2006; Cyberschoolbus 2010; UN 2010). This was recognised early on by the UN although, despite their efforts on the Standard Country or Area Codes for Statistical Use (1969 and revised 1999) there still lacks homogeneity of similar regional and

geo-political boundaries (ibid). This is not solely a problem for cross-agency statistics, it is also often true of different departments within the same bodies. This leads to a particularly troubling practice, where reports cite information on seemingly identical regions that contain different country groupings, as in the case of different UN bodies regional groupings' of sub-Saharan Africa (SSA) and the Near East (ibid). There are many examples of this within and without the UN family, which makes any analysis of regional intra- and inter-institutional data unnecessarily difficult.

That said such pitfalls have at least been recognised and to some extent partly addressed. In recognition, and as a result of the Millennium Development Goals (MDG), the UN created a level playing field in which all MDG data from all UN agencies could be presented in the same format (MDG 2000). In particular, within the MDG collated data, regions are collectively aggregated based on a combination of geographical and developmental criteria (ibid). While undoubtedly a step in the right direction, this practice has not trickled down to general analysis. This is evidenced in the many institutional reports that still insist on using proprietary classifications that make it difficult to compare across reports.

Lastly on the subject of the use of terminology, once again there is also much room for confusion when talking of 'developing' and 'developed' area's in reference to countries. By way of illustration it can be seen that on the one hand, the UN suggest that such terms are not bound by any established convention, and are instead, merely conceptual groupings (UNSD 2006). On the other hand, another UN website suggests that 'developed' countries exclude the high income groupings as well as those economies in transition (UNSD 2006; Cyberschoolbus 2010; UN 2010). Such contradictions according to Cohen (2008), are unfortunately more widespread than the UN and do little to help unravel the food security position (Cohen *et al.* 2008).

1.3.1.3 Data Relevance

The last area of possible confusion concerns the timeframes of some of the data sets that are collated by many national governments and organisations (Svedberg 2002). The difficulty here is that much data collected for many reports are all too often out of date, in many instances by as much as several years. This comes about through the different time frames in which country's collect or report data. It is also exacerbated by the fact that different countries also use different frequency periods, so while,for example, Uganda might collect population data starting in 1960, it might be based on consensus reports every four to five years, whereas on the other hand, South Africa might have had a start date of 1959 and take a national consensus every three years. These inconsistencies makes collecting and collating data for the purpose of direct comparison very difficult (ibid).

This situation results in two problems. Firstly, original data sets might be quoted even if it appears to be years out of date, or secondly, estimates are made to project all data to represent present day estimates (Svedberg 2002). This then brings in a further set of problems where one agency might use sophisticated probability data to make projections, while others use empirical past trends to predict future growth (ibid). One way however, to ensure reliability and quality estimates is to obtain data, whether original or estimated, from reputable sources. Although what constitutes a reputable source is itself a subjective and sometimes contradictory choice.

Having explored some of the difficulties in the choices and availability of data and how it is presented, this next section provides the final piece in the research aim of providing an overall picture of food insecurity in the world. It is also worth re-iterating at this point, that the aim of this research is not to determine the causality of food security, but rather collate the multitude of possible influences determined by the literature. As a result the following section helps place this research in context and illustrate the extent to which food security has become a global phenomenon. This aids the research on two fronts; firstly, by providing underpinning knowledge for the overarching comprehension of the subject; and secondly provides for later analysis of the components of the proposed framework itself.

1.3.2 Global Food Security

One way of organising the data is to utilise the FAO's earlier mentioned four-pillars of food security, those of availability, access, utilisation and stability. This is the convention followed in this section. Furthermore, two additional sections following on from these, look specifically at the outcomes of the insecure in terms of numbers of undernourished and those affected by micronutrient deficiencies.

1.3.2.1 Availability

As one of the four main pillars of food security availability is an important component of any framework that attempts to describe the phenomenon (WFP 2010). Availability in this sense is about food production and is governed by many factors, which can be measured in many different ways. A country's food production indices for example, can determine relative productivity over time or between regions. Other useful indicators might include import and export figures, or indicators that measure stability and dependency, such as the ratio of the five major grain exporters' supplies to requirements. As a core indicator though, one of the most widely quoted is that of Dietary Energy Supply (DES) (ibid).

Dietary Energy Supply (DES)

The DES is calculated using the FAO's food balance sheets and is used to illustrate the extent of the daily available food supply per capita (Hoddinott 1999). Figure 1.5 highlights the availability of per capita DES for the world as a whole in 2007, as well as for those in the least developed countries.

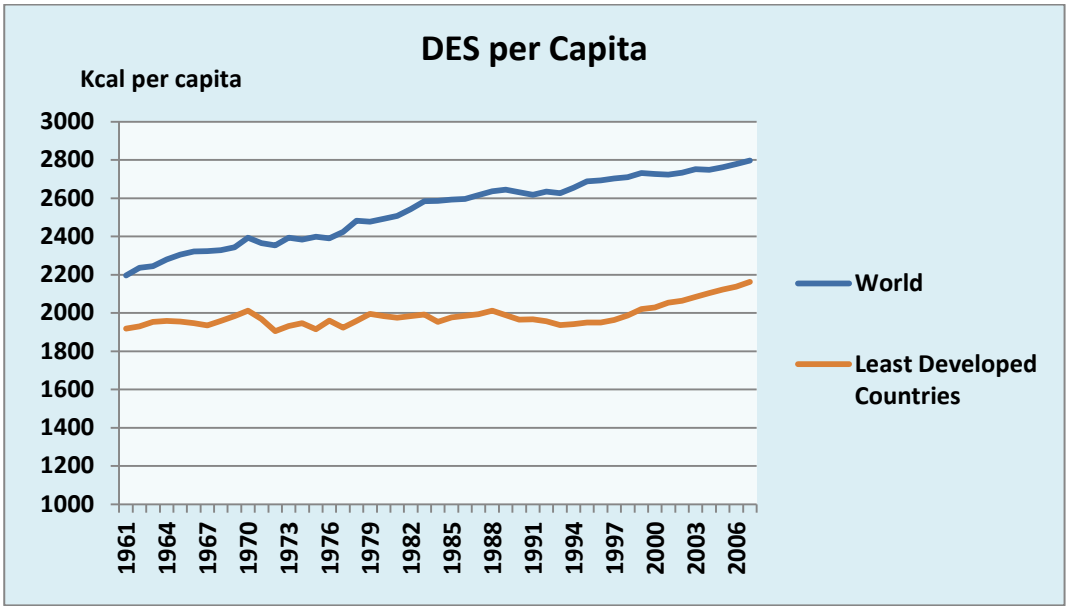


Figure 1.5 Dietary Energy Consumption Per Capita

Source: compiled from (FAOSTAT 2011) (based on UN definition of LDC, (UN/DPI 2004; UNCTAD 2011).

While the above chart is useful further disaggregation, figure 1.6 shows the extent of the regional disparity. This, taken with other metrics, such as poverty and the like can help analysts draw hypotheses as to possible correlations which ultimately benefits any conceptual framework.

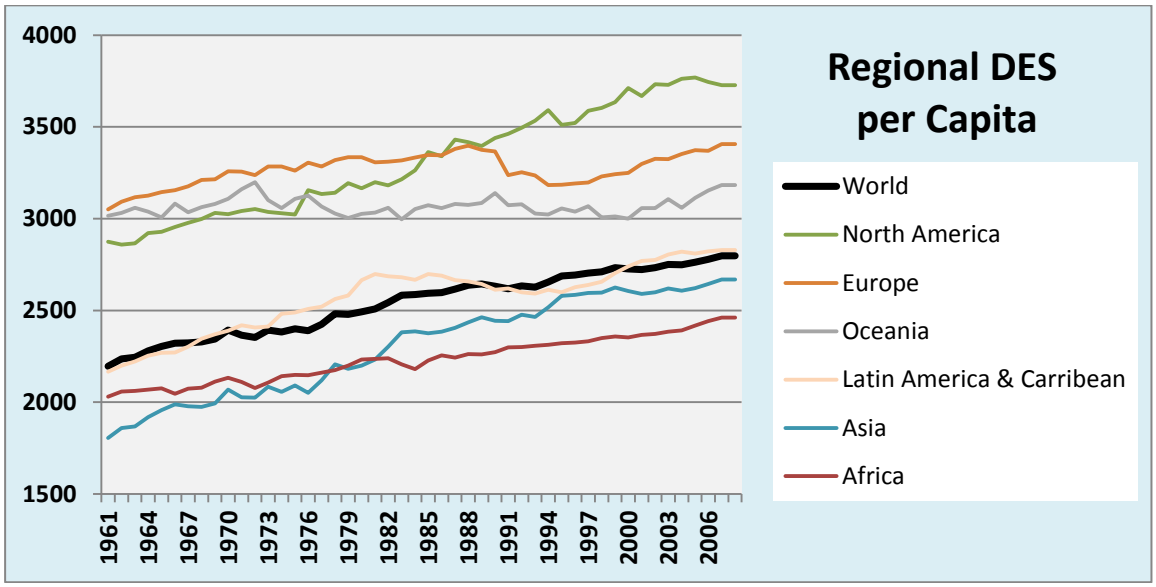


Figure 1.6: Regional DES 1961-2007

Source: compiled from (FAOSTAT 2011).

As a measure, DES can be a useful index of the overall global and national food supply and its change over time. In this respect it can be seen that North America, Europe and Oceania enjoy considerably more availability than Africa and Asia; a situation which incidentally has not changed much in the last 4 decades. In terms of food security and availability of food however, what also becomes immediately clear from the above statistics, is that an overall food supply of 2800 kcals per person per day, falls well within the 2100 to 2400 kcals range

dictated by the FAO and the USDA as sufficient to meet most people daily requirements. In short, it can clearly be seen that for the last 30+ years the world has produced sufficient food to feed everyone on the planet.

Enough Food

Despite this, in terms of the awareness of food availability, and in large part thanks to the popular media, there still exists persistent general perceptions of global food shortages (Charles 2008; Sachs 2008). Whether used for sensational headlining, or out of genuine belief is a matter of debate and beyond the purview of this study. What is of interest, is the salient fact that there is not a world food shortage. In fact as figure 1.7 demonstrates, while food shortages, hunger and starvation are still prevalent in many regions of the world insufficient aggregate global food production is not, nor has been, the cause for several decades (DeRose, Messer *et al.* 1998; Freedom 21 2008).

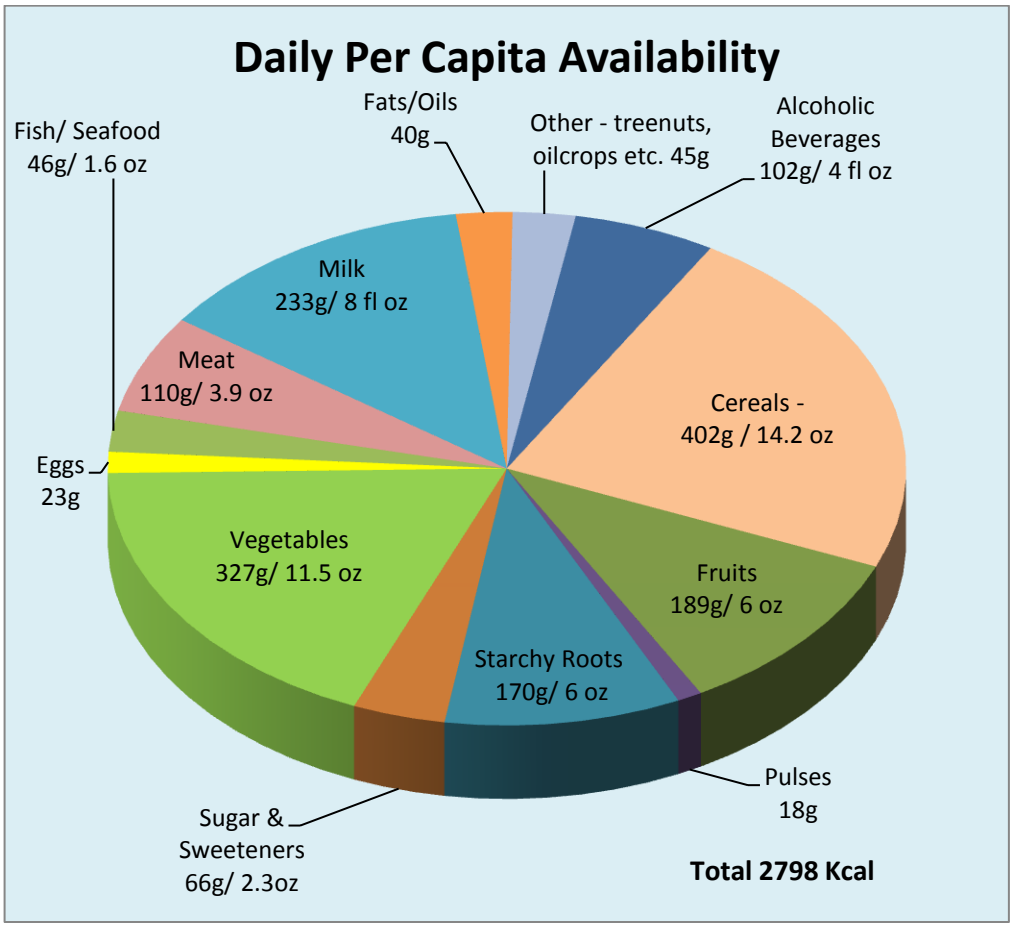


Figure 1.7: Per Capita Global Food Production 2007

Source: Figures Calculated from the FAO Food Balance Sheets (FAOSTAT 2008).

The literature also tells us that this is not a new outcome. In fact, due largely to the green revolution and the industrialisation of agriculture over the last half century, food production has continuously outpaced global population; defying the worst of Thomas Malthus's predictions (Smith, Obeid *et al.* 2000; FAOSTAT 2008). This is evidenced in terms of availability of food over the last 30 years; a period in which world population grew by nearly 60% and world agriculture generated 17% more calories per person.

While taken together, such measures provide a snapshot of the availability of potential food supplies, the regionally disaggregated food consumption figures show a different situation. This is where these kind of reported metrics' limitations become evident. That is to say, overall global averages assumes all regions are homogenous and are provided with an equal share of the food. Moreover, the same is said of the regional desegregations in which every person is assumed to have equal access to such supplies. The reality however, is different.

This brings into question an individuals' access to food and highlights the fundamental and underlying truth that, while there is no global food shortage as such, there does in fact exist, vast regional disparities in availability, access and ultimately, consumption patterns (DeRose, Messer *et al.* 1998; Freedom 21 2008).

1.3.2.2 Access

This has implications for any potential conceptual model. Clearly it can be seen that, global availability of food is insufficient by itself, to give a clear picture of the food insecure. By looking at the second dimension noted by FAO, USAID and others, it is common to think of access in both physical and economic terms (Shaohua and Ravallion 2001; Sillers 2008). For some, physical access might include growing their own food, or it might involve the physical location of markets; whether regular and accessible for instance. When considering the financial or economic access to food on the other hand, this might involve employment and other income, or perhaps the ability to barter or trade for food (ibid). Beyond the personal level too, this also relates to the national level where the country's healthy national accounts are needed to pay for imports or where there is sufficient infrastructure to ferry goods to and from markets *etcetera* (Shaohua and Ravallion 2001; Sillers 2008).

Taking the national perspective for the moment, the sum of all the productivity of a country is the measure of country's Gross national Product (GNP). This is then usually divided by the population to determine a per capita contribution. Of course, as in the food availability measures, this assumes a homogeneity of distribution, when in fact there is not (Shaohua and Ravallion 2001). One way around this is to incorporate several accompanying metrics that help clarify the picture (ibid). These could include the prevalence of those living below the national or absolute poverty lines, as well as the Gini coefficient or the index of income distribution. Each measure however has benefits and limitations.

In food security on a national level, measures of national or absolute poverty lines, give an indication of relative income to the national average, while the Gini coefficient of income distribution, determines the equality of income. In other words, the spread of income throughout the country or region (ibid). The difficulty with national poverty thresholds is that, they vary across countries and it has been observed that such measures tend to be

relative to the average earnings in each country (Sillers 2008). Therefore if for instance, America's average earnings are in the region of $30,000, then poverty might be considered as those earning under a certain percentage, or based on the cost of a basket of goods. Either way, it is likely that the chosen threshold is at a higher rate than perhaps Lesotho, who might be earning $1000 American equivalent, which makes comparing the poor in one country to another, very difficult (Sillers 2008).

As a result, on a global or regional scale, comparable cross-border analysis of poverty is better considered using absolute poverty lines based on purchasing power parities (PPP).

People Living on Less Than $1 Per Day

The concept of purchasing power parity (PPP) is widely accepted as a good measure of the comparative cost of living between countries, more so in fact, than the more familiar market led exchange rate system (Shaohua and Ravallion 2001; Sillers 2008). PPP works on costing a basket of goods and services and comparing this with a similar basket from the US. This method is behind the principle that allows for international comparison of all comparable economic indicators. It also forms the basis of the World Bank's (WB) absolute cross-border comparable poverty lines. In 1990, the first year of use, the poverty line was set at $1 based on 1983 prices. This was revised in 1993 to $1.08 and $1.25 in 2005 however, the metric is still referred to as $1 a day. It has been adopted by many, including the UN and as an indicator for achieving one of the Millennium Development Goals (MDG). All in all, the cross-border metric of absolute poverty is an important consideration when inferring access to food irrespective of the available supplies.

By way of example, most of the developing countries' rural poor (over 85%) rely on agriculture for food and income, with approximately 880 million (out of a global 1.2 billion) people living on less than $1-a-day. Besides this, a further 2.1 billion get by on less than $2-a-day (World Bank 2009). With little income, and being overwhelmingly dependent on agriculture, the rural poor are particularly vulnerable to man-made or natural crisis (ibid). However, this might change in the coming future, with a growing population large projected rises are made in respect of the urban poor (von Braun 1995; SOFI 2005).

Thus by linking food availability to the concept of access, whether economic, social or physical the literature allows for the two concepts to be correlated or at least associated in any conceptual framework.

1.3.2.3 Utilisation

In understanding the biological utilisation of food within the overall concept; this dimension, along with that of stability, are the two most open to interpretation (Vos, Rodriguez *et al.* 2009). Implicit in the utilisation of food, is the efficient use of appropriate food supplies to

meet the dietary needs. This it seems, is where the concept opens up considerably and takes in wider societal issues such as: education with regard to nutritional and care practices; knowledge of appropriate food storage and processing; adequate health care services; non-food inputs such as clean water and sanitation; as well as investment among others things (Riely, Mock *et al.* 1999). In turn this number of variables suggests a potential wide indicator base for monitoring such things (ibid). Briefly, such indicators might include: health services expenditure; education enrolment and drop-out rates; access to adequate sanitation and water as well as morbidity rates of associated diseases *etcetera*. Such deliberations bring in to any model many of the wider societal issues that have to be considered along with how and at what point such linkages are made. Thus hard choices need to be made in respect of what to include and exclude in any model of food security.

The final of the four-pillars looks at stability. As with utilisation, there are many ways to consider risk or vulnerability to food security. The following looks at two in particular, natural and man-made emergencies.

1.3.2.4 Stability

Discussing risk, vulnerability or stability allows for the examination of the susceptibility of food supply and access. As with the utilisation dimension, this aspect is open to diverse interpretation and measurement and might include natural or man-made disasters; stability of the political or economic environments; or perhaps the risk of environmental consequences of poor agricultural practices among others (CRED 2009). While such issues have an important bearing on the food security of individuals and nations, it is quite often difficult to calculate the extent of each crisis on the affected (ibid). As a result, a whole industry surrounding emergency food and humanitarian aid has sprung up in an effort to analyse and provide for the needy.

Natural Emergencies

The Centre for Research on the Epidemiology of Disasters (CRED) has created a database of over 18000 natural disasters that have occurred since 1900 called EM DAT. Each emergency is classified as belonging to one of five categories: geophysical, meteorological, hydrological, climatological, biological (CRED 2009). In 2009 worldwide, there were 335 reported natural disasters (Vos, Rodriguez *et al.* 2009). The difficulty here, the literature tells us, is that just how and to what extent, each emergency affects a particular region in respect of food security (ibid). Moreover, combinations of emergencies can easily exacerbate the problem and understanding, and ameliorating the worst effects of these disasters, is an involved and complicated business that requires on the ground surveillance and action (ibid). Two such natural disasters are particularly relevant to the food security debate, floods and droughts (Vos, Rodriguez *et al.* 2009).

Table 1.3 highlights the frequency of these two phenomena in 2009 and clearly shows that Africa and Asia bear the brunt of global natural disasters. Of note here, is that no matter the number and severity of disasters, there are some in the world more prepared than others.

Table 1.3 Natural Disasters 2009

Region	Droughts				Floods			
	Number of Incidents	Number Killed	Number Affected (thousand)	Est. Damage (US$ Million)	Number of Incidents	Number Killed	Number Affected (thousand)	Est. Damage (US$ Million)
World	26	6	90,000	563,000	150	3487	57, 000	8,004,000
Asia	6	0	55,000	234,000	47	2242	53,000	Incomplete
Africa	10	6	31,000	No Data	27	416	1,600	No Data
The Americas	9	0	3,000	Incomplete	33	275	2,200	Incomplete
Europe	No Data	No Data	No Data	No Data	15	61	38	Incomplete
Oceania	No Data	No Data	No Data	No Data	5	40	28	Incomplete

Source: (OFDA/CRED 2010).

This, according to Vos *et al.*, needs more in-depth understanding and preparedness from all concerned:

> "Countries need to be better prepared for the destructive impact of natural disasters. Underlying factors and preconditions that make human populations vulnerable to disasters need to be addressed in order to mitigate impacts and create resilient and sustainable societies." (Vos, Rodriguez *et al.* 2009, pg 2).

By achieving this it is hoped people and countries can better offset the worst effects of food insecurity in times of such emergencies.

Conflict, War and the Displaced

When it comes to man made disasters such as conflict and war the challenges are different to those of natural emergencies (UNHCR 2009). In this scenario the difficulty lies in the ability to comprehend factors such as forced migration, land confiscation and financial withdrawal on the security of food access and availability (UNHCR 2009). Such humanitarian emergencies are monitored by the Office of the United Nations High Commissioner for Refugees (UNHCR). The problem is vast and widespread, as can be seen in table 1.4. In 2009 alone, there were estimated to be over 43 million displaced people worldwide, with 27 million of these being internally displaced persons (IDPs) (UNHCR 2009). These numbers make up a large percentage of the UNHCR's remit supported by the World Food Program.

Table 1.4 Refugees, Asylum seekers and Internally Displaced Persons 2009

Category of displaced population	2008 Protected/assisted by UNHCR or UNRWA mandates	2008 Total	2009 Protected/ assisted by UNHCR or UNRWA	2009 Total

			mandates	
Refugees	10.5	15.2	10.4	15.2
Asylum-seekers (pending cases)	0.2	0.8	0.2	1.0
Conflict-generated IDPs	14.4	26.0	15.6	27.1
Total	25.1	42.0	26.2	43.3

Source: (UNHCR 2009).

Note: figures do not include natural disaster-related displacement.

Understanding and providing for the needs of the food insecure in this environment, is not without its problems (UNHCR 2009). While generally, the food security debate concerns itself with understanding the phenomenon, with a view to preventing such disasters, emergencies on the ground require different considerations (ibid). As a result the food security debate can be divided into two camps: preventative and palliative. Both require holistic understanding, yet both face difficulties of conceptualisation.

In consideration of these factors, any conceptual model must be inclusive of such risks both known and potential. How such factors are also portrayed and to which variables these may apply, also needs to be taken into account; these are discussed in more detail in the next section (chapter 2).

While consideration of the four-pillars highlights something of the mechanics of food insecurity, it does not provide details on how many are suffering and to what degree. In answer and as mentioned previously, a suite of indicators provides some background. However, there are certain measures more readily identifiable, by the wider community, as being more closely reflective of food insecurity than others (Riely and Mock 1995; Hoddinott 1999; Hoddinott, Cohen *et al.* 2008). Two such measures include, the prevalence of undernourishment and the extent of macronutrient deficiencies.

1.3.2.5 Nutritional Outcomes: Identifying the Insecure

Measures of nutritional outcomes are useful tools in assessing the overall numbers of affected, or for analysing the success or failures of intervention or policy responses (Cohen *et al.* 2008). An obvious limitation at this juncture, would be to mention that such measures are outcome or retrospective measures, and while forward looking measures would be preferable, there does not exist a suitable measure of such (ibid).

As a result, choosing the right indicator becomes problematic, with as many critics of each measure as there are advocates (Cohen *et al.* 2008). This is no less true of the prevalence of undernourishment statistics. Of important consideration in this respect, is the fact that there are several institutional bodies all collecting data to determine such metrics. Each claims to represent global undernourished and each go about it in different ways, with resultant differing outcomes. Being some of the most recognisable and most important of the

representative food security statistics, these are examined in a little detail. This serves two purposes. By highlighting the dissention among institutional bodies on this important metric, it is shown as representative of the lack of convergence of the wider debate in general. Secondly, and more specifically to this research, the different variables used range from anthropometric measures of the under 5's to DES and income distribution. This has implications on which variables to include and their interactions in the overall conceptual framework of this research's goal.

FAO Percentage of Population Undernourished

The FAO's percentage of population's undernourished is calculated on the basis of three key parameters: the per person average food consumption (or availability); people's inequality of access; and the minimum calorie requirement for the average person (weighted by demographics) (MDG 2000). According to FAO figures there were an estimated 925 million undernourished in 2010 table 1.5, (FAO 2010). Although down on 2009 figures of 1.02 billion, the downturn it seems, had more to do with favourable economic conditions than any advance in the fight against food insecurity (FAO 2010). That said, this figure is still high and represents around 14% of the global population (CIA Factbook 2010; FAO 2010).

Table 1.5 Prevalence of Undernourishment

Year	1969-1971	1979-1981	1990-1992	1995-1997	2000-2002	2004-2006	2008	2009	2010
World	**878**	**853**	**845.3**	**824.9**	**856.8**	**872.9**	**915**	**1020[b]**	**925**
Developed World			**19.1**	**21.4**	**18.7**	**15.2**		**15**	**19**
Developing World	**864.2***	**774.2***	**826.2**	**803.5**	**838.0**	**857.7**		**1005**	
Asia And The Pacific	**689.7***	**591.5***	**585.7**	**528.5**	**552.1**	**566.2**		**642**	**578**
East Asia	464.7*[a]	336.1*[a]	183.3	152.0	141.7	136.3			
Southeast Asia			105.7	88.6	93.9	84.7			
South Asia	225*	255.3*	286.1	278.3	302.8	336.6			
Central Asia			4.0	4.7	9.3	5.8			
Western Asia			6.1	4.4	3.5	2.1			
Latin America and the Caribbean	**49.6***	**43.2***	**52.6**	**51.8**	**49.4**	**45.3**		**53**	**53**
Central and North America			9.3	10.2	9.3	9.0			
The Caribbean			7.5	8.6	7.2	7.8			
South America			35.8	33.0	32.9	28.5			
Near East and North Africa	**38.6***	**21.1***	**19.1**	**29.6**	**31.6**	**33.8**		**42**	**37**
Near East			15.0	25.3	27.1	29.0			
North Africa			4.0	4.3	4.5	4.9			
Sub-Saharan Africa	**86.3***	**118.5***	**168.8**	**193.6**	**205.0**	**212.3**		**265**	**239**
Central Africa			22.0	38.4	47.3	54.3			
East Africa			77.2	85.7	83.4	86.5			
Southern Africa			32.4	35.8	36.5	36.7			
West Africa			37.3	33.8	37.7	34.7			

Notes: *Based on SOFI country compositions.*
Several historic figures have been retrospectively revised by the FAO based on the new FAO standards for human energy requirements of 2004 the new WHO Body Mass Index standards of 2006.
**Authors estimations based on 1996 FAO's Sixth World Food Survey figures and FAO's Agriculture: towards 2010 which are then adjusted based on FAO's downward revision. These figures are intended as approximations only .*
[a] *Includes Southeast Asia*
[b] *While (DESA/CSD 2010)(SOFI 2009) suggest the totals are 1020 million discrepancies in their sub aggregates equate to 1035 million (SOFI 2009)*

Source: compiled from FAO statistics database (SOFI 2008; SOFI 2009; DESA/CSD 2010; FAO 2010).

This can be better viewed in graphic form in figure 1.8 where the majority of the worlds undernourished can be seen to exist in the developing regions of Africa and Asia.

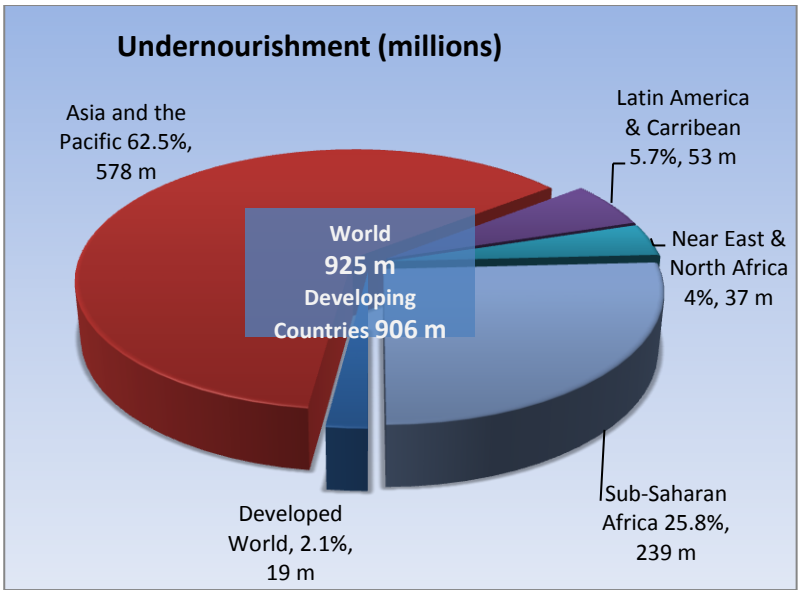


Figure 1.8 Number and Prevalence of Undernourished by Region 2010

Compiled from (FAO 2010).

Snapshots like this are useful and are indeed commonly used however, it does not tell the reader anything about trends over time. For this purpose the preferred choice is the use of time series data. By plotting the various total numbers over the last 40 years against the trend in percentage of global populations (figure 1.9), two different pictures emerge. On the one hand, the overall numbers of undernourishment over this period suggests there has been little change over the last 40 years. On the other hand however, it can be seen that while such numbers have remained consistentl high, the trend line tells a different story. As the graph shows, the global undernourished, according to the FAO's metric actually fell from a high of about 25% in the 1970's to about 13/14% in 2005/6 followed by a slow turnaround after that (FAO 2010). This trend, despite the last few years, shows a considerable trend over time in the right direction.

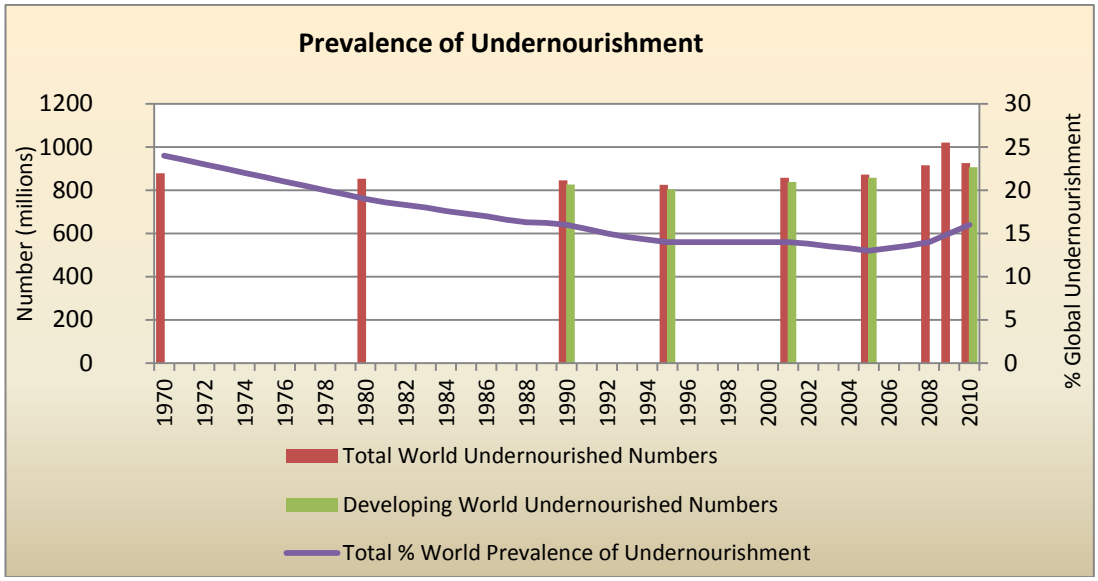


Figure 1.9 World Undernourishment Trend 1969/71-2009

Compiled from (FAO 2010).

Further breaking these numbers and prevalence down into those of the majority of sufferers; the developing countries, the data once again takes on different significance. It can be seen from figure 1.10 that of the developing countries the overall numbers fell from an all time high of 35% in 1969, dipped at around 19% in 2004 and has climbed again ever since (SOFI 2009; FAO 2010). This, despite repeated calls that bewail the lack of progress, seem to miss the point that over the last 40 years, considerable progress has in fact actually been made (FAO 2010). By projecting the prevalence over the region in today's terms, (a procedure often used in economics) would show that, if left unchanged, the 1969/71 figures of 35% undernourished super-imposed on today's estimated population of close to 7 billion (2011), that this would represent a total of 2.45 billion (DESA/POP 2010). Compare this to actual undernourished figures in the region of 906 million and progress can be seen to the extent of over 1.35 billion.

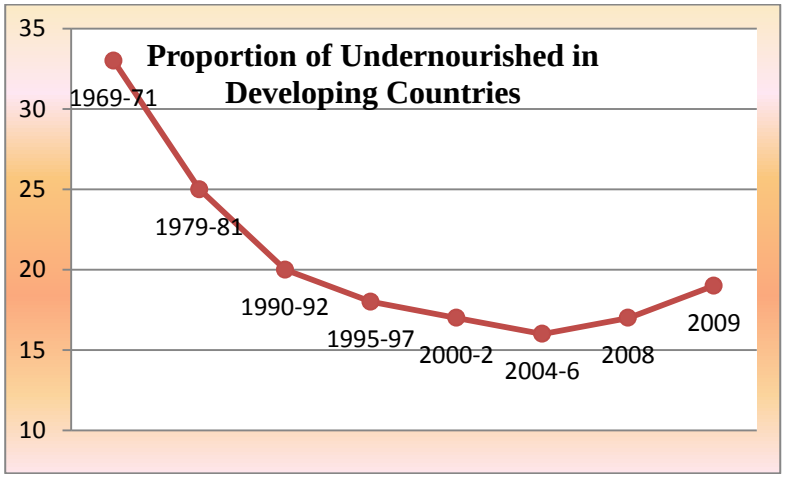


Figure 1.10 Proportion of Undernourished in Developing Countries 1969-71 to 2009

Source: Compiled from FAO statistics (SOFI 2009; FAO 2010).

USDA/ERS

In a similar vein to the FAO the United States Department of Agriculture's Economic Research Service (USDA/ERS) also use their own prevalence of undernourishment figures (Rosen 2010). There are differences however, firstly, the ERS use a different methodology relying greatly on a universal energy cut-off point of 2,100 kcals and secondly, the data is restricted solely to 70 developing countries (ibid). Using the USDA/ERS figures in 2010, the prevalence of undernourishment figures for these 70 countries, was estimated to be 882 million (Rosen 2010). The cautionary note here would be, that only by comparing the same 70 countries from both the ERS and FAO can judgments then be made about the different figures.

WHO Undernourishment

Lastly, the World Health Organisation (WHO) also collect measurements of undernourishment. They concentrate their efforts on children and adults separately and use a completely different methodology to the above two institutions (WHO 2010). With regard to children the WHO work on the principle that under 5's are more vulnerable because of their greater needs and therefore are more susceptible to any reduction in food intake (ibid). Using child metrics this way, the WHO insist that such measures act as a barometer of the wider population (WHO 2010). Methodologically speaking, unlike other institutions where the measures are subject to complex statistical manipulation, the WHO collect simple anthropometric data. The three main measures in their portfolio are: low height-for-age – **stunting**; low weight-for-height – **wasting**; and low weight-for-age – **underweight.** The main adult anthropometric used by the WHO for undernourishment purposes is the Body Mass index (BMI). In 2008 the proportion of children under 5 that were Underweight were reported to be 129 million (WHO 2010), figure 1.11.

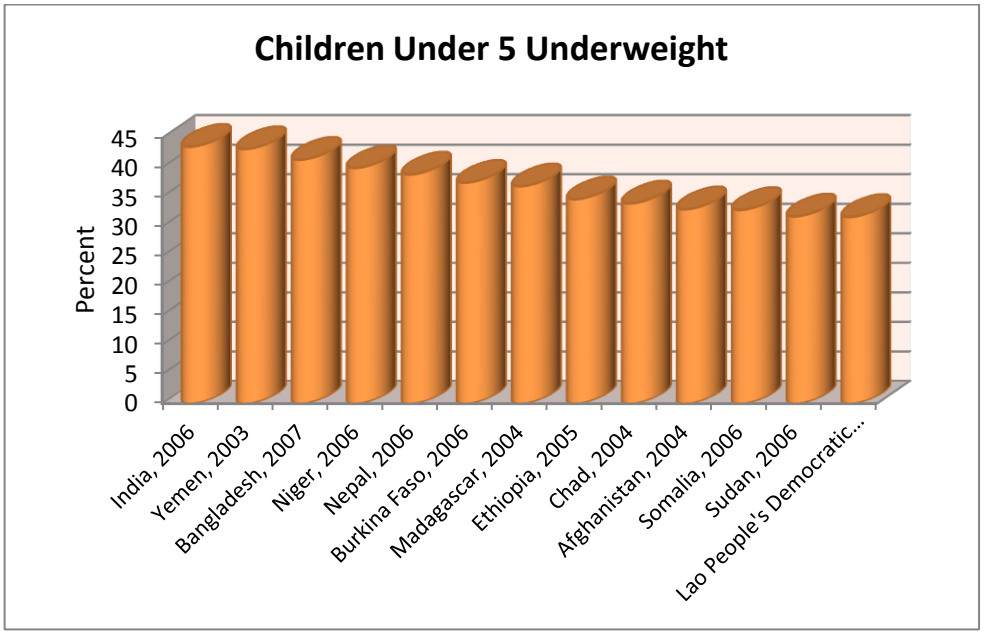


Figure 1.11 Proportion of children under 5 that are underweight. %

Source: (WHO 2010).

With regard to adults over the same period the WHO's data on the percentage of adults with body mass index (BMI) below 18.5kg/m^2 is once again, a simple index of weight divided by the square of the height (WHO 2010). These data are collected from household survey's, and while considered crude by some, it is in fact a simple but effective measure of underweight (WHO 2010). The following graph (figure 1.12) lists the latest available figures, although there is an important caveat here in the relevance of the date of the data. In this particular graph the latest available data range in the WHO's database of BMI range from anywhere between the 1990's through to 2008 (WHO 2010).

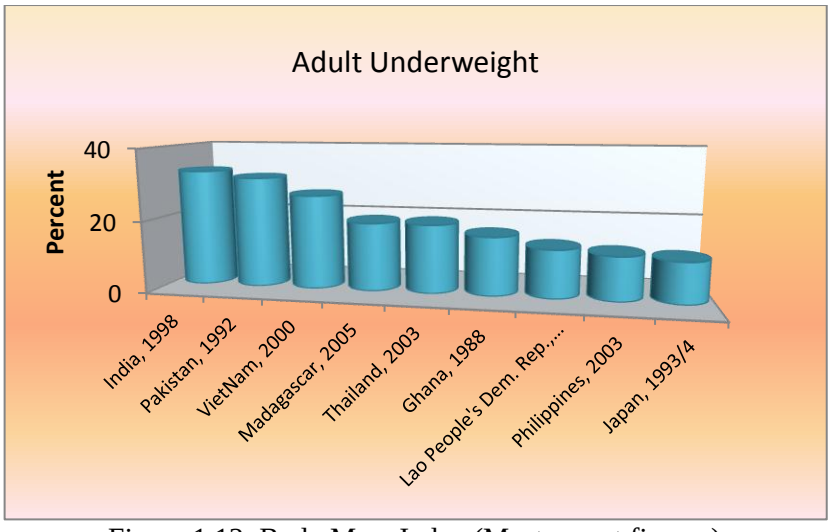


Figure 1.12: Body Mass Index (Most recent figures)

Source: Compiled from (WHO 2010).

As well as these single indices, there are others who combine metrics in composite indicators that better aims to fill the perceived weaknesses of each of the previous undernutrition metrics. Two such measures are looked at here; the IFPRI Global Hunger Index and the

Integrated Food Security Phase Classification (IPC). A brief examination of the composite indices, helps this research evaluate the direction of the emerging indicator debate.

IFPRI Global Hunger Index

In recognition of the limitations of these institutional metrics of undernourishment, the International Food Policy Research Institute (IFPRI) sought to combine several of the available indices into a single composite indicator (Wiesmann 2006). Launched in 2006 IFPRI's Global Hunger Index (GHI) aimed to draw attention to the problem of hunger and malnutrition. It began as a collaboration between the FAO and IFPRI, in recognition of existing weaknesses within the current methodologies and combines three dimensions of undernutrition: the FAO's proportion of undernourishment; the WHO's indices of underweight; and UNICEF's under 5 mortality rates (Wiesmann 2006). The GHI index then is calculated giving equal weight to each measure using the following equation:

$$GHI = \frac{PUN + CUW + CM}{3}$$

Key: *GHI = Global Hunger Index; PUN = proportion of the population undernourished %; CUW = prevalence of underweight in children under five %; and CM = % of under 5 child mortality.*

From this calculation, a single index from 0-100 is returned and used to give hierarchical rankings to each country and the further ability to spot trends over time. There are limitations to this measure; the two most important are firstly, there are no measures of the developed countries as these are thought of has having taken care of the problem of hunger and secondly, no measures are given for those countries providing more than 2,900 kcal (Wiesmann 2006). However, even with these limitations table 1.6 details the rankings of the GHI to 2009. From this table it can be seen that, with the exception of Haiti, all of the worst affected countries fall in the African and Middle East areas of the globe.

Table 1.6 IFPRI's Global Hunger Index by Ranking

2009 Ranking	Country	1990	2009
84	Congo, Dem. Rep.	25.5	39.1
83	Burundi	32.2	38.7
82	Eritrea	-	36.5
81	Sierra Leone	33.1	33.8
80	Chad	37.7	31.3
79	Ethiopia	43.5	30.8
78	Niger	36.5	28.8
77	Madagascar	28.1	28.3
76	Haiti	33.6	28.2
75	Central African Republic	30.0	28.1
74	Yemen, Rep.	30.7	27.0
73	Comoros	22.7	26.9
72	Zambia	25.3	25.7
70	Rwanda	29.6	25.4
70	Timor-Leste	-	25.4
68	Angola	41.5	25.3
68	Mozambique	35.9	25.3

Source: (Grebmer, Nestorova *et al.* 2009).

Integrated Food Security Phase Classification (IPC)

The Integrated Food Security Phase Classification (IPC) is another composite indicator of food security. It originally began in Somalia with the Food Security Analysis Unit (FSAU) (IPC 2007). Citing a gap in needs-assessment and decision-making in the humanitarian sector, the ICP's initial idea was to improve on the many existing classification systems currently in use (ibid). Essentially, the IPC aims to summarise and consolidate a country's Situation Analysis, or the elemental aspects of food security (severity, causes, magnitude, *etcetera*) (IPC 2007). This, according to the IPC, is an often overlooked stage of food security analysis (ibid). The Phase Classification is divided into five Phases: Generally Food Secure (1A and 1B); Moderately/Borderline Food Insecure; Acute Food and Livelihood Crisis; Humanitarian Emergency; and Famine/Humanitarian Catastrophe (IPC 2007). The IPC's reference table also includes information on three levels on the risk elements of food security including: (1) Watch, (2) Moderate Risk, (3) High Risk (IPC 2007).

While, strictly speaking, the IPC is a classification system and not an assessment method *per se,* the strengths of this method allows for the categorisation of the food insecure based on integrating existing metrics from multiple data sources (table 1.7) (IPC 2007). Moreover, it does not aim to replace, but rather complement existing methodologies.

Table 1.7 IPC Reference Table

	Phase Classification	Key Reference Outcomes *Current or imminent outcomes on lives and livelihoods.* *Based on convergence of direct and indirect evidence rather than absolute thresholds. Not all indicators must be present for classification.*
1A	**Generally Food Secure**	• **Crude Mortality Rate** < 0.5 / 10,000 / day • **Acute Malnutrition** <3 % (w/h <-2 z-scores) • **Stunting** <20% (h/age <-2 z-scores)
1B	**Generally Food Secure**	• **Food Access / Availability** usually adequate (> 2,100 kcal ppp day), stable • **Dietary Diversity** consistent quality and quantity of diversity • **Water Access / Avail.** usually adequate (> 15 litres ppp day), stable • **Hazards** moderate to low probability and vulnerability • **Civil Security** prevailing and structural peace • **Livelihood Assets** generally sustainable utilisation (of 6 capitals)
2	**Moderately / Borderline Food Insecure**	• **Crude Mortality Rate** <0.5 / 10,000 / day; U5MR<1 / 10,000 / day • **Acute Malnutrition** >3% but <10 % (w/h <-2 z-score), usual range, stable • **Stunting** >20% (h/age <-2 z-scores) • **Food Access / Availability** borderline adequate (2,100 kcal ppp day); unstable • **Dietary Diversity** chronic dietary diversity deficit • **Water Access / Avail.** borderline adequate (15 litres ppp day); unstable • **Hazards** recurrent, with high livelihood vulnerability • **Civil Security** Unstable; disruptive tension • **Coping** "insurance strategies" • **Livelihood Assets** stressed and unsustainable utilisation (of 6 capitals) • **Structural** Pronounced underlying hindrances to food security
3	**Acute Food and Livelihood Crisis**	• **Crude Mortality Rate** 0.5-1 / 10,000 / day, U5MR 1-2 / 10,000 / dy • **Acute Malnutrition** 10-15 % (w/h <-2 z-score), > than usual, increasing • **Disease** epidemic; increasing • **Food Access / Availability** lack of entitlement; 2,100 kcal ppp day via asset • stripping • **Dietary Diversity** acute dietary diversity deficit • **Water Access / Avail.** 7.5-15 litres ppp day, accessed via asset stripping • **Destitution / Displacement** emerging; diffuse • **Civil Security** limited spread, low intensity conflict • **Coping** "crisis strategies"; CSI > than reference; increasing • **Livelihood Assets** accelerated and critical depletion or loss of access
4	**Humanitarian Emergency**	• **Crude Mortality Rate** 1-2 / 10,000 / day, >2x reference rate, increasing; • U5MR > 2 / 10,000 / day • **Acute Malnutrition** >15 % (w/h <-2 z-score), > than usual, increasing • **Disease** Pandemic • **Food Access / Availability** severe entitlement gap; unable to meet 2,100 kcal • ppp day • **Dietary Diversity** Regularly 3 or fewer main food groups consumed • **Water Access / Avail.** < 7.5 litres ppp day (human usage only) • **Destitution / Displacement** concentrated; increasing • **Civil Security** widespread, high intensity conflict • **Coping** "distress strategies"; CSI significantly > than • reference • **Livelihood Assets** near complete & irreversible depletion or loss of • access
5	**Famine / Humanitarian Catastrophe**	• **Crude Mortality Rate** > 2 / 10,000 / day (example: 6,000 / 1,000,000 / 30 days) • **Acute Malnutrition** > 30 % (w/h <-2 z-score) • **Disease** Pandemic • **Food Access / Availability** extreme entitlement gap; much below 2,100 kcal • ppp day • **Water Access / Avail.** < 4 litres ppp day (human usage only) • **Destitution / Displacement** large scale, concentrated • **Civil Security** widespread, high intensity conflict **Livelihood Assets** effectively complete loss; collapse

Source: (IPC 2007)

In sum, it can be said that the often quoted figures of undernourishment are rarely qualified as they have been in the above analysis; that is, in respect of the differences and similarities. As an exercise in understanding the extent of current understanding, the above example

serves as a cautionary note when considering data and statistics that purport to represent the same phenomenon. Furthermore, in lieu of detailed analysis as in the above, responsibility falls on the reader to exercise caution and determine the value of the data; from where it came and exactly what the measurements represent.

Other Nutritional Outcomes

Because women tend to be the primary care-givers responsible for the health and feeding of children, and in many cases of the entire households, the fact that women often make up 60% of the total malnourished is a significant finding (WHO 2010). In fact building on from this, it is this susceptibility that gives rise to one of the most important measures of a societies' general health; the mortality rates of under 5 year-olds (ibid). This is because childrenm in this age group are more susceptible than adults to shortages in food intake and are considered more likely to be among the first to succumb to shocks, shortages and emergencies. As a result both women and their children tend to be the focus of muchm in the way of targeted solutions (WHO 2010). The mortality rates for the under fives can be seen in figure 1.11. These representdeath rates per 1000 live births, with the latest figures showing the most deaths occurring in Afghanistan followed by several African countries.

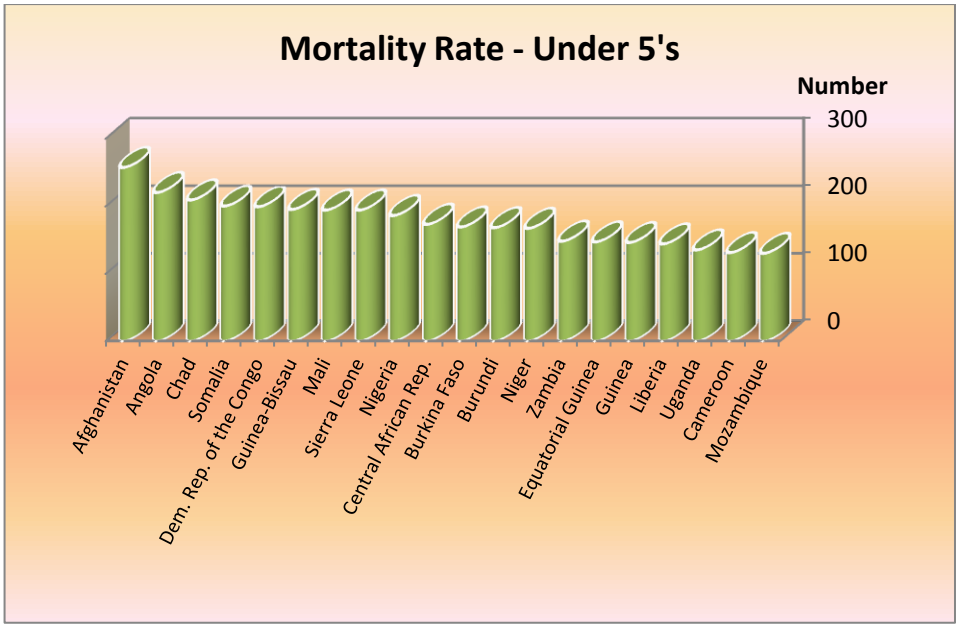


Figure 1.13 Mortality Rate of Under Five Year Olds - 2008

Source (WHO 2010).

However, alone these mortality rates represent total deaths and not by cause (WHO 2010). Further analysis by the World Health Organisation (WHO) actually indicate that such mortality varies considerably by cause (figure 1.14). In this analysistotal deaths attributable to malnutrition represent as much as 60% of total global child under 5 deaths.

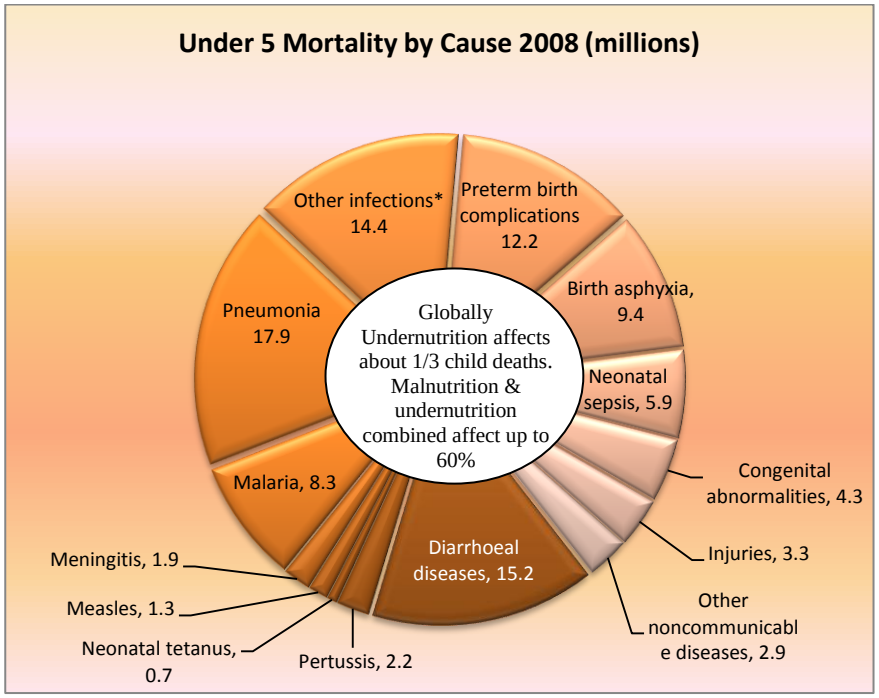


Figure 1.14 Under 5 Mortality by Cause in 2008 (millions)

Source: (WHO 2010).

Alongside the nutritional aspects of health there are also the considerations of infection and non-food food security issues, such as water and sanitation *etcetera* (WHO 2010). Health and vitality have long been associated with good nutrition, yet more recently there has been connections directly made with nutrition and infection (ibid). Following long studies in Mexico in the 1960's and 70's nutrition and infection has undergone much research (ibid). Nowadays, the connection is accepted, yet in the food security arena there still lacks this holistic approach, which sees many of the food insecure being treated in isolation of infection; an approach which is increasingly being seen as improvident (Ruxin 1996).

Children are especially vulnerable. An estimated 126 million every year are underweight from acute or chronic hunger; this leaves them weak and unable to fight off disease (WFP 2008). Furthermore, every year over 6 million (53%) out of the 10 million people that die annually of hunger and related diseases, are children (SOFI 2006) that is one child's death every five seconds (ibid).

Put another way, the International Monetary Fund (IMF) illustrated the full scale of the problem when they calculated that food aid, provided only about 7 kg of every metric ton of food actually needed (ActionAid 2003; Barrett and Maxwell 2005). This was further highlighted by another FAO report (FAO 2006), that listed over 80 Low-Income Food-Deficit Countries (LIFDC) most of which incidentally, could be found in Asia and Sub-Saharan Africa. Moreover, in 2007/2008, food security crises brought about by lack of availability, access or other severe localised problems left 37 countries requiring external humanitarian assistance (FAO 2008).

Not surprisingly, the scale of the problem attracts a lot of criticism and condemnation over the lack of progress, yet this obvious form of malnutrition, PEM and PEU is often dwarfed by the hitherto named silent hunger; that of the prevalence of global micronutrient deficiencies (WHO 2010). This directly relates to food availability and to the utilisation and stability components of the four-pillars of the concept.

1.3.2.6 Micronutrient Deficiencies

It is estimated that up to 2 billion people globally, suffer from some sort of micronutrient deficiency (WFP 2009). This has been in the recent past (and continues to be in some quarters), a silent form of malnutrition. This came about as previous simple measures of undernourished, tended to focus on macronutrient or energy deficiencies (ibid). This is changing and when considered alongside the macronutrients, combine to provide a fuller picture of the nutritional outcomes of food insecurity (MacAuslan 2009). There are many micronutrient deficiencies however, the global predominance of three in particular; iron, iodine and vitamin A, tends to prevail to a greater degree and is thus worth considering here (WFP 2009).

Anaemia

Anaemia, or Iron Deficiency Anaemia (IDA) occurs in both the developed and developing countries and affects up to 25% of the world's population (WHO 2009). It is believed to be the single most prevalent deficiency today, affecting mostly women and pre-school children (Ralte 1996; DeRose and Millman 1998; WHO 2009). IDA is characterised by fatigue (tiredness) and breathlessness, as well as impaired mental development and eradicating it has been estimated could improve national productivity by as much as 20 percent (UNICEF 2009; WFP 2009).

Iodine deficiency Disorders (IDD)

The second most common deficiency, iodine, leads to goitre and cretinism (UNICEF 2009). Both Goitre and Cretins diseases are often concentrated in areas containing iodine-poor soils, these are typically mountainous regions, glaciated areas or those areas prone to flooding and/or heavy rainfall (Ralte 1996; DeRose and Millman 1998). As with anaemia, IDD also affects both the developing and developed world, with considerable concentrations in 2009 in Europe (52%) and Africa (42%) (UNICEF 2009). It can be especially harmful during childhood and early pregnancy, and in its severest form, IDD's can include cretinism and stillbirth, while milder deficiencies can introduce other symptoms such as goiter (enlargement of the thyroid gland) (SCN 2004; WHO 2006; ChildInfo 2009).

Vitamin A

Vitamin A is essential for both eye health and the functioning of the immune system. It is a major cause of blindness among malnourished children in developing countries and has also been linked to complications of measles, respiratory infections and diarrhoea (Tomkins and

Watson 1989; DeRose and Millman 1998; UNICEF 2009). Globally, it is estimated that Vitamin A deficiency could account for anywhere, from between 1-3 million deaths a year (Reinhardt 2004; SCN 2004). This is placed in perspective when, it is considered that up to 684 thousand childhood deaths, according to the WFP could be saved by increasing access to vitamin A and zinc (WFP 2009).

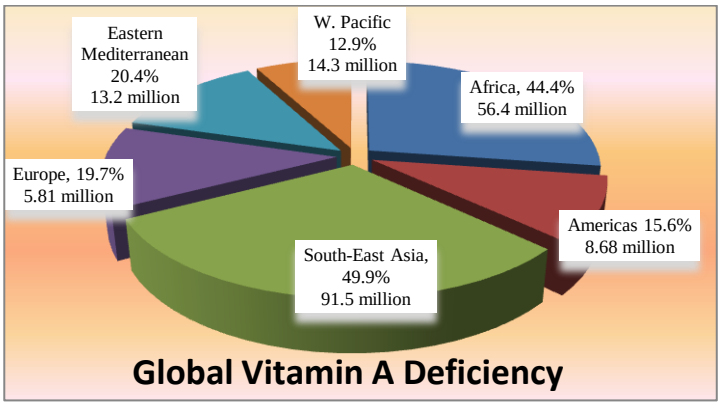


Figure 1.15 Global Vitamin A Deficiency in Under 5's (Source: Compiled from (WHO 2009)

1.3.3 Different Methodologies, Different Pictures

It can be seen from the above discussion that, garnering a picture of the insecure is fraught with difficulties in both conceptual problems, as well as practical issues surrounding appropriate measurements and analysis. There is much criticism of many of these methodologies and conceptual stances however, by far the biggest questions concern the FAO's metrics. According to Haddad (2002):

> "There has not been enough debate on the adequacy of FAO's indicators of food security… The World Bank has focused on money metric poverty and inequality indicators, whereas UNDP has focused on indicators of human development such as literacy and life expectancy. World Health Organisation (WHO) has focused on child undernutrition and the Consultative Group on International Agricultural Research (CGIAR) has focused on indicators of productivity and environmental sustainability" (Haddad 2002, pg 2).

This ties in to the earlier comments of Darcy and Hoffman (2003) who, while accepting that such specific focus is important, argues too for the need to examine the situation from of a holistic perspective (Darcy and Hofmann 2003). Going back to Haddad's comments it can be seen that important methodological and conceptual differences can sometimes lead to marked differences in results. Svedberg too, a long time reviewer of the FAO methodology is in agreement with this point and vehemently argues against the FAO's methodology in their estimates of malnutrition, citing it as fundamentally flawed (Svedberg 2002).

By way of example, Svedberg pointed out at the International Symposium on the Measurement and Assessment of Food in 2002 that in that year the FAO placed the Sub-Saharan African countries as having the highest prevalence of undernourishment. In a

comparative analysis, he used anthropometric indices to show that in reality, South Asia in the same year was actually identified as having the highest incidence of underweight and stunting (indications of malnutrition) by far (Svedberg 2000).

This "most challenging observation" explains Svedberg, was a direct result of the two different methodologies that supposedly measured the same phenomenon. In the FAO's workings for instance, a top down approach, continues Svedberg (2002), is based on food availability and a distribution coefficient whereas, the World Health Organisation (WHO) and the Demographic and Health Survey's (DHS), utilise a bottoms-up approach whereby representative anthropometric survey data is used to estimate the number of people with body weights below threshold. Thus, the results' differences in Svedberg's view can be explained by measurement errors and inherent biases in both methodologies (Svedberg 2002). Others however, disagree in principle, with Kennedy (2002) for instance, suggesting that both measures; while purporting to measure the same thing, actually measure different realities (Kennedy 2002). Yet another view from Klasen (2002), sees these measures not so much as mutually exclusive but rather, complementary (Klasen 2002). Klasen further proposes using both these measures in different ways. By using anthropometry at the clinical or grass roots level and the FAO methodology at the national, it is offered that both metrics are utilised to their full benefit (Klasen 2002).

The debate does not stop there. When it comes to calorie requirements for use in calculating the prevalence of undernutrition figures for instance, the FAO opt for geographic specific minimum daily food requirements ranging from 1990 calories in Croatia to as 1680 in Eritrea (FAO 2011). The U.S. Department Of Agriculture's Economic Research Service (ERS) on the other hand, while using a similar methodology, set a higher caloric benchmark ranging from 2,000 to 2,100 calories per day. Furthermore, while the FAO's calculation factor in physical activity level, the ERS only allows sufficient caloric allowance for the purpose of gathering food (USDA 1999).

Further criticising such methodologies, the Centre for World Food Studies (WFS) undertook their own calculations of the prevalence of hunger based solely on anthropometric data and found the Millennium Development reports had over-estimated the prevalence of undernourishment; 17.3% against the WFS's 27.8% (Wesenbeeck, Keyzer *et al.* 2009) Conversely, other observers like Nandy *et al* (2005), in a paper exploring similar methods suggested that use of such standard indices like stunting, wasting and underweight may actually be woefully underestimating the problem (Nandy, Irving *et al.* 2005).

In conclusion, an interesting and telling find in such methodological differences, was highlighted in 1999 when, the USDA ERS used their proprietary methodology to retrospectively recalculate 58 of the FAO's 93 studied countries in that year and found that

over one billion people fell short of adequate nutritional requirement, compared to approximately 845 million by FAO's criteria (USDA 1999).

It can be seen then, that there exist many differences in the conceptual understanding of food security, particularly when it comes to measures of undernutrition. Whether one is better than the other is beyond the remit of this research, instead this divergence serves to illustrate the nature and disunity in the food security debate. Moreover, while such figures are important the salient point here, is that while some refer to undernourishment figures solely as the main proxy for food security, this can be misleading for two reasons. Firstly, food insecurity is more than just undernourishment and secondly, there is widespread disunity over the best and appropriate undernourishment methodology to use. As a result, this research concurs with earlier evaluation, which shows that in order to provide the best picture of the insecure, triangulation of data through the use of a suite of indicators is essential.

1.4 Food Security: Concept Summary

The previous two sections aimed to build or elaborate some of the basic precepts introduced in section 1.2. In satisfying the first aim and part of the second aim of this research, it can be seen from an examination of the literature, that the task of properly identifying the food security concept in any great detail is in today's inclusive definition, very difficult. While over time, understanding of the global food security challenge has undoubtedly grown, this has also involved the full realisation of its inherent complexity, as well as the sheer number of variables at play. This has also meant understanding of the subject has become exponentially more difficult, with subsequent predictions or projections that much more complicated (McCalla and Revoredo 2001; Ericksen 2008). Indeed, this need is not new, even back in 1999 Riely and colleagues noted that:

> "Clarifying [the determinants of food security]… is critical…The complexity of the food security problem in developing countries suggests the need to develop a framework which leads to a consistent analysis of the actual mechanisms which undermine the food security of specific population groups…" (Riely, Mock *et al.* 1999, pg 12).

This need however, according to many, has not been delivered and until such ideas are incorporated into a collective consensus, then tackling the underlying issues will continue to be difficult to address (Misselhorn 2005; Ericksen 2008; Novak and Cañas 2008). However, despite this, the above review of the literature has given this research a solid foundation upon which the rest of this study builds. Having gained some understanding of the various aspects of the concept, this study now turns to the role of conceptual modelling in conveying this complex phenomenon. With this in mind the following chapter explores and evaluates the components of good social science modelling and evaluation techniques. From here, this

allows this research to properly evaluate existing frameworks and to provide underpinning research that allows the improvement and construction of a new updated framework.

2 Existing Frameworks: Modeling Food Security

In various attempts to understand and convey the processes and relationships of the food security phenomenon, the social scientific community adopt the use of modelling (Devereux 2000; Devereux *et al.* 2004). However, confounding an overarching understanding of the food security problem, is the fact that, many such models might only deal with singular dimensions of the concept such as malnutrition, poverty, nutrition or entitlement *etcetera* (ibid). Others however, while attempting to tackle the big picture, might do so with an alternative central focus. Some might view the concept from perhaps livelihoods, community or household food security perspectives; or perhaps simply omit one or two important branches of the concept (Devereux 2000; Radimer 2002; Devereux *et al.* 2004; Scaramozzino 2006; Greenway 2008).

Moreover, and more specific to this research, it has been said that the models or frameworks that are used to convey this notion of food security, can be just as confusing as the definitions themselves. Furthermore, with many linkages and causalities erroneously implied, the usefulness of such frameworks is continually being brought into question (WFP 2009). What is needed, according to the World Food Program, are frameworks that are simple, clear and unambiguous and it is this premise that drives this research forward (WFP 2009).

As such, this research aims to address such issues by learning from both the literature as well as the primary research, to create an updated framework, that reflects current knowledge. Furthermore, any model would only be acceptable if it were to improve on current examples. For both of these goals it becomes prudent to understand something of current modelling practices. This is achieved in the proceeding sections, first with a look at the philosophical underpinnings of modelling, as well as the various components of the model building and evaluation processes. After this a thorough evaluation is carried out in respect of existing models *vis-à-vis* their strengths and weaknesses.

2.1 Type and Epistemological View

Frameworks or models (as they are interchangeably referred to in this study), have been around for centuries (Müller 2000). They are particularly useful in communicating complex ideas, especially with the purpose of elucidating phenomena, entities, relationships, causes and processes (Müller 2000). In simplified terms, modelling creates representations of a real or imagined world through the use of textual, graphical or mathematical techniques (Gerster-Bentaya and Maunder 2008; Kotiadis and Robinson 2008). This world might include: known realities, outcomes and relationships; conceptual and theoretical notions, that postulate theories and ideas; or simply, the derivation of new lines of thought or principles (Müller 2000). Modelling is also used, not just to illustrate such worlds, but just as frequently as an

aid in simplifying complex phenomena into cogent designs, that are more readily understood (ibid). Further, from the perspective of different stakeholders and differing focal points, the use of appropriate models facilitates discourse and structured debate about the many interrelated aspects of a phenomenon under discussion (Ericksen 2008; Kotiadis and Robinson 2008; Novak and Cañas 2008; Holweg and Donk 2009).

In short, from the modelling literature there is, it can be seen that there are several model types, which can be used to represent one of two forms or realities; theoretical/conceptual or descriptive (Novak and Cañas 2008; Holweg and Donk 2009). This research concentrates on the conceptual modelling process, as a descriptive model of food security would denote proven linkages between variables (ibid). With this in mind, there are many different ways of conceiving of such models, which are greatly dependent on the issuer's research philosophy or viewpoint (ibid). Karl Popper for instance, offers that scientific research begins with a process of deduction; that is to say speculation of a problem is hypothesised, from which logical predictions can be deduced and tested by experimentation (Bajaj 1988). This however, is in stark contrast to Francis Bacon's rigid methodological approach which prescribes an inductive design, where evidence is first gathered then considered and conclusions inferred as a result (Bajaj 1988). Being inductive, this research follows this latter view and aims to gather evidence before any hypothesis or conclusions can be inferred.

In keeping with food security in particular, there are perhaps two main theories of understanding that fits with both the above philosophical approaches. These can be summarised as a linear (component or reductionist), or a non-linear (a systems) approach (Hannon 1985; Schmidt and Jacobsen 2004). This is important as, whichever approach is chosen, it is generally considered to have a direct bearing on the type of model and analysis that is employed (ibid). A systems or non- linear approach for example, is a holistic approach, which determines that the whole is greater than the sum of its parts and is thus viewed as a complete working unit (Schmidt and Jacobsen 2004). A linear or reductionist approach on the other hand, as practiced by the likes of Descartes and others, view systems through their individual constituent components (ibid). That is, they explore the components as individual units or subsystems within the whole. While the Overseas Development Institute (ODI) offer that the linear approach has been largely discredited for its limitations, it has been countered that the two approaches are not necessarily mutually exclusive and, in reality, overlap in many respects (Schmidt and Jacobsen 2004; ODI 2009). As a result of this convergence, there has been a propensity in recent years to combine these two ideologies, which in turn has led to the beginning of a modern proliferation of techniques and approaches (ODI 2009). The Overseas Development Institute (ODI) alone, working in the sphere of policy analysis, have for instance collated over 30 'types' of models in their assessments alone (ODI 2009). As a result of these considerations this research also does not

distinguish between a linear or non-linear approach and instead sees advantages in combining both viewpoints.

Specifically regarding the models or frameworks used in food security analysis; while there have been many studies and reports linking various of the variables together, there is a distinct absence of scientific data in support of such links (Misselhorn 2005). Yet despite this, many existing models do not distinguish between implied, proposed or proven linkages (Ericksen 2008; Novak and Cañas 2008). In this way, food security frameworks tend to be conceptual in nature and ad-hoc in execution. However, this does not mean that such frameworks need be less scientific, on the contrary, by applying some of the criteria used in other fields such frameworks if properly conceived can be of tremendous help in understanding variables and elucidating relationships (McCalla and Revoredo 2001; Ericksen 2008). In light of this, correlations and relationships used in this research's model are carefully considered when determining the operational constructs to be used.

2.2 Modelling in Social Science

In recent years modelling has created a lot of interest, this is especially so in the field of knowledge engineering (KE), where much research has been devoted to investigating the various techniques and tools used by analysts in general model creation (Wand, Storey *et al.* 1999; Davies, Green *et al.* 2006; Kotiadis and Robinson 2008). Furthermore, within the field of KE modelling is particularly robust in the areas of information technologies, such as computing and database analysis, where data modelling is well advanced (ibid). However, in the field of social science modelling, comparable techniques have fallen behind, leading to the long standing charge that an unacceptable number of models are more likely to confuse rather than enlighten readers (Brandt 1939; Riely *et al.* 1999; Ellis and Briggs 2001; Misselhorn 2005). This, we are told, often results from ill designed frameworks, over-simplification or more fundamentally, the poor interpretation of a concept that often assumes or overlooks linkages and relationships (Ellis and Briggs 2001; Misselhorn 2005). In this way, poorly operationalised concepts hinder adequate understanding, which can further adversely affect appropriate analysis of the food security concept (Dilley and Boudreaub 2001). While this research aims to avoid these pitfalls, unfortunately there is very little guiding literature in the process of building good models (Earp and Ennett 1991; Holweg and Donk 2009). Despite this though, what literature there is provides a foundation upon which this study can build.

An early book on the subject of modelling in social sciences by Lave and March (1975), offer a comprehensive look at abstracting observable phenomena into cogent models. Their work specifically focuses around the creation of a model based on a process of recursive speculation. This speculation, suggests Lave and March (1975), is not only inherent within the field of social science, but fundamental to scientific modelling in general. This is very

similar in approach to Earp and Ennett's earlier paper (1991), although in this paper Earp and Ennett further elucidate the problem of multi-causality in model making (Earp and Ennett 1991). In their understanding, Earp and Ennett suggest that while multi-causal models serve to illuminate dynamic inter-relationships among concepts and variables, it is more often difficult to:

> "…sort out relationships, much less directionality or causation." (Earp and Ennett 1991, pg 164).

That said, Earp and Ennett go on to propose that far from being problematic the role of these models is not necessarily to attempt to properly define such relationships rather to:

> "…call attention to the play of [such] factors at multiple levels…" (Earp and Ennett 1991, pg 166).

This approach, suggests a more subjective interpretation of concepts and relationships in any model. Therefore, thought must be given to this research's model in respect of whether causation and relationships are to be elucidated, as explicit, or whether to simply draw attention to the fact they exist. Before such decisions are made though, there are some criticisms worthy of note.

2.2.1 Criticisms

Critics of the seemingly informalised approach to modelling, favoured by the likes of Earp and Ennett, regard the process as little more than subjective approximation (McCalla and Revoredo 2001). In specifically regarding conceptual models, McCalla and Revoredo (2001) compare, what they call 'ad-hoc' models; those that are more inclined to qualitative subjective production, to those scientific models based on tested theoretical or conceptual linkages. On their usage, McCalla and Revoredo (2001) suggest, the latter are more likely to utilise clearly defined relationships and express consistency in ways that ad-hoc models do not (McCalla and Revoredo 2001). Further criticisms levelled at ad-hoc models, include the arbitrary weightings of particular variables or the extrapolation of variables of interest without recourse to empirical evidence (ibid). Such charges are evidenced in the discussion of existing frameworks summarised in section 2.5 and in more detail in appendix 15. These shortfalls, cite McCalla and Revoredo (2001), are specifically amplified when considering future projection or forecasting type models. Consequently, McCalla and Revoredo openly wonder whether in the worst case scenarios, practitioners might not be making erroneous assumptions about crucial exogenous and endogenous variables, in order to support a particular case or viewpoint (ibid). Although harsh criticism, McCalla and Revoredo do not dismiss the use of ad-hoc models completely, they do however, caution that even the best practitioners will struggle against the consistency and replicatability of the scientifically testable frameworks (ibid). In conclusion, suggest McCalla and Revoredo (2001) too many conceptual frameworks it would seem are rarely 'formalised' and are too often simply drawn up without consideration of the basic principles of good modelling (McCalla and Revoredo 2001).

An important caveat however, brought up by Earp and Ennett at this point is echoed by other proponents of modelling and concerns the use the terms 'theory' and speculative concepts such as 'hypothesis' (Earp and Ennett 1991). Clarifying the distinction between theory and hypothesis is useful at this stage, as it is suggested both terms are often used synonymously when they ought not. As Bacharach suggests, such differences are important particularly during experimental design (Bacharach 1989). In this sense then, a theory can be described as a well-established principle; that is, a statement of relationships among variables and constructs. Furthermore, while such theories are perhaps descriptive in nature, descriptions themselves are not theories (Bacharach 1989). In this way they can be described as prescriptive. On the other hand, a hypothesis is a specific, educated guess or prediction about what is expected to happen. This can then be tested recursively and modified accordingly (ibid). In short it can be said that a theory, is a generally accepted predictor of events or relationships, which has been extensively tested empirically whereas, hypotheses are speculative guesses that have yet to be tested (Bacharach 1989). This distinction is important as, Earp and Ennett conclude, conceptual models might be promoting certain hypothesis and in such endeavours are free to call upon multiple theories in their execution (Earp and Ennett 1991). This separation is important in view of this research, as the model to be created is of an inductive process and as such, crosses both boundaries. Thus by its iterative natur,e this research's model draws on primary and secondary research to postulate hypotheses of connections and relationships. In achieving this, certain theories might also emerge that can then be tested empirically in future research that can help further improve the model.

Therefore in an effort to avoid the traps of speculative or 'ad-hoc' modelling this research seeks to formalise the process of modelling. However before this can be achieved an understanding of the modelling evaluation and building processes follows.

2.3 Evaluating and Developing Models

Evaluation

When promoting, introducing or utilising frameworks and models, it must be noted that both good and bad examples exist (EPA 2009). Moreover, when considering that expensive management decisions might also be influenced by model-predicted relationships or effects, it is incumbent to consider the worthiness or credibility of the model or framework (EPA 2009). In this case, to ascertain a models' worth, it is subject to evaluation; that is, the systematic assessment of the merit or worth of the framework under scrutiny in to provide a useful feedback for the various stakeholders (Trochim 2006).

Often part of a larger process - a planning-evaluation cycle, evaluation techniques allows this circular process to improve understanding and implementation of projects or ideas, further strengthening credibility and usefulness (Trochim 2006).

In common with the model building process itself, there is very little in the literature regarding guidance in evaluating the quality and efficacy of such models (Holweg and Donk 2009). As a result, Holweg and Donk offer a summary of 6 criteria based upon findings of Pfeffer, Whetten and others as a convenient place to start. These include:

- Selectivity;
- Simplicity;
- Specificity;
- Comprehensiveness;
- Novelty;
- Meaning.

With reference to the last criteria: meaning, Holweg and Donk (2009) suggest that the model should reflect the original intended purpose, and in terms of evaluation, just how well this was achieved. For the sake of clarity and cross comparability, this criteria for the purposes of this research is amended to represent comparability. This allows the frameworks to be compared directly to the definition of food security and by extension to each other.

Holweg and Donk further stipulate that, it is preferable that a framework be rejected completely if any outcome hypotheises are in turn also rejected (Holweg and Donk 2009).
Lave and March (1975) on the other hand, suggest that when it comes to evaluating a model, an important preferable technique, rather than attempting to accept or reject a single model *per se*, might be to compare alternative models. In this way, a more balanced critical approach can properly evaluate alternative scenarios for the same models, which might otherwise be dismissed too early (Lave and J. G. March 1975). In their view, the fundamental aim in testing a model is, not to defend it against criticism or awkward data, but relish the chance to prove it wrong. This approach in Lave and March's opinion (1975) encourages the iterative process which ultimately strengthens, rather than weakens, the end result (Lave and J. G. March 1975). Lave and March also agree that simplicity through incorporating the fewest necessary assumptions, will ultimately present the best framework. On the other hand Shoemaker, Tankard and Lasorsa playfully add:

> "Models should be poked, prodded, kicked and torn apart." (Shoemaker 2004).

From this it can be seen that, while there is loose agreement over the evaluation process, there is less consensus over the initial purpose of the model itself. Therefore, in considering Trochim's (2006), Lave and March's (1975) and Holweg and Donk's (2009) views this research's framework is not to be rejected if any hypotheses do not fit, but rather seek to test alternative scenarios and canvass specialist evaluation that aims to improve the model.

Developing Models

As with model evaluation techniques there is not a great deal of literature regarding the creation of models in social science (Holweg and Donk 2009). Earp and Ennett on the one hand, suggest starting at the end goal of the model and working backwards taking into account:

> "… interest, practical considerations, the relative importance of various factors or relationships, past research and scientific merit, and theoretical considerations." (Earp and Ennett 1991, pg 168).

This approach however, suggests McCalla and Revoredo (2001), is vague and subjective and lead to criticisms of non-rigorous 'ad-hoc' modelling (McCalla and Revoredo 2001). An alternative approach, is based on the soft systems methodology (SSM), and although originally designed for the computer industry, the principles have been successfully applied to social science (Williams 2005; Kotiadis and Robinson 2008). This approach advocates a more structured process whereby, knowledge is acquired from real life or any other observable phenomenon and extracted to form a conceptual model (ibid). Supporting this approach, Lave and March similarly present a four-step process which consist of: observation (consequences), speculation (implications), deduction (predictions) and evaluation. As it turns out, both these methods are remarkably similar in design to the research cycle proposed by Tashakkori and Teddlie that suggests an iterative inductive process of knowledge acquisition (Lave and J. G. March 1975).

All models or frameworks begin with ideas about realities; these ideas can be created by individuals or groups and can be purely conceptual or descriptive in nature depending on the model's purpose (Kaplan and Beinhocker 2003). These can be generated through either concept maps, mind maps or any other number of options (ibid). This research however, aims to formalise the process and avoid, where possible, much of the subjectivity inherent in single-person generated ideas. With this in mind, this study looked at group generated concept mapping versus single-person generated concept mapping based on a wide and thorough literature review.

Concept Mapping

The goal of models or frameworks is to facilitate the solid understanding of any phenomenon, relationship or reality under study (Kaplan and Beinhocker 2003). In turn, a quality model is reflective of the full reality in question, conceptual or otherwise. Predicated on this then, is an acceptable common fact base and the agreement of any inherent assumptions (ibid). One popular method that has arisen in recent years to assist in this process, is the use of group concept mapping techniques (Kaplan and Beinhocker 2003). Of particular note in this area is the technique introduced by Trochim and Linton in 1986 of a formailsed group methodology that aims to generate concept maps based on collective consensus (Trochim and Linton 1986). This method grew as an alternative to creating maps through existing text based analysis of literature reviews or through surveys and interviews *etcetera* (Jackson and Trochim 2002). Methodologically speaking, Trochim's technique purportedly blends the strengths of existing text analysis, with multivariate statistical methods, which ultimately enables the representation of group generated ideas in the form of

concept maps (ibid). Such methods have great advantages to research such as enabling multiple inputs from a variety of people that potentially can bring new ideas into the mix.

All of these techniques used in model building have elements of good and bad design which are considered in the methodology section of this research. However, specific methodologies aside, the process of creating a conceptual model also requires decisions to be made with regard to scope and detail of the model in question (Kaplan and Beinhocker 2003). In this way the modeller has to determine which elements to include and exclude and at what level of detail the model is to be drawn (ibid). Further, when modelling careful consideration must also be given to the likelihood that models might need to base certain theories, linkages or facts on assumptions, implicit or otherwise (ibid). This has to be considered carefully, for in short, as the number of assumptions increases, so the accuracy and relevance of the model diminishes (Bacharach 1989). This is particularly important, if the model is being used, as in this research, to support inferences and conclusions. Also, the nature of a model, by definition, implies the simplification of a concept or idea (Lave and J. G. March 1975). As a result, there might be times when concerns arise that a particular framework might oversimplify an idea, overlook or wrongly assumes certain of the linkages and relationships leading to confusion rather than understanding (Ericksen 2008a; Kotiadis and Robinson 2008; Novak and Cañas 2008).

All these considerations involve a level of subjective judgment and explicit in such assumptions, is the fact that such decisions can never be entirely value-free (Ericksen 2008a; Kotiadis and Robinson 2008; Novak and Cañas 2008). One way to reduce this effect though, is to properly and adequately operationalise any constructs used in the modelling process, as well as in the model itself (ibid). For this research, guidance on this is provided by Wand and colleagues (1999), who emphasise the importance of effectively defining constructs and terminologies by employing a rigorous structural methodology (Wand, Storey *et al.* 1999). In this, Wand suggests the clear distinction of entities that define physical and conceptual objects or constructs; the unambiguous usage of attributes to represent these entities; and an adequately defined separation of relational associations that describe interactions, connections, causality or simply the binding of similar entities (ibid). In other words, essential in any good modelling practice is the precise defining of constructs, terminologies and relationships that leave little room for misconception.

2.4 Framework Summary

After reviewing four books and many academic papers and reports based on the various modelling methods, there appear to be several themes that run central to good social scientific modelling techniques (Lave and J. G. March 1975; Trochim and Linton 1986 ; Bajaj 1988; Bacharach 1989; Earp and Ennett 1991; Müller 2000; McCalla and Revoredo 2001; Kaplan and Beinhocker 2003; Trochim 2006; Gerster-Bentaya and Maunder 2008;

Kotiadis and Robinson 2008; Novak and Cañas 2008; Holweg and Donk 2009; Muller and Jahn 2009).

The first, is that there tends to be two types of models; those descriptive models that aim to explain reality and those conceptual models that are concerned with theoretical posturing of associations and linkages (Kaplan and Beinhocker 2003). The second important discovery, is that there is not the same rigorous procedural methods of creating social science models as there are in mathematical or computer modelling techniques (McCalla and Revoredo 2001; Kaplan and Beinhocker 2003). Importantly too, the evaluation of a model or framework is determined by many factors (Lave and J. G. March 1975; Holweg and Donk 2009). In this way, the evaluation of a model, it can be said, is less to do with whether it depicts a scenario accurately or not, but more to do with the type and number of elements involved, the quality of the relationships and the clarity of execution (ibid). With such considerations in mind, it can be argued that the efficacy of a model is directly associated with the quality of the model. This view is one that this research adopts to serve as a suitable benchmark in this study (Trochim 2006). Also of note within the literature, is the realisation that too many of models that exist, are charged with being subjective and of little academic value (Trochim 2006). In redressing this imbalance, the goal of this research aims to apply the best elements of these methodologies to form new guiding principles for the purpose of this research, in the creation of a new food security model. As such this critical review has implications for this research and this is further discussed in the methodology.

2.5 Existing models

In understanding something of the modelling process, this research can now look at those models considered in this study. In order to ascertain suitable models to evaluate, three methods were employed in the literature search. The first was a computer-assisted search of the Science Direct database; the British Library Direct website; and PubMed database based on the following keywords:

- food security framework;
- food security model;
- food security AND (Boolean) Conceptual framework;
- food security AND (Boolean) Conceptual Model;

The second was a review of the publication archives of the United Nations, USDA, USAID, various policy institutes, NGO's and CSO's plus databases of the WHO, WFP, UNDP, UNHCR. DFID, ODI, IFPRI, CARE, OXFAM and others. The third looked at keyword searches from both Google books and Google scholar.

The orders of preference were the publications (including NGO and CSO's) dealing directly with food security issues. Following this, emphasis was placed on keyword searches within

the four scientific journal databases mentioned above before examination of Google results were undertaken.

All three methods yielded over 18,000 possible journal papers, articles, reports, white papers, books and other publications that could potentially have offered food security models or frameworks. Unfortunately because of time constraints, the full complement could not be investigated, however in total 2012 publications were examined. From these publications a total of 56 models were identified. Out of this number however, it was considered that several of the models were unsuitable for this research for the following reasons. Unsuitable models were those that regurgitated or re-worked previous authors' ideas, or those models that were considered by this research to be overly simplified, or conversely overly complex, were not considered in this evaluation. Further models were discarded that were, fundamentally flawed (in the opinion of this researcher) for their lack of operationalisation of concepts associated with food security. Other models omitted too were, those that failed to consider at least one of the basic dimensions of access, availability, utilisation or stability of food security. The models that were discarded are summarised as follows:

- those based on existing author's frameworks - 9
- overly simplified/ complex - 12
- lack of clarity or operationalisation of concepts – 7
- did not consider at least one dimension of food security - 3

The final group consisted of those frameworks whose central focus was the concept of food security. Other models based on associated concepts such as malnutrition/ nutrition and livelihoods perspectives were also chosen for their close proximity to the central focus of this study. This gave a total of 25 models to be considered in this review. These are detailed in table 2.1.

Table 2.1 Models of Food Security Considered in this Review

Overarching Models of Food Security	
• Model A1: Gross and Colleagues Model of Food and Nutrition Security 1999	(Gross *et al.* 1999)
• Model A2: FAO Four Pillar Construct	(FAO 1996)
• Model A3: Smith and Colleagues Hierarchical Framework of Food Security 2002	(Smith, Obeid *et al.* 2000)
• Model A4: US Agency for International Development (USAID) Model 1	(Riely and Mock 1995)
• Model A5: US Agency for International Development (USAID) Model 2	(USAID 2007)
• Model A6: The International Fund for Agricultural development (IFAD)	(IFAD 2009)
• Model A7: Conceptual Understanding of Food Security in Cambodia	(CARD 2001)
• Model A8: UNU Theoretical Framework of Food Security 1998	(UNU 1998)
• Model A9: Human Resources and Skills Development, Canada	(Rainville and Brink 2001)
• Model A10: Polly Ericksen Model of Food Security 2008	(Ericksen 2008)
• Model A11: Achieving Food Security in China 2010	(Zhou 2010)
• Model A12: Committee on World Food Security Model 2000	(CFS 2000)
• Model A13: Work Stream 5: Food Security 2009	(Workstream 5 2009)
• Model A14: Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS) Food Security	(FIVMS 2008)
Vulnerability Models/Frameworks	
• Model A15: Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS)– Vulnerability 1	(FIVMS 2008)
• Model A16: Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS)– Vulnerability 2	(FIVMS 2008)
• Model A17: FAO Løvendal and Knowles, 2005	(Løvendal and Knowles 2005)
Malnutrition and Nutrition Security Models/Frameworks	
• Model A18: The United Nations Children Fund (UNICEF), 1990/98	(UNICEF 1990; UNICEF 1998)
• Model A19: Committee on Food Security (CFS) 1998	(CFS 1998)
• Model A20: Beaton and Bengoa Comprehensive Health and malnutrition Model, 1976	(Beaton and Bengoa 1976)
Livelihoods Perspective Models/Frameworks	
• Model A21: Department for International Development's (DFID), 1997	(DFID 1999)
• Model A22: Timothy Frankenberger -2002, Livelihood's Strategies Model of Food Security	(Frankenberger, Luther *et al.* 2002)
• Model A23: FAO Sustainable Livelihoods Approach	(FAO 2007)
• Model A24: The United Nations Development Programme (UNDP)	(Brill, Brown *et al.* 2009)
• Model A25: Cooperative for Assistance and Relief Everywhere (CARE International), 1994/99	(Ashley and Carney 1999)

These 25 models were then evaluated using an adapted Holweg and Donk (2009) methodology as determined from the pilot studies in the methodology (section 4.2). The aim of this was three-fold, firstly, as the literature attests, the quality of a model best determines its representability of the intended concept. Secondly, to highlight the variety and thus the range of acceptable model types. Thirdly, to narrow the number of models to the six best examples that could then be taken into the case study for further analysis.

Using this methodology, the following tables 2.2 to 2.5 highlight the key findings along with their respective 'quality' scores as determined by this research. The full reviews can be found in either the Case Study section (section 5), or appendix 16 (Food Security Framework Evaluation) of this research. The range of scores were 0-100 with 100 representing a perfect score of quality.

In the first grouping, the overarching models (table 2.4), the four pillars have come to represent the foundation on which many frameworks are built. Yet, while many of the UN based models see this as the end goal of any model, many others see this as a starting point that aims to incorporate wider notions of livelihoods and other holistic perspectives. Moreover, nutrition security, as opposed to solely focusing on food security is increasingly being favoured by a growing band of modelers. It can be seen too, that there is a whole spectrum of frameworks ranging from the very simplistic to the complex and others with much accompanying text, each displaying varying degrees of quality.

Table 2.2 Overarching Models of Food Security Summary

Model Title	Author/Year	Full Review	Comments	Score
A1 Gross and Colleagues Model of Food and Nutrition	Gross, Schultink and Kielmann 1999	Appendix 16	Cleverly separates out food and nutrition security but fails to adequately portray the big picture. There is no mention of many of the other variables at play leaving the model oversimplified and difficult to extrapolate to the concept.	**51**
A2 FAO Four Pillar Construct	Food and Agriculture Organisation	Case Study section 5	Good High Scoring Example Example – Reviewed in the Case Studies section 5.	**65**
A3 Hierarchical Framework of Food Security	Lisa Smith and colleagues 2002	Appendix 16	Concentrates mainly on access and availability with little consideration of outside influences. It is very simple with well defined relationships although this is perhaps at the expense of the big picture.	**57**
A4 US Agency for International Development (USAID) Model 1	Rielly and Mock 1995	Case Study section 5	Good High Scoring Example – Reviewed in the Case Studies section 5.	**64**
A5 US Agency for International Development (USAID) Model 2	USAID 1995	Case Study section 5	Good High Scoring Example – Reviewed in the Case Studies section 5.	**64**
A6 IFAD's Flow Chart of the Determinants of Household Food Security	The International Fund for Agricultural development (IFAD)	Appendix 16	Concentrating on household food security this model employs use of the access and utilisation dimensions. Dimensions of availability of food and the exogenous variables of vulnerability are missing. It is simplistic yet this is at the expense of clarity.	**57**
A7 Achieving Food Security in China	Zhangyue Zhou 2010	Appendix 16	Ignores two of the 4 pillars and combines illogical variables under the banner of food availability.	**55**
A8 UN Committee on World Food Security Model 2000	CFS 2000	Appendix 16	Good representation although relies on external textual clarification of certain relationships and assumptions not clear solely in the model.	**60**
A9 Human Resources and Skills Development, Canada	Rainville and Brink 2001	Case Study section 5	Good High Scoring Example – Reviewed in the Case Studies section 5.	**63**
A10 Polly Ericksen Model of Food Security 2008	Polly Ericksen 2008	Case Study section 5	Good High Scoring Example – Reviewed in the Case Studies section 5.	**65**
A11 Scottish Government Work Stream 5: Food Security 2009	Work Stream 5: Scottish Government's Food Forum 2009	Appendix 16	Oversimplified and relates a few disparate variables while ignoring some of the more important components like access and utilisation. This model also assumes relationships to be direct and linear	**60**
A12 Conceptual Understanding of Food Security in Cambodia	The Council for Agricultural and Rural Development (CARD) 2001	Appendix 16	Generally very good although lacking in the non-financial flows of access. Also this model would benefit from the interactions of some of these variables being made explicit.	**55**
A13 UNU Theoretical Framework of Food Security	The United Nations University 1998	Appendix 16	While specifically a household model of food security there is still no mention of access and availability. It is also not clear why some variables have been chosen at the exclusion of others leaving the model and incomplete.	**52**
A14 Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS) Food Security	FIVIMS 2008	Case Study section 5	Good High Scoring Example – Reviewed in the Case Studies section 5.	**64**

Key: scores range from 0-100 with 100 representing a perfect score of quality

The second grouping concentrated on vulnerability and overall, it can be said that this group tended to be very narrowly focused in terms of overall food security. Consequently, as models of the concept of food security they become extremely limiting although, having said that, they can be useful adjuncts that might further shed light on the specific areas of risk. The summary findings can be seen in table 2.3.

Table 2.3 Vulnerability Models/Frameworks Summary

Model Title	Author/Year	Full Review	Comments	Score
A15 FIVIMS Model of Food Security Vulnerability (part 1)	Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS)	Appendix 16	Very narrow in scope with very few variables although what is there is simple and intuitive. As an addendum to an existing model this is fine although as a standalone model of food security it is not suitable.	**56**
A16 FIVIMS Model of Food Security Vulnerability (part 2)	Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS)	Appendix 16	As above this model is very narrow in scope and would also be useful as an addendum to existing models although once again as a standalone model it is not suitable. By concentrating on vulnerability the model omits other important aspects of the food security concept.	**57**
A17 FAO Framework for Analysing Vulnerability to Food Insecurity	Løvendal and Knowles 2005	Appendix 16	Employs all four dimensions of the 4-pillar approach and interestingly separates out the vulnerability component into shocks and risk management procedure's. A useful tool in the risk management profile of food security but is not sufficient of breadth and scope to act as a model of food security.	**59**

One of the components of food security is the nutritional aspect and while many such models contain elements of nutrition or malnutrition, there are some whereby this is their central focus. This possibly reflects an evolution of ideas that at one time saw the separation of food and nutrition into complementary goals. One incidentally which many still believe in today as evidenced in the following frameworks table 2.4.

Table 2.4 Malnutrition and Nutrition Security Models/Frameworks Summary

Model Title	Author/Year	Full Review	Comments	Score
A18 UNICEF Framework of Malnutrition, 1990/98	The United Nations Children Fund (UNICEF), 1990/98	Appendix 16	A detailed analysis of malnutrition although this model was never intended for use more of a starting point for other models.	**61**
A19 Committee on Food Security Nutritional Framework	Committee on Food Security (CFS) 1998	Appendix 16	Is an early overarching example. Very detailed including all aspects of the four dimensions of food security however it details much textual information that possibly over burdens the framework.	**58**
A20 Comprehensive Health and malnutrition Model	Beaton and Bengoa 1976	Appendix 16	Very good early example with clear progressive goals however the relationships are numerous and not immediately understandable.	**47**

Models detailing the livelihoods approach tended to concentrate on the access and to some extent the stability or environmental components of the 4-pillars of the concept of food security. However, there was little convergence with one model for example (IFPRI) concentrating on access and utilisation while another (the UNU model) concentrated solely on production and availability. Others too, have differing foci and as such many are naturally limited in their breadth of coverage and their applicability as an overarching model. This however, does not have to be the case, as in the early example by the CFS model shows which attempted to combine both, see table 2.5.

Table 2.5 Livelihoods Perspective Models/Frameworks

Model Title	Author/Year	Full Review	Comments	Score
The DFID A21 Sustainable Livelihoods Approach	Department for International Development's (DFID), 1997	Appendix 16	A good representation of the access components of food security but little else. For this reason its representability as an overarching framework is severely limited.	**56**
A22 Livelihood's Strategies Model of Food Security	Timothy Frankenberger - 2002.	Appendix 16	More detailed than the DFID model Frankenberger's model is a good representation of both access and stability however as with many SLA approaches it lacks considerations of availability and utilisation of food.	**57**
A23 FAO Sustainable Livelihoods Approach	Food and Agriculture Organisation 2007	Appendix 16	This model introduces the cyclic notion of the livelihoods framework and portrays many of the associated variables of the external environment. In terms of its failure as representative of the wider picture this model too lacks components of access and utilisation.	**57**
A24 The UNDP expanded Livelihood Framework	Brill, Brown *et al.* 2009	Appendix 16	Too basic and simple with a lack of clarity over the variables included and the reasons for some inclusions.	**55**
A25 CARE International's Household Livelihood Analysis Framework	Frankenberger, Drinkwater *et al.* 2000	Appendix 16	A better example of the SLA approach yet once again limiting in its ability to represent the food security concept in full.	**53**

All in all the above models represent a cross section of the ideas contained within the food security concepts. While more in-depth examination is found in Appendix 16 some generalisations can be made. It was noted from the literature that a good model should stand alone as being representative of an idea, with minimal extra-textual clarification. However, with the nature of the food security phenomenon being broadly conceptually based, it is difficult to portray this in visual terms alone, and indeed many such models rely on a combination of relationships and textual cues. That said, even with this in mind many of the

models simply lack the breadth of coverage to represent the overarching coverage of the food security concept.

However, before this can be stated with any degree of certainty and to learn from some of the better techniques, the highest quality scoring models were taken into the case study analysis for further in-depth evaluation. The final 6 frameworks according to their scores were:

Model A2 FAO Four Pillar Construct;
Model A4 US Agency for International Development (USAID) (model 1);
Model A5 US Agency for International Development (USAID) (model 2);
Model A9 Human Resources and Skills Development, Canada;
Model A10 Polly Ericksen Model of Food Security 2008;
Model A14 Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS).

3 Research Design Theory

When it comes to research design it has been noted by several prominent researchers that proper or sufficient planning is all too often lacking (Love and Cowan 1999 ; Maxwell 2005; Towers and Chen 2008). The problem has been, for far too long, research design philosophy has been erroneously treated as being synonymous with research design methodology (Love and Cowan 1999: Maxwell 2005). That one informs the other is not in question; what is, is the practice of putting the cart before the horse. That is to say, poorly constructed research oftentimes sees methodological tools dictating the philosophical stance of the research paradigm, rather than the other way around. According to Terence Love, this practice has a lot to do with the relatively young modern theory of research design being misunderstood or misapplied. This, he further offers, has ultimately contributed to the common merging of a researchs' methodological perspective (its philosophy); its methodology (the research design); and the many methods (tools) used (Love and Cowan 1999).

Consequently, in avoiding this all too often basic error and ensuring a proper and valid approach to research, is the implementation, tacit or otherwise, of a framework or blueprint (Maxwell 2005). In considering the specific design of this research's blueprint there are two factors that need to be articulated. The first is the researcher's paradigmatic stance; a core set of personal, philosophical and practical beiefs that involves the researcher's assumptions about the nature of the world itself (ontological stance) and how it is understood (epistemological view) (Maxwell 2005). Secondly, consideration needs to be given to the needs of the study itself. These are two important and distinct considerations, as the needs of the study and the researchers needs are not always in line with each other. Finding and operating the right balance between the two is a challenge and a must if the resultant research is to hold any value (ibid).

3.1 Personal Epistemological View

It is widely considered that a persons set of beliefs or assumptions about reality; their ontological stance, plays an important role in choosing an appropriate methodology (Dobson 2002 ; Bryman 2004 ; Krauss 2005 ; Maxwell 2005). Indeed Maxwell provides a good analogy in this respect when he offers: "Trying to work within a paradigm (or theory) that doesn't fit your assumptions is like trying to do a physically demanding job in clothes that don't fit—at best you'll be uncomfortable, at worst it will keep you from doing the job well."(Maxwell 2005). Conversly, it is also considered equally important to recognise the feasibility of perhaps adopting different paradigmatic approaches involving different philosophical positions (Towers and Chen 2008). In this way, an appropriate design approach can be considered on merit as well as personal motivation. In the latter case though, Maxwell cautions that while it is perfectly acceptable to operate from outwardly apparent incompatable stances, appropriate measures must be incorporated to guard against

inherent biases which might compromise the adopted design (Maxwell 2005). Such considerations are not just academic either. Literature contends that proper understanding and clarification of such theoretical perspectives ensures that the more practical application of research writing is not only grounded in a definable structure but it also markedly contributes to the researchs' improved quality and weighted credence (Love and Cowan 1999).

This researcher's personal ontological view sees the world as being real and existing independently from human existence. In line with this, this researcher's epistemological stance views knowledge as objective and also independent of the mind. This falls neatly into the French philosopher Auguste Comte's Positivist camp, and in line with the true fundamentals of positivism, this view is closely associated with empiricism, pragmatism, and logical positivism (Richardson 2003). This 'scientific' viewpoint also traditionally presupposes a strong quantative methodological approach (Bryman 2004).

3.2 Research Needs

On the other hand in considering the philosophical or paradigmatic research needs of the study itself, careful consideration is given to the different aspects or goals of each of the aims from both the perspectives of data collection and data analysis.

- In the first aim; 'to analyse the rationale behind the food security concept', the emphasis is on evaluation and interpretion, which is strongly suggestive of qualitative interpretivism.

- The second aim on the other hand has mixed needs. The aim is concerned with collating and assessing factors affecting food security itself, in this regard from a data collection point of view the overriding approach is inductive. This involves amassing enough data that causal relations can be sufficiently, fully or partially inferred so as to include them in the the new framework. From the point of view of analysis, the needs are also mixed, for while there is some leaning towards interpretivism by far the more crucial requirement is analytical and draws heavily on empiricism for its conclusions.

- The third aim; 'evaluating existing frameworks', is sufficiently similar in needs to the first aim that comparable research needs were anticipated.

- The penultimate aim; to develop a new framework from existing knowledge, calls for intuitive and tentative hypothesis building from the literauture with regard to inclusion and causal relationships. This continues in the vein of a qualitative inductive stance building on interpretation and extraopolation of data.

- Finally in testing the framework, because the nature of the relationships are conceptual rather than having been empirically established to any degree of certainty, the aim is not to test the strength of the correlations but rather the suitability of the chosen variables and any inferred relations. This means that analysis is largely dependent of qualitative assessment, while where quantitive analysis in this respect is needed would be to strengthen any findings made.

3.3 Combining the Two

Noting the differences between the researcher's and the research's viewpoints or needs; it can be seen that while generally speaking paradigms are largely opposing belief systems, in reality the degree of separation is not always great or in fact that distinct (Burrell 1979). This is also a view echoed by Ron Weber (Weber 2004), and similarly Tashakkori and Teddlie concerning the 'Paradigm Wars' between positivism and constructivism (and its close ally interpretivism). In their view, rather than the mutually exclusive worldviews, in which positivism denotes quantative methodologies and constructivism a qualitative approach, they suggest that a compromise can be found in a more pragmatic approach where mixed method studies combine the best of the quantitative and qualitative approaches. Moreover, it also allows for the adoption of 'mixed methods' across all aspects of the study (rather than just the methods) which called a 'mixed model' method (Tashakkori and Teddlie 1998). The resultant pragmatic approach or pragmatic paradigm, according to many (Tashakkori and Teddlie 1998 ; Maxwell 2005 ; Armitage and Keeble-Allen 2008), reconciles the methodological differences and rejects the forced choice between positivism and constructivism. This rationale is applied to the research design of this study and effectively resolves any possible paradigmatic conflicts.

It can be said then, that the large majority of the needs in both data collection and analysis is of this study is qualitative in nature and leans toward an interpretivist paradigm. In considering the above analysis, the researcher's view and this study's needs, the following research design decisions have been made with regard to this study.

Pragmatist Paradigm

By combining the study's predominant but not sole qualitative needs and the researchers' own theoretical lens, the need to adopt a pragmatic approach is reinforced as the best means in achieving the aims of this study. This researcher sees clear benefits in adopting a single pragmatist research design methodology that allows for the beneficial usage of both qualitative and quantitative tools, whilst also lessening any personal or research related paradigm conflicts.

Action Research

While action research is not a methodology per se, it does typically draw on many qualitative methods (Meyer 2000 ; Reason and McArdle 2006). Specifically, it tends to be more of an approach or an attitude to the study, that promotes collaboration and participation that creates an environment of action and reflection in both theory and practice. In this way it can be seen as an "…orientation to inquiry rather than as a methodology…" (Reason and McArdle 2006). As such the orientation of the general qualitative approach of this research leans towards the action research style.

Grounded Theory

Lastly regarding the particular qualitative aspect of the study viv-a-vis the overall research outlook.. The type and methods of data collection and analysis depended largely on the way the data was approached. Once again this was informed by the research design, As an aid, some of the major guiding paradigms can be loosely summarised as:

- **Case Study** - In case studies specific people, organisations, groups or phenomenon are studied over a given time frame.
- **Phenomenology** - Phenomenology is not generally oriented toward finding patterns instead this method seeks to discover the underlying essence of the experience through the study of individual cases.
- **Ethnography** - Ethnographic research methods are traditionally involved in interpreting the processes of cultural behaviour or beliefs. This approach gets to know cultures and groups through an iterative process thematic categorisation and interpretation etcetera.
- **Grounded theory** - Focusing on action and research, grounded theory is an inherently inductive approach using iterative techniques to facilitate emergent theories (Hale and Astolfi 2007).

From the above options the qualititative aspect of this study was seen to be well suited to grounded theory. This refelcted the general recursive or iterative nature of the data analysis that involved constant comparison and improvement in which theory emerged and formed the basis of further data input. This specifically inductive approach, allowed for the ease and emergence of substantive analytical ideas. From a qualitative stance, this was also considered to be best suited to grounded theory and recognising this from the outset allowed the research to choose appropriate tools or methods (Trochim 2006).

Mixed Method Approach

Regarding the use of mixed methods (across all aspects of the study) as opposed to a mixed model methods (solely in methodology), it has been suggested that such studies often entail complex or perhaps competing decisions that need to be reported in ways that are clear and

transparent. Only by explicitly emphasising these research design decisions whilst highlighting the rationale for the sequencing and combining of methods, can the research be considered valid. For these and other reasons, it has been said are the misuse of such methods are collectively in danger of rendering any results subject to question (Buber *et al.*, 2004).

With this in mind, the extent to which the qualitative and quantitative tools used in this study are to be mixed is best determined by the practical issues of the study. These are discussed in detail in the methodolgy chapter (next section).

4 Methodology

Whilst exploring the food security literature and in particular how the concept was comprehended by others, it became evident that a major gap existed with current models being out of date and non-reflective of modern notions of food security. Furthermore there were also serious questions raised in the literature review as to the quality and efficacy of these existing frameworks. To address this shortfall a new model was proposed that would improve on such frameworks. This was achieved through the application of a rigorous methodological research design that applied scientific principles in the construction and application of the new framework.

As an overview the methodology for creating the new framework can be thought of as comprising three parallel but connecting branches of progression. The reason for this approach was two-fold. Firstly one of content; that is to say by studying existing models and generating two new ones a more comprehensive analysis of the components of the overarching concept of food security could be established. The second goal was to evaluate existing methodologies and incorporate any of the methodological elements that would aid in the development of this research's final conceptual model. As a result it was decided the best methodological approach involved the three branches of primary data consisting of 11 stages in all. The following flow diagram (figure 4.1) helps visualise this process while the proceeding sections describe the adopted methodologies in more detail.

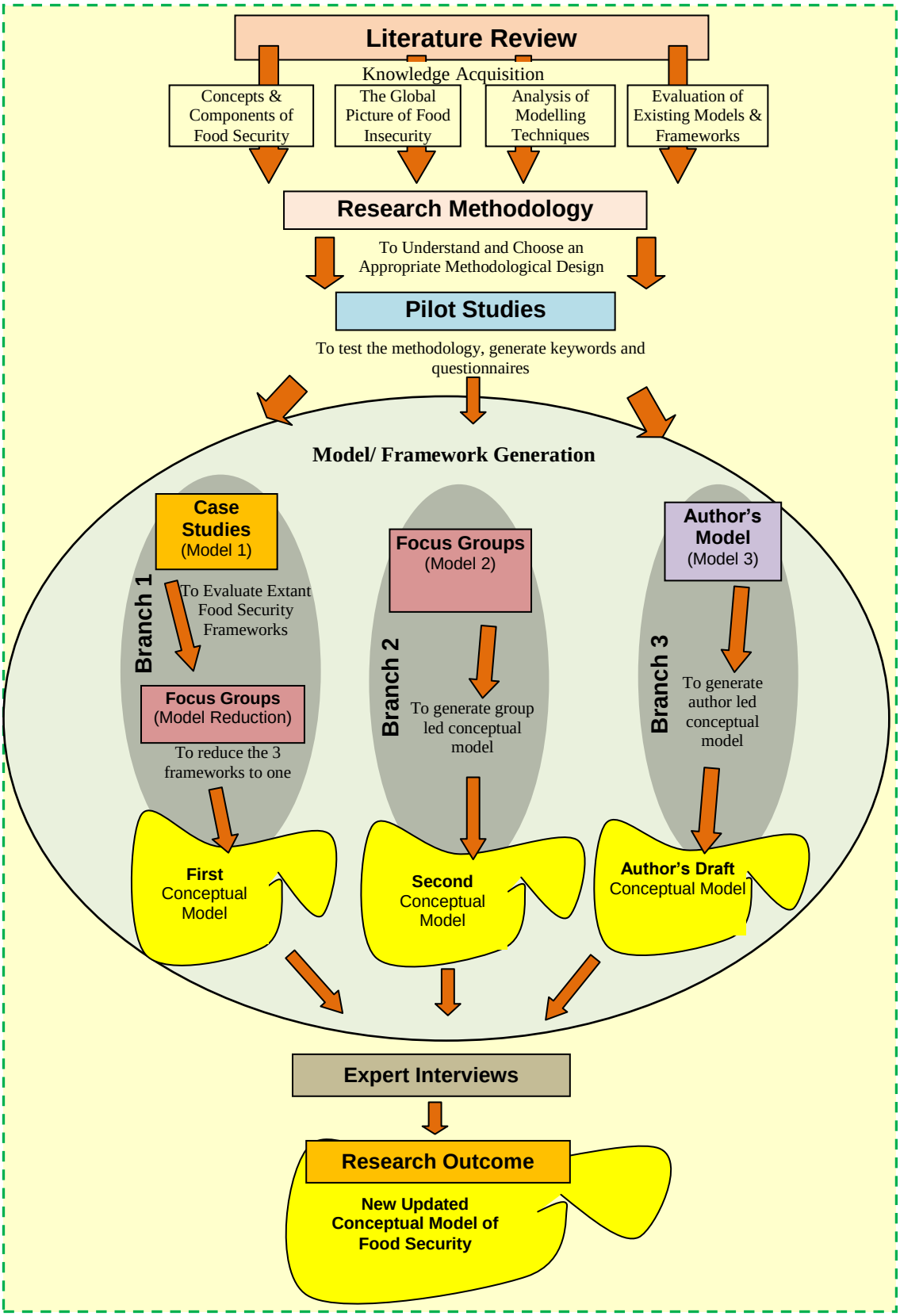


Figure 4.1 Flow Diagram of Research Methodology

The first branch took the 6 highest scoring models of the 25 identified from the literature review. Then using case study analysis condensed these to three final models. From here the focus groups took these three models and determined, through questionnaire evaluation and

discussion, the single best model in terms of quality and representability of the food security concept. This became the first model of food security.

The second branch used another set of focus groups with no expertise knowledge of the concept to generate a new conceptual model from the ground up. This involved employing Trochim's (2006) general social scientific modelling technique and through discussion and group consensus the results were formalised in a concept map. This was the second model of food security.

The third branch sought to combine the best evaluated elements from several methodological processes from the literature review as well as from the above two branches. Using these findings and the knowledge of this researcher's experiences the author's conceptual model (the second of the two new concept models) was generated. This was the third overall model of food security.

Together the three models were then evaluated by specialists for quality and efficacy. The results of this evaluation were then fed back into the author's model and improvements were made creating the final generated model.

The following research matrix is a summary the branches detailing the individual stages as well as the methods of collection and analyses.

Table 4.1 Methodological Research Design Matrix

	Stage	Objectives	Methodology	Analytical Tools
	1st Stage - Secondary Data Collection and Evaluation	• An evaluation of the food security concept (**Objective 1**) • To review methodologies for creating and evaluating concept maps (**Objective 2**)	• **Literature Review** - Inductive analysis of the secondary data	• Critical Analysis
	2nd Stage - Pilot Studies	• To test and asses the evaluative questions (**Objective 3**) • To dry run the final focus groups	• **Focus Groups** – discussion of methodology and procedure's	• Analysis of Variance • (ANOVA) • Internal Consistency • (Cronbach's alpha)
Branch One	**3rd Stage** – Primary Data Collection and Evaluation	• To assess present frameworks to determine models' quality and efficacy (**Objective 3**)	• **Case Studies** – Systematic review of 6 food security models	• Effect size (Cohen's *d* • standardised mean difference) • Significance of effect size (Confidence Interval)
	4th Stage – Primary Data Collection	• Further primary data gathering regarding the suitability of such frameworks (**Objective 3**)	• **Focus Groups** – group discussion of existing food security frameworks	
	5th Stage – Primary Data Analysis	• Analysis and evaluation of 4th stage primary data (**Objective 3**)	• **Content or Constant**	• Comparative Analysis - using Nvivo computer software
Branch Two	**6th Stage** – Primary Data Collection	• Gathering primary data on focus groups ideas of food security (**Objective 1, 3**)	• **Focus Groups** - to generate data toward new framework	
	7th Stage – Primary Data Analysis	• To generate a new conceptual framework of food security through the use of concept mapping (**Objective 4**)	• **Concept Map** generation	• Multidimensional scaling (MDS) • Hierarchical Cluster analysis • using Ward's algorithm
	8th Stage – Primary Data Collection	• Further primary data gathering to organise the new conceptual framework (**Objective 4**)	**Focus Groups** – group discussion of findings and to further extract information regarding relations of the groupings	
Branch Three	**9th Stage – Author's First Draft Model**	• Introduce a rigorously generated food security model based on the author's experiential knowledge (**Objective 4**)	• **Mind Map** generation	• Elements of multiple processes – section 4.5
	10th Stage – Primary Data Collection and Analysis	• Semi- structured interviews to gather data on the 3 generated frameworks (**Objective 4, 5**)	• **Interviews** – experts interviews	• Content or Constant Comparative Analysis of the interview stage
	11th Stage – Author's Final Concept Framework	• Building on the interview analysis improvements were made to complete the final research outcome (**Objective 4, 5**)		

The conceptual framework within which this study is formulated is bounded by many factors outlined in the following sections.

4.1 Stage 1: Secondary Data Collection and Evaluation – Literature Review

As an important component of research, secondary data in the form of a literature review sought to satisfy the first two aims of the study. These included the rationale behind food security concepts and the factors that ultimately affect or are affected by the concept itself. The literature review also contributed to the third aim of this study by evaluating extant food security frameworks:

- To analyse the extent of the issues involved in the big picture of food security
- To assess the components of good social modelling construction and evaluation procedure's
- To evaluate existing frameworks' abilities to successfully convey these complexities

With so much secondary data around, there are many inherent benefits for the researcher, chief among which, were the savings of time and financial considerations (Saunders, Lewis *et al.* 2007). Other benefits also included the ability to avoid data collection problems, as well as allowing this researcher access to data that might otherwise have been unavailable (Kumar 1999; Saunders, Lewis *et al.* 2007). This was particularly evident in this research, in which numerous databases including those of the United Nations and others were consulted. However, benefits aside, there were also several important disadvantages. Drawbacks were concerned with the understanding of the context within which the original research was gathered (Saunders, Lewis *et al.* 2007). Having not participated in the original research, questions of bias, partial illumination or errors of omissions needed to be carefully considered. Even the timeliness, or the time frame of such data was a determination of its relevance and whether or not of its final inclusion (Hollensen 2007).

For these and other reasons, this research exercised both caution and judgment in evaluating the source and content of the material that was used (Hollensen 2007). As a result data from reputable and peer reviewed reports and journals, as well as up to date statistics, drew heavily on the institutions of the United Nations, various US and EU agencies as well as other reputable stakeholders. These sources were chosen primarily for two reasons. Firstly, collectively such organisations are forefront in the battle to implement food security and as such much of their literature form the basis of a great deal of other associated research. Secondly, many of these agencies themselves are responsible for setting global standards and methodologies that many others quote and follow (CFS 2001).

Target Output of Stage One– a comprehensive study of the literature aided in outlining an overarching understanding of the food security issues. It also brought to light certain of the contradictions and illuminated the level of consensus and disunity within the concept. A

critical analysis also allowed the formation of a method of coneptual modelling design and construction as well as providing the tools for their eventual evaluation.

4.2 Stage 2: Pilot Studies

The goal of stage two of these studies was to finalise the evaluative criteria to be used for both the 'Case Studies' as well as the 'Branch One' components of this study. The second goal of these studies was also to field test the method and structure of the proposed information delivery methods, to the focus groups in the final research. With this in mind the research benefitted from two pilot studies. Although initially, only one study was envisaged, after discussion, it was felt a second study would further help clarify the methodology further. The following explains the rationale for this and the outcomes.

Target Output of Stage Two – To generate and test the validity and reliability of the questionnaires to be used in the main primary data collection phase of this study. Also to determine through discussion, trial and error an efficient means of delivering the complex concept of food security to non-experts.

4.2.1 First Pilot Group

The first pilot consisted of 6 postgraduate individuals conveniently sampled. At the beginning of the session the first pilot group was given a five minute talk, followed by a ten minute brainstorming session on the concept of food security as outlined in appendix 12.1.

Later discussion partly focused on this process and it was unanimously considered that different people took in information in different ways. Two of the group admitted difficulty in this area, while a third suggested an alternative delivery method that included a more visual approach. Further probing questions and discussion resulted in unanimity of opinion in favour of an alternative method of delivery. This was considered by the researcher and it was felt a PowerPoint demonstration might prove useful in this respect.

Following this, the participants were then asked to comment on the idea of the quality of a model. This built on the literature review's model evaluation procedure by Holweg and Donk (2009). This involved generating two statements each, which in the pilot group participent's opinions, would best represent each of the 6 domains of quality of the models'; comprehensiveness, novelty, stability, specificity, comparability and simplicity. The group was asked to produce one positive statement and one negative statement each. The negative questions were included to balance out any perceived bias on the part of the participants. This generated a total of 12 statements describing each domain. A discussion regarding structure, the questions and any possible improvements ensued. Feedback was sought in respect of any ambiguous or difficult questions or concepts and it was also used to establish an adequate range of responses. After sifting through duplicate statements, or those

sufficiently similar the group was then asked to choose and rate the top six statements in each domain in order of preference. Transcripts can be seen in the electronic supplement to this thesis and participants responses can be seen in the following table 4.2.

Table 4.2 Top 6 Questions of Each Dimension of Quality

	Q No.	Question	Participant					
			1	2	3	4	5	6
Comprehensibility	Q1	1 The model does not fully describe the concept of food security	3	3	3	1	5	4
	Q2	2 The model fully reflects the pillars of availability, access, utilisation and stability	6	6	6	4	2	6
	Q3	3 Most of the pillars of food security are clearly present (not ambiguous)	2	4	4	6	5	5
	Q4	4 The model does not adequately portray the aspects of access, availability, utilisation & stability	2	5	5	4	6	6
	Q5	5 The framework is fully comprehensive of the food security definition.	4	1	5	2	3	3
	Q6	6 This model includes access, availability, utilisation and stability in a comprehensive fashion	1	5	1	5	6	2
Novelty	Q7	7 The definition and the model are in equilibrium	2	2	5	2	4	1
	Q8	8 The framework does not bring anything new to the concept	6	6	6	4	6	3
	Q9	9 The model introduces new insights into the food security definition	3	6	6	6	5	5
	Q10	10 The new insights are for the better	6	5	4	1	2	3
	Q11	11 The framework explains the model and no more	5	3	2	4	3	2
	Q12	12 The model redefines traditional relationships	4	4	3	5	6	6
Selectivity	Q13	13 The relationships between the entities are clear and precise	6	4	5	3	6	5
	Q14	14 There are some entities that seem non-relevant	5	6	4	5	6	4
	Q15	15 There are entities noticeably left out	4	6	5	6	5	5
	Q16	16 There needs to be more entities in the framework	3	1	3	2	6	6
	Q17	17 There are superfluous variables in the model	6	5	6	5	2	3
	Q18	18 The model's variables are not clear	2	4	3	3	3	4
Specivity	Q19	19 The overall concept is properly elucidated/ clear	3	6	2	6	6	6
	Q20	20 There sufficient of the right variables	4	2	3	5	4	2
	Q21	21 The boundaries of the concept are properly defined	6	5	6	6	5	6
	Q22	22 There is a clear concise concept outlined in the framework	2	4	1	4	3	1
	Q23	23 The boundaries are blurred and need defining	2	4	5	4	5	3
	Q24	24 There are noticeable omissions	6	2	2	6	4	2
Comparability	Q25	25 There are things that could be added to make the model clearer	5	6	6	4	4	5
	Q26	26 The model compares well to the food security definitions	6	5	5	2	6	6
	Q27	27 The definition is not reflected in the model	6	3	4	6	5	6
	Q28	28 The model needs to be redefined	3	2	5	1	3	3
	Q29	29 The model nearly fills the remit of the definition	3	2	4	4	5	3
	Q30	30 The definition and the framework do not tally	2	4	1	2	6	2
Simplicity	Q31	31 The model is simple and easy to follow	3	2	5	1	6	6
	Q32	32 The framework is complex and unwieldy	6	4	5	5	2	2
	Q33	33 The overall concept is easily understood	5	5	6	3	4	3
	Q34	34 There are quite a few variables but they work really well in a simple way	4	4	4	5	2	4
	Q35	35 The framework is unnecessarily complex	5	5	6	3	6	5
	Q36	36 There too many variables or concepts involved	1	6	4	1	4	6

Note: Highlighted questions denote negatives.

This final agreed questionnaire was titled ‘Dimensions of Quality’. It was further analysed to reduce the 36 questions to a total of 18 (three per single dimension of quality). The reasons for this reduction came out of this research’s supervisory meeting, which felt that three questions alone were considered adequate and secondly, considering the data that would be generated it was felt to be more manageable.

The first step involved subjecting the results to a one-way ANOVA analysis to test for significant differences between groups. This was achieved by testing whether the means of the 6 groups of questions were all equal and therefore, too similar to be representative of distinct groups; this then became the null hypothesis. In order to analyse these results however, the negative questions’ responses (those highlighted), were flipped during the analysis phase to represent their positive corollaries, in order that positive answers all pointed toward an increasing scale. As table 4.3 shows the significance level of the test was 0.001, below the 5% or 0.05 threshold. This suggested the groups were sufficiently distinctive to be representative of the chosen dimension of quality, which therefore allowed this research to reject the null hypothesis and recognise significant differences among the group of questions.

Table 4.3 ANOVA test of Significance

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	163.148	35	4.661	2.176	.001
Within Groups	385.667	180	2.143		
Total	548.815	215			

Key: ANOVA was used to compare the differences between groups of questions (dimensions) of quality in the questionnaire

Further analysis of the plotted ‘means’ within each dimension in graph 4.2 (separated by the red hashed line), highlighted those questions with the highest mean scores. From this the three questions with the highest mean scores, within each group, were selected as strongly representative of the domain in question.

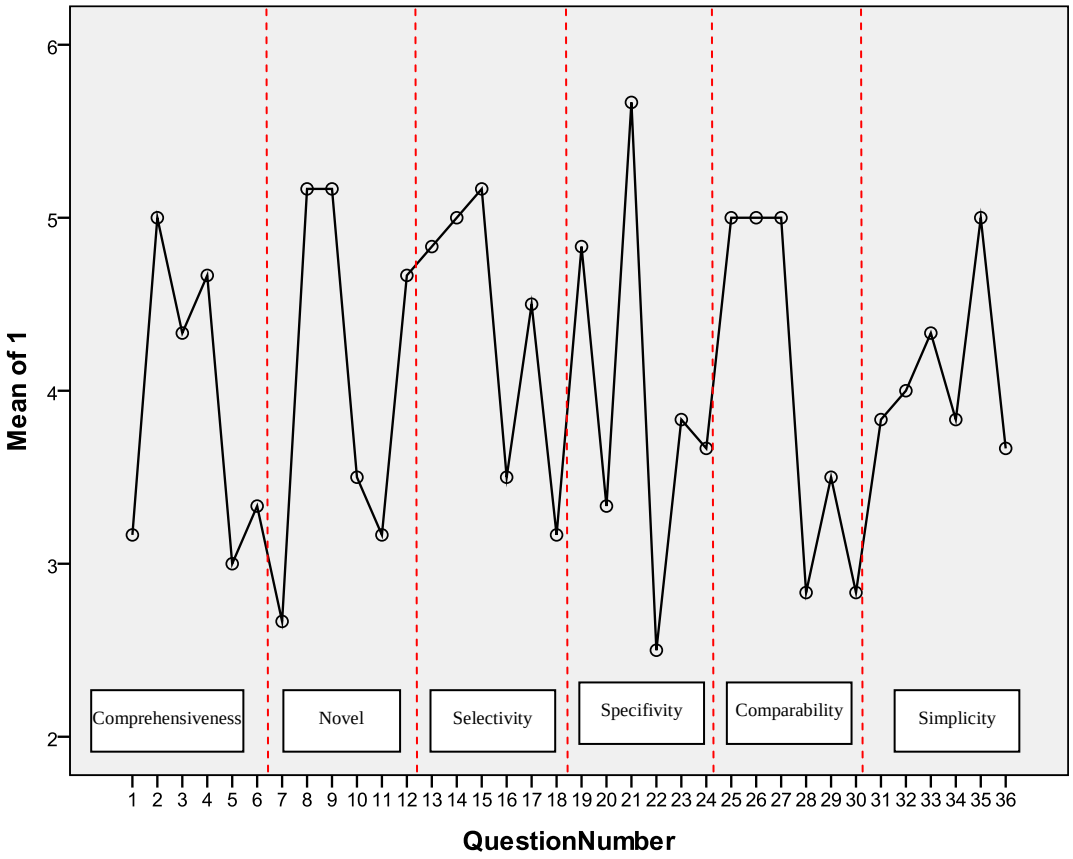


Figure 4.2 Plotted Mean Values of Questionnaire Scores

Key: x-axis no's 1-36 correspond to the original 36 questions

From this analysis a final list of questions were found to be strongly representative of each of the domains of quality (table 4.4). By adding a Likert scale of 1 representing 'disagree to 5 representing 'strongly agree' the questions were then ready for final testing with regards to validity and internal consistency in the second pilot study. However, there were important issues regarding the use of Likert scales which was considered in this research (following section).

Table 4.4 Final Six Questions for the Second Pilot Study

Quality Criteria	Descriptor	Original Question Number	Final Questions	Likert Scale
Comprehensiveness	Comprehensive to support any claims - adequately achieve its stated aims	2	A. The model fully reflects the pillars of availability, access, utilisation and stability	Disagree 1 2 3 4 5 Agree
		3	B. Most of the pillars of food security are clearly present (not ambiguous)	Disagree 1 2 3 4 5 Agree
		4	C. The model does not adequately portray the aspects of access, availability, utilisation & stability	Disagree 1 2 3 4 5 Agree
New or Novel	Is this model new or a Novel in any way?	8	D. The framework does not bring anything new to the concept	Disagree 1 2 3 4 5 Agree
		9	E. The model introduces new insights into the food security definition	Disagree 1 2 3 4 5 Agree
		12	F. The model redefines traditional relationships	Disagree 1 2 3 4 5 Agree
Selectivity	Logical variable choices	13	G. The relationships between the entities are clear and precise	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
		14	H. There are some entities that seem non-relevant	Disagree 1 2 3 4 5 Agree
		15	I. There are entities noticeably left out	Disagree 1 2 3 4 5 Agree
Specificity	Clear and precise - delineating the extent of the models coverage and assumptions	19	J. The overall concept is properly elucidated/ clear	Disagree 1 2 3 4 5 Agree
		21	K. The boundaries of the concept are properly defined	Disagree 1 2 3 4 5 Agree
		23	L. The boundaries are blurred and need defining	Disagree 1 2 3 4 5 Agree
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	25	M. There are things that could be added to make the model clearer	Disagree 1 2 3 4 5 Agree
		26	N. The model compares well to the food security definitions	Disagree 1 2 3 4 5 Agree
		27	O. The definition is not reflected in the model	Disagree 1 2 3 4 5 Agree
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	33	P. The overall concept is easily understood	Disagree 1 2 3 4 5 Agree
		34	Q. There are quite a few variables but they work really well in a simple way	Disagree 1 2 3 4 5 Agree
		35	R. The framework is unnecessarily complex	Disagree 1 2 3 4 5 Agree

Likert Scales

This study used Likert scales in the collection and analysis of the questionnaire data. However, one of the continuing debates about such data use, is the best way to analyse what is technically considered to be ordinal data (Göb, McCollin *et al.* 1967; Jamieson 2004). As a result, there lacks an agreed common standard for Likert scale datum's correct interpretation and analysis (ibid). The debate is centred on the how the differences in the scales are perceived. On a Likert scale for instance, consisting of **1 – strongly disagree** to **5 - strongly agree**, the question arises as to whether the intervals on these scales are equal thus making them interval data. The difference is not academic either, as interval and ordinal data both require different analysis and can often produce different results, which in turn can lead to different conclusions (ibid).

Many prefer to consider the data as ordinal and subject it to non-parametric tests of median, percentage of responses, or regression analysis, as well as analysis of variance techniques such as the Mann Whitney or Kruskal Wallis test (Knapp 1993). Others however, prefer to treat the data as interval, either in its raw state or rescaled using the item response theory (IRT). This is then subjectedto parametric tests such as: the t-test; the Analysis of Variance (ANOVA); Analysis of Covariance (ANCOVA); and many other multivariate methods like factor analysis; multidimensional scaling; cluster analysis and so on (Harwell and G.G. 2001). Another advantage in using interval data and subsequent parametric testing, is that it also assumes a normal distribution of underlying data and, on the whole, is considered more robust in terms of strength and validity of results (Harwell and G.G. 2001). With regards to validationa and reliability of treating the Likert scale responses as interval data, Hasson and Arnetz, in their 2005 study, defend its use after having rigorously tested the idea using Cronbach's α**.** (Hasson and Arnetz 2005).

On balance, weighing these factors, this research considered, like others, that **interval** data (and parametric testing) gave flexibility and opportunity for in-depth analysis. This research also accepted that **ordinal** (and non-parametric testing) data provided beneficial statistics that add value to the results. In this way, this research saw benefits in both approaches. On this basis this research assumed the data to be legitimately, both ordinal and interval, which in turn was then subjecteded to both parametric and non-parametric testing. As a point of clarity for the respondents, when using the Likert scale as interval data, this study used the following diagram (figure 4.3) to articulate symmetrical scalars, that implied equidistant intervals to imply equal interval values.

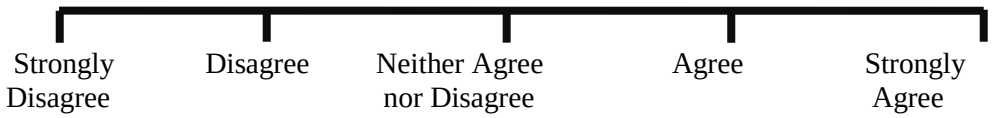


Figure 4.3 The Visualised Likert Scale

4.2.2 Second Pilot Study

The first pilot study left this research with concerns regarding the proposed focus group's general ability to absorb difficult esoteric knowledge, solely with a verbal introduction and short discussion alone. In conclusion, it was felt a more visual approach would have been beneficial. On top of this, there was further need to verify the validity of the chosen questions in the first group. In response to these needs, and after discussion with this researcher's supervisory team, it was felt that a second pilot study was warranted. This was undertaken using a different cohort of the similar population sample.

The second pilot study found the PowerPoint presentation, which was created in response to the outcomes of the first study (section 12.1.1), very useful in dispelling the concerns raised above. Indeed, from this it was found that a good working knowledge of the basic concept of food security, was sufficiently grasped, within the time frame.

Furthermore, the questionnaire design proved to be rigid and robust, and by conducting this as a group exercise, any ambiguous meanings were made clear through discussion. Further analysis served two purposes, firstly, to consider the reliability of the measures themselves, and secondly, to strengthen the findings and to guard against subjective bias, inherent in personal choice.

Three of this research's 25 selected food security models, were randomly chosen for this exercise and the results were analysed using three measures:

- firstly, estimates of the standard deviation of each question were computed over the 6 respondents indicating the degree of convergence; a low standard deviation would suggest a high degree of consensus over this attribute as a measure of quality;
- secondly the internal reliability or consistency of the evaluative criteria used was conducted using a measure of Cronbach's alpha. This was computed for each factor (domain) and an alpha ≥ 0.7 was considered significant;

- lastly the mean of overall scores was taken for each model and taken as the final mark of quality. Collectively these measures allow a certain measure of confidence in the results which are summarised.
-

Table 4.5 Summary of Pilot 2 Model Scores (Flipped)

Models 3,5,6		Comprehensiveness			Selectivity			Specificity			Comparability			Simplicity			Evaluation Score
	Question	A	B	C	G	H	I	J	K	L	M	N	O	P	Q	R	
Model 5	**Participant** 1	2	2	2	1	2	2	2	3	2	2	1	3	2	2	3	31
	2	4	3	3	3	2	2	3	2	2	2	2	3	3	3	4	41
	3	2	2	3	3	2	2	3	2	3	4	4	4	3	2	3	42
	4	2	4	3	3	3	4	2	3	3	2	3	5	2	2	2	43
	5	2	3	3	2	2	3	3	3	1	2	2	2	2	2	2	34
	6	3	4	3	2	2	2	2	2	2	3	3	2	2	2	2	36
														Mean Total			**37.8**
	Standard Deviation	0.8	0.9	0.4	0.8	0.4	0.8	0.6	0.6	0.8	0.8	1.1	1.2	0.5	0.4	0.8	
Model 6	**Participant** 1	5	4	3	3	4	3	3	4	3	3	4	5	3	3	4	54
	2	4	5	4	2	3	2	3	4	4	4	4	4	3	3	4	53
	3	5	5	5	3	4	3	3	4	4	3	3	2	4	4	3	55
	4	3	4	3	3	4	4	4	4	3	4	5	4	4	4	3	56
	5	5	4	2	4	4	3	5	5	4	5	3	3	3	4	2	56
	6	4	5	2	4	4	3	3	4	4	4	3	4	3	3	2	52
														Mean Total			**54.3**
	Standard Deviation	0.8	0.6	1.2	0.8	0.4	0.6	0.8	0.4	0.5	0.8	0.8	1.0	0.5	0.6	0.9	
Model 3	**Participant** 1	5	4	5	4	3	3	3	4	3	2	2	3	4	3	4	52
	2	2	3	2	2	3	3	3	3	4	2	3	4	4	3	3	44
	3	3	4	1	3	3	3	5	4	4	3	3	3	2	2	2	45
	4	3	3	2	4	3	3	3	4	4	3	4	5	2	3	3	49
	5	5	5	5	2	2	3	4	3	4	3	4	5	2	3	3	53
	6	5	4	3	2	3	2	3	3	2	2	3	2	3	3	5	45
														Mean Total			**48.0**
	Standard Deviation	1.3	0.8	1.7	1.0	0.4	0.4	0.8	0.6	0.8	0.6	0.8	1.2	1.0	0.4	1.0	
Cronbach's α		**.77**			**.75**			**.78**			**.72**			**.80**			

- Note: Novelty is not part of the evaluation criteria for non-experts as it was felt this was an attribute that required esoteric knowledge. Q's C,D,H,I,L,M,O,R scores, being negative responses are flipped in this table.

The low standard deviation (SD) results, from all three models, ranged between 0.4 and 1.2. Although there was one model (model 3), that resulted in a standard deviation of 1.7. This was due to two outlying high scores. Otherwise, the remaining low SD scores were all representative of closely grouped responses. The Cronbach's α scores ranged from .72-.8 were all above the accepted 0.7 threshold of significance. Thus, the combination of both SD and Cronbach's Alpha scores suggested the final questionnaire was an acceptable representation (reliability) of the quality dimensions of the food security concept,

Validity

Validity was addressed in several ways using construct validity, face validity, content validity and predictive validity. In this aspect of the study, by engaging in discussion with the postgraduate cohort, the evidence for face and content validity was determined from the pilot studies, with the final strong recognition of subject matter and appropriate question and responses. Construct validity addressed whether the questions used to establish the overall construct of quality, via the six domains of comprehensiveness, comparability, novelty, specificity, simplicity and selectivity actually measured what it intended to. This was addressed using factor analysis as described above.

Collectively both of these pilot studies strengthened the proposed methodologies and contributed to the final selection.

With the secondary analysis and the pilot studies complete, the following three branches of this research sought to produce three separate models of food security for the final consideration of the experts. The first came from existing models found in the literature review (branch one) while the second was generated using Trochim's group consensus methodology (branch two) and lastly the third model was generated by the author of this research (branch three).

4.3 Branch One

The literature review had already identified and analysed 25 models of food security. Using the evaluation methodology based on Holweg and Donk's (2009) criteria (section 2.3), this number had already been reduced to 6. Branch one of this research then aimed to take these 6 conceptual models and analyse them further, to find a single overall model that best represented the food security concept. This was achieved in three stages (stages 3-5 of the design matrix) and summarised as follows:

- **stage 3** - first the 6 models from the literature were analysed using the case study method to reduce these to three;
- **stage 4** - this involved the use of focus groups to evaluate the three remaining models;

- **stage 5** - the analysis of the focus group data was used to determine the final literature review scores and ultimately the single best model.

The 6 models for the case study reviews were:

- FAO Four Pillar Construct;
- US Agency for International Development (USAID) (2 models);
- Human Resources and Skills Development, Canada ;
- Polly Ericksen Model of Food Security 2008;
- Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS).

These stages are described in detail.

4.3.1 Stage 3: Case Studies

Rationale for Use

Although some case studies in the past have been criticised for their lack of scientific rigour, it still remains an important method in the suite of analytical tools (Noor 2008). Yin (1984) refers to case studies as events, entities, individuals or even units of analysis (Yin 1984; Yin 1994). He further suggests that by investigating contemporary events, or phenomena in real life context, then insight of great value can be extracted (Yin 1984; Yin 1994). However, some criticisms have been made regarding the lack of methodical data handling, as well as not having any real basis for scientific generalisation (Noor 2008). Despite such criticisms, its relevance and importance to social science research has been recently re-affirmed by Noor (2008). Noor offered that case study research exceled at articulating understanding of complex issues which can extend experience or add strength to what was already known through previous research" (Noor 2008). Also in response to such criticisms Yin further strengthens the argument for its use when he suggested that the purpose of a case study was not to generalise to populations *per se*, instead he suggested it was rather, to postulate theoretical propositions (Yin 1994).

In view of such considerations, case studies were well suited to this study, as it promoted the evaluation of the food security phenomenon within its own contextual environment (Yin 1984; Yin 1994).

There are predominantly three types of study: exploratory, descriptive, and explanatory. This study used the exploratory method as it reflected this research's aim which was specifically tasked with examining and evaluating the quality of food security models. Analysis of the case studies looked to determine the best model in terms of quality and representability. This was achieved based on the research design of Yin (1994) which is summarised in table 4.6.

Table 4.6 Components of Case Study Design

The study's theoretical propositions	Bringing events to attention, understanding the limiting aspects, suggesting possible links, causation or relationships between phenomena.
Units of analysis	These must be at the same level as the study questions. Comparing like for like.
Logic linking	Linking or matching of data to the propositions.
Criteria for interpreting the findings	Qualitative and/or quantitative analysis incorporating iteration between propositions made and the data gathered.

Source: based on guidance from Yin (Yin 1994).

Thus using Yin's research design it was possible to set an action plan that guided the methodology from questions to conclusions. The first consideration was setting the research question of the case studies. In the case of this research the outcome aim of these case studies was distilled into the following question:

- How well did the chosen frameworks convey the phenomenon of food security?

The answer would be represented by the quality of the model, that is to say, the better the quality score of the model the better the framework adequately describes the concept of food security.

Analysis

By way of analysis and, once again drawing on the guidance of Yin (1984;1994), the six chosen frameworks were evaluated for quality against 6 criteria extracted from the literature review (section 2.3). This ultimately narrowed the frameworks down to three. The rationale for this decision was based on discussions and guidance from research supervisors, who considered that taking six frameworks to stage 4 (the focus groups), would be an unrealistic task in terms of time and complexity.

The evaluative dimensions of quality, by which the six models were evaluated, were based on Holweg and Donk's (2009) proposed criteria summarised as: comprehensiveness, novel, selectivity, specificity, comparability, simplicity. However importantly, according to the literature review, a need to adequately operationalise these domains was also recognised. In operationally defining these terms more specifically, the following clarifies the criteria used in this study (table 4.7).

Table 4.7: Conceptualising the Dimensions of Quality

Comprehensiveness	Holweg and Donk (2009) describe the term 'comprehensiveness' to encapsulate a breadth of knowledge or understanding that is fully inclusive. Applied to food security issues this is suggestive of all the elements that make up the concept or support any claims.
New or Novel	The food security concept is a dynamic concept, as such it is continuously evolving taking into account new understanding and new knowledge. However, operationalising the term 'novelty' in the literature is often vague and contradictory Croft and Li, working in the field of knowledge recognition see novelty as satisfying: " …new answers to the potential questions representing a user's request or information need[s]." (Croft and Li 2004). In their work they advocate the use of a question-answer approach to identifying novelty. Although working from a slightly different perspective; that of identifying new or novel information in an unfolding narrative, the fundamentals are still relevant and as such can be applied to this study. The main consideration in respect of the evaluation criteria would be concerned with novelty, not chronologically over time but rather against an the accepted definition of food security. In this approach evaluation then is to be conducted not against those that came before it but in respect of both the FAO and USDA/USAID definitions.
Selectivity	In the choice of variables that is incorporated it is important that the logical and clear justification for a variables' inclusion or exclusion is evident. That is not to suggest a written addendum be included for every variable. Instead any variable through the iterative evaluation process found to be 'out of place' is to be marked down as such.
Specificity	This criteria suggests the framework should be clear and precise with boundaries clearly delineating the extent of the models coverage. This becomes difficult if the coverage is poorly operationalised or is simply too complex and unwieldy.
Comparability	Comparability in this sense is an indication of whether the framework or model in question fits with the original remit. That is to say with the definition of food security as detailed by the FAO. Comparability in this way is also a measure of one model against another in determining which is a better measure of the construct.
Simplicity	Simplicity ensures the framework is simplified and uses the fewest variables sufficiently adequate to explain the concept. By clouding a framework with extraneous or superfluous variables that does not directly fit with the stated purpose the model risks being convoluted or unnecessary complex.

Source: Based mainly on criteria outlined by Holweg and Donk's (2009)

These operationalised terms were then translated into three statements or questions, that best described the concepts. This was accomplished by the pilot study participants (shown in table 4.8). The resultant evaluative criteria was then appended with a Likert scale and used as the benchmark of overall model quality throughout the case study stage of this research.

Table 4.8 Framework Quality Evaluation Criteria

Quality Criteria	Descriptor	Final Questions	Likert Scale
Comprehensiveness	Comprehensive to support any claims - adequately achieve its stated aims	A. The model fully reflects the pillars of availability, access, utilisation and stability	Disagree 1 2 3 4 5 Agree
		B. Most of the pillars of food security are clearly present (not ambiguous)	Disagree 1 2 3 4 5 Agree
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	Disagree 1 2 3 4 5 Agree
New or Novel	Is this model new or a Novel in any way?	D. The framework does not bring anything new to the concept	Disagree 1 2 3 4 5 Agree
		E. The model introduces new insights into the food security definition	Disagree 1 2 3 4 5 Agree
		F. The model redefines traditional relationships	Disagree 1 2 3 4 5 Agree
Selectivity	Logical variable choices	G. The relationships between the entities are clear and precise	Disagree 1 2 3 4 5 Agree
		H. There are some entities that seem non-relevant	Disagree 1 2 3 4 5 Agree
		I. There are entities noticeably left out	Disagree 1 2 3 4 5 Agree
Specificity	Clear and precise - delineating the extent of the models coverage and assumptions	J. The overall concept is properly elucidated/ clear	Disagree 1 2 3 4 5 Agree
		K. The boundaries of the concept are properly defined	Disagree 1 2 3 4 5 Agree
		L. The boundaries are blurred and need defining	Disagree 1 2 3 4 5 Agree
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	M. There are things that could be added to make the model clearer	Disagree 1 2 3 4 5 Agree
		N. The model compares well to the food security definitions	Disagree 1 2 3 4 5 Agree
		O. The definition is not reflected in the model	Disagree 1 2 3 4 5 Agree
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	P. The overall concept is easily understood	Disagree 1 2 3 4 5 Agree
		Q. There are quite a few variables but they work really well in a simple way	Disagree 1 2 3 4 5 Agree
		R. The framework is unnecessarily complex	Disagree 1 2 3 4 5 Agree

Analysis was conducted using quantitative methods. The aim of this was to determine a relative score of quality whereby each model could then be placed in hierarchical order thus allowing the top three to be chosen for further analysis in stage 4. The tool for this analysis, was the measure of standardised Cohen's *d* effect size. The effect size was chosen over traditional tests of statistical significance for two main reasons. Firstly, the tests were looking to place the models in ordinal ranking based on test scores, whereas tests of statistical significance, simply answered the question of whether an outcome was likely an accident of sampling (Glass 2000). Furthermore, while small differences in data might be found to be statistically significant, statistical significance does not itself provide any real information about the absolute size, or significance (in the general sense of the word) of an outcome (Glass 2000; Coe 2002; Neill 2008). Also on this point, the true effect size quantifies the size of the difference between the observed measures, and may therefore be considered, to be a true measure of the significance of the difference itself. In this way the greater the effect size, the greater the difference and the stronger the inference of quality of the model in question. The second reason for using effect size, was that this research was interested solely in the outcome of these tests and as such were not generalisable to the population.

In order to utilise Cohen's *d* effect size several processes were first required. This processes can better be visualised in figure 4.4.

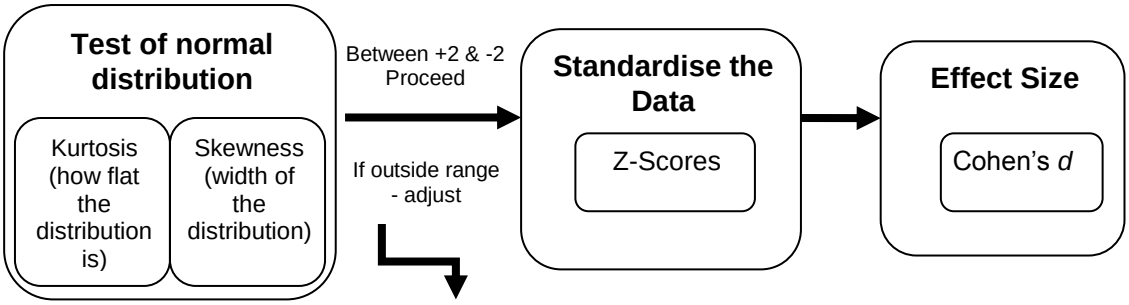


Figure 4.4 The Processes to Determine the Effect Size

The various processes include:

- **Test of normal distribution** - results would only be valid if the data was normally distributed. This was tested using SPSS (version 16) with tests of kurtosis and skewness. In such tests if both kurtosis and skewness were not between -2 and +2, the data was considered non-normally distributed and would have to have been adjusted (Coe 2002). Once satisfied the data was normally distributed, from here the resulting scores were standardised.
- **Standardised data** - before the effect size could be calculate, the data was first standardised. The reason for this is that, as in other descriptive statistics, such as percentages for instance, standardisation allowed this research to translate absolute scores into relative scores, allowing the characteristics; in this case the scores of quality to be compared against each other. This was achieved by standardising the data in the

form of z-scores. From these, the effect sizes were then calculated using the Cohen *d* algorithm.

Having chosen effect sizes as the tool to analyse the data, it did not assign any significance to its results beyond a measure of the differences themselves. In view of this there is sometimes a need to assign some measure of probability to the outcome (Coe 2002). However, the practice of assigning a measure of probability with effect sizes can be problematical (ibid). This is because while traditionally, probability or p-values are undertaken using the t-test, this becomes inappropriate in this case due to a statistical anomaly (ibid). That is, a 'significant' result would result if either the effect was very big, even in spite of a small sample, or if, vice versa the sample was big and the effect size was small (Coe 2002). A workaround solution instead was the use of a likely 'margin for error' or 'confidence interval' (CI), (Coe 2002).

Confidence intervals are chosen for two reasons, firstly to strengthen any generalisable results to the larger population or secondly to indicate the spread in the data around the mean effect size (James Neill 2008). While the former is not applicable in this research, displaying the spread in the data around the mean is like the measure of standard deviation and highlights the general strength of consensus in the chosen results (ibid).

As such in calculating the confidence interval for the effect sizes, Hedges and Olkin's formula was used. Illustrated in the following equation, N_E and N_C are the numbers in the experimental and control groups or in this case the combined sample frame.

$$\sigma[d] = \sqrt{\frac{N_E + N_C}{N_E \times N_C} + \frac{d^2}{2(N_E + N_C)}}$$

Figure 4.5 Hedges and Olkin's formula for Calculating Confidence Intervals for Effect Sizes

Hence working on a 95% confidence interval for *d*, a range from: $\boldsymbol{d - 1.95 \times \sigma[d]}$ **to** $\boldsymbol{d + 1.95 \times \sigma[d]}$ would be considered significant (Coe 2002). From these results, the top three frameworks were considered as closely representing the food security concept and were used as inputs for the first round focus groups.

The internal reliability of these criteria had already been determined using Cronbach's Alpha in the pilot phase of this research. The concept of validity at this stage was addressed in several steps. Evidence for face and content validity was determined from the pilot studies. Construct validity; whether the questions used to establish the overall construct of quality via the six domains of comprehensiveness, comparability, novelty, specificity, simplicity and

selectivity actually measured what it intended to, was tackled using Cronbach's Alpha. Cronbach's alpha also doubled in considering the reliability of the measures and to guard against subjective bias inherent in personal choice.

Target Output of Stage 3 – Quantitative data was used to determine three suitable frameworks that were then further evaluated in the focus groups.

4.3.2 Stage 4: Focus Groups (Model Reduction) - Primary Data Collection

Armed with the results of the case studies above a focus group was convened for stage four of the research to discuss the suitability of the remaining three models. These three frameworks were compared to the various dimensions of model quality, as outlined previously, to determine the final framework from the literature review that best represented the concept of food security.

Rationale for Use

A focus groups' strength lies in its ability to explore multiple variables, or where there is relatively little known, or sufficient disunity about a particular topic or subject (Morgan 1998; Crandall 1999). This process would allow for the brainstorming of the many food security ideas, which could be openly created and rejected through this form of discussion. Furthermore, such brainstorming could tap in to a rich seam of ideas and concepts regarding the security of food, that would perhaps be unavailable in other interviewing techniques (Dawson and Manderson 1993; Gibbs 1997; Howze 2000). In keeping with these views, focus groups were chosen as part of the research design of this study.

Focus Group Sampling and Number

There is a great deal of debate in the literature regarding suitable numbers and composition of focus groups (Guest, Bunce *et al.* 2006; Morgan 1998). While it is widely accepted that, a group needs to be small enough that everyone has a say and large enough to provide diversity of opinions, there is no consensus as to the required number of groups or participants in a group. Several, like Bedford and Burgess, Cronin, Kitchen and Cameron suggest that a focus group is a one-off meeting of between four to ten people (Guest, Bunce *et al.* 2006; Bedford and Burgess 2001; Cronin 2001). Others like Longhurst (1996), used several focus groups comprising just two people and although questioned by peers at the time, it was later accepted as a legitimate method of data collection (Hopkins 2007).

On the whole, many suggest that in the region of between 6-10 people based on the complexity and goals of the group are recommended (DePaulo 2000). As for the number of groups, it has been said that, as the type of data is qualitative, the results tend to be descriptive rather than prescriptive and, as a result, the need for large sample sizes is diminished (ibid). Peter DePaulo, a marketing research consultant, succinctly sums up the debate when he suggests, that all this talk of sufficient data reaching saturation is all very

well however, it lacks grounding and any real idea of actual numbers. He goes on to say, that if the population (as in this case) is not truly a random sampling, then confidence intervals (probability) do not apply (DePaulo 2000). Instead based on his and other research, a sample size of approximately 30 respondents is a reasonable starting point for revealing the full range of potentially important perceptions (Mack *et al.*; Mud Valley 2010; DePaulo 2000). This view is further strengthened in the writings of Perner, who advocates a similar number based on total participants, whether 3 groups of 10 or 4 groups of 8 *etcetera* (Perner 2003).

Based on these considerations, this research employs 3 groups of 6 people for each of the two rounds of focus groups.

The final focus group participants were selected according to the selection criteria and sampling methods outlined here.

Focus group participant selection criteria

In choosing appropriate focus group participants, the end users of the proposed framework were taken into consideration. In this respect, this research adopted findings from the literature review, that suggested that all stakeholders from novice to experts were in need of better holistic understanding (Misselhorn 2005). With this in mind, the sole participant criteria of the focus group, was for participants to be able to address current issues with a good level of analytical ability. Importantly, this criteria negated the need for any degree of expertise on the subject of food security. Such critical and analytical skills are commonly taught at postgraduate level and, as such, the target population group was taken as this cohort. Furthermore, it was considered that the level of analytical skills attained at postgraduate level would not vary significantly, between campuses or across universities. In view of this, the Manchester Metropolitan University's Hollings Campus (MMU) postgraduate attendees were taken to represent the population.

Focus Groups Data Gathering

These groups were briefed by the moderator on the nature and understanding of the food security concept, as garnered from the literature review and modified by the pilot study (Appendix 12). This was achieved with the use of a ten minute PowerPoint presentation and a further ten minute open discussion. The goal, was to provide a level of knowledge and understanding from which further intuitive analysis could be facilitated. From here, a level of consensus was sought as to the suitability of such models in terms of quality and representativeness by using the questionnaire perfected in the pilot study stage. This was repeated for a further two focus groups in this round.

Target Output of Stage 4 – To gather primary data in the evaluation of existing food security models.

The resultant data was analysed in stage 5.

4.3.3 Stage 5: Primary Data Analysis

In keeping with the considerations outlined in the literature review, the Likert-scaled data was treated as both ordinal and interval and appropriate analysis was used in each.

Ordinal Treated Data (Non-Parametric)

Stage five was concerned with the analysis of the above focus group. In the qualitative aspect, the non-parametric analyses that best suited the needs of this research were twofold; Content or Constant Comparative Analysis (CCA); and frequency and median descriptive statistics to explore commonality and patterns. NVivo software was used to aid in the analysis of the group, which specifically regarded perceptions of the suitability or otherwise of the three models. NVivo software enabled this research to codify phrases and keywords and map these keywords according to usage and frequency. By utilising the NVivo software it made it easier for similarities and consensus to be identified and subsequently compared, across individuals responses. Particular emphasis was given to the descriptive and interpretive processes of the group. As well as determining the most appropriate final framework, notes regarding the strengths and weaknesses of each models' needs were also sought. Upon conclusion, a single framework was determined as the most suitable of the contenders available, which was then to be compared later in the final analysis of this research.

Interval Treated Data (Parametric)

Secondly, as with the case studies parametric analysis was also used. The participants of the focus groups were shown the Likert scale diagram allowing them to visualise the equidistant nature of the response criteria. This and the measure of fit of responses for normality of distribution gave this research validity in undertaking an analysis of effect size. Once again, as with the case studies, confidence intervals were calculated using Hedges and Olkin's formula. Together both analyses allowed for scoring and insight of the chosen models

Target Output of Stage 5 - Results of this round of primary analysis were used to strengthen those of the case studies and to evaluate the suitability of existing frameworks. Completion of stage five also satisfied the third aim of this research namely:

3) To evaluate existing frameworks' abilities to successfully convey the concept of food security.

From here completion of branch one allowed this research to select one model from the existing literature review selection as being the best representation of the food security concept.

4.4 Branch Two

Putting the results of the case studies and the first round of focus groups aside for the moment. Branch two of this research aimed to generate the first of two new concept maps for later evaluation. This first map was generated based on the established methodology of Trochim's concept mapping technique. This allowed for the collection and structuring of participant-generated ideas (Trochim 2006). Non-expert participants were chosen to reflect the literature review demographic of food security stakeholders, which sees a good proportion of non-experts in positions of influence within the field (Misselhorn 2005).

This round of focus groups were asked to consider the issues and concepts of food security itself. The idea was to create a conducive environment, in which a selection of keywords and statements could be generated by the participants themselves. These keywords and statements would then represent the collective knowledge base of the food security phenomenon of this group. Through a process of statistical analysis, these keywords were sorted and compiled into clusters that best represented the views of the collective participants and, after further analysis a final diagrammatic model was produced.

The specific stages of this process are discussed in detail.

4.4.1 Stage 6: Trochim's Conceptual Model Generation - Primary Data Collection, Part One

After participant selection (criteria as above), the data gathering aspect of this stage was concerned with generating and structuring ideas (the keywords). The questions and format are outlined in appendix 14 which were perfected and validated using the pilot studies.

Generating ideas

Once again the group participants were briefed by the moderator on the nature and understanding of the food security concept, the goal was to provide a level of understanding that allowed for further intuitive analysis. Key cards were used to represent key variables and concepts of food security. Participants were also given writing tools and paper and were then asked to brainstorm ideas generating further data and keywords. Upon completion the focus group was asked to structure their ideas.

Structuring the ideas

The participants were asked to organise their ideas or keywords into associated categories that made sense to them. The categories used were generated from the concepts of food security outlined from the literature review. Participants were also asked to rate the keywords and groupings in order of importance. Lastly, participants were asked to elucidate the relationships between the categories whether uni, bi, or multivariate and to assign a

numbered weighting to their choice. This generation and grouping of ideas of similar notions into respective categories, together with associated weightings, provided the primary data for the next stage of analysis. This was repeated for a further two focus groups in this round.

Target Output of Stage 6 – Generation of ideas and keywords and groupings that best expressed the food security concept as a whole.

4.4.2 Stage 7: Primary Data Analysis

Stage 7 of the research was tasked with analysing the data gathered in this round of focus groups. The idea was to evaluate the data based on a framework by Trochim and others (2006), that would see the results subjected to quantitative multivariate analytical tools (i.e., multidimensional scaling and hierarchical cluster analysis). These analyses were then used to produce cluster maps depicting relationships among ideas which were then presented in a concept map. This involved the following specific steps:

Organising the data: the focus group data at the pre-analysis stage were, as expected, somewhat judgmental. To determine some form of consensus and reduce its subjective variability, a co-occurrence matrix was constructed. This sought to compare participant responses. The sum of these responses, was used as input for the next multidimensional scaling step.

Multidimensional scaling (MDS): Multidimensional scaling (MDS) is a visualisation tool. It takes data that are related in a complex spatial manner, such as this study's results and reduces the complexity to 2 or 3 dimensions, that are more readily interpretable. This study used non-parametric or non-metric MDS as dictated by the ordinal nature of the data. In using the co-occurrence matrix of the participants chosen variables as input this step, this step made use of the 2-dimensional geometric plane called Euclidean space to further elucidate relationships. As determined by Trochim's (2006) methods, the MDS algorithm involved using isotonic regression analysis, which aimed to find the weighted least-squares fit of the data points. This was achieved using SPSS and resulted in the construction of a two dimensional point map, representing the relationship of each focus group's participants' chosen variables against the others. This bivariate x, y graph or relational point map was then ready for further analysis.

The next step involved further analysing the data to determine a more precise clustering of groups of variables.

Hierarchical cluster analysis (HCA): was chosen over factor analysis, as the latter tends to group single variables together rather than groups of variables as in HCA (Trochim 2006). Trochim also advocates using the X-Y multidimensional scaling coordinate values (the output of the previous MDS results), as the input for HCA, rather than the original similarity

co-occurrence matrix data itself. This is because of ambiguities where the same data in both tests consistently produce visually differing maps (ibid). Furthermore, in executing the HCA, **Ward's** method was used. This was because as, distinct from all other methods, Ward's method uses an analysis of variance approach, rather than distance metrics or measures of association, to evaluate the distances between clusters (Trochim 2006). However, although this method has been described as an efficient algorithm in cluster analysis, it can sometimes produce small numbered clusters and is something that needs to be considered when interpreting the results.

4.4.3 Stage 8: Trochim's Conceptual Model Generation - Primary Data Collection and Analysis

A fourth and final focus group in this round was made up of 10 members of the previous focus groups in this round. The purpose was to present the finalised data after it had been analysed with MDS and HCA. The goal was to find agreement among the group, as to the naming of the clusters as well as gaining further opinions about how the final groups were related and how they might collectively influence food security. Once again, this focus group was recorded and analysed using Nvivo software to help elucidated any consensus.

From the above stages in this branch and using Trochim's (2006) methodology the following outputs were produced:

- The Point Map - the map displaying keywords and ideas as analysed by multidimensional scaling;
- The Cluster Map - the map which shows how these ideas were grouped by the cluster analysis;
- The Point Rating Map - the numbered point map with average participant keyword ratings;
- The Cluster Rating Map -the cluster map with average participant cluster ratings overlaid.

Interpreting the data:

The main map in this sequence was that of the cluster map. Using this and the ratings provided, as well as the relational data and weightings, gathered from the focus groups, the final concept map was drawn and used as the basis of the food security conceptual framework.

This helped satisfy part of the second aim of this PhD:

4) To assess the components of good social science modelling construction and to improve on existing formal procedures that add academic rigour.

On top of this branch also contributed to the content and ultimate methodology of the author's final framework.

Target Output of Stage 8 – Through a process of multivariate statistical analyses to use focus group data to generate a new conceptual framework of food security.

4.5 Branch Three

Branch three of this study aimed to provide the foundation of the main outcome of this research by generating a second concept map. This map however was to be based on the experience of this research's author. By employing this researcher's knowledge, this new model would contrast with the previous model, which was generated using novices and provide a balance of perspectives. The goal of this approach aimed to satisfy the notion that many stakeholders are involved in food security from those with little experience to experts and specialists too.

It has already been established from the literature review, that there are several model types representing one of two forms or realities; theoretical/conceptual or descriptive. From this it was established that this research concentrated on the former. Furthermore, it has also been shown that existing models of food security were often charged with being informal or 'ad-hoc' representations, with little or no apparent scientific basis (IPC Global Partners 2008; SCAR 2008; McCalla and Revoredo 2001).

In response, this research aimed to formalise the modeling process and generate an updated map of food security that reflected current thinking. This involved the application of scientific and academic rigour as conceptualised by Harold Kincaid (1996) in his book the 'Philosophical Foundations of the Social Sciences'. In Kincaid's view academic and scientific rigour involves the accurate careful research, the critical analysis and the detailed examination of a topic. Furthermore, in the case of experimentation or methodological design, the approach must be open and transparent allowing for exacting observation, measurement, or in the case of this research; the rationalisation of methods employed (Kincaid 1996). Thus, in this study, the application of academic and scientific rigour involved the systematic and accurate application of these principles.

4.5.1 Stage 9: Author Generated Model

In generating the second concept map of this research, the methodology of Trochim's, as employed in the first concept map, was not considered suitable in this endeavour. This was because, being a group led exercise the final outcome of Trochim's methodology relied on consensus. While this might be considered a good exercise in defining the general outline of a topic, in the specific context of this research, where the aim was to provide a detailed overarching perspective of food security it was felt that too many individual's ideas would perhaps be lost through non-consensus in the group approach.

Consequently, this research looked to the literature for guidance. However, as with model evaluation techniques there was not a great deal of literature regarding the creation of models within the social science sphere (Holweg and Donk 2009). As a result, the final methodology involved incorporating elements of design from several methodologies. The following explains.

In Earp and Ennett's approach to model creation, they suggest starting at the endpoint and working backwards, based on empirical and theoretical evidence as well as any personal experiential knowledge (Earp and Ennett 1991). They then offer that, causality is made explicit through the use of directional arrows. While Earp and Ennett conceded that this was perhaps one of the hardest elements of designing a new model, such considerations seemed vague and too subjective. Moreover, in the view of this research, this approach seemed to support the previous criticisms of non-rigorous 'ad-hoc' modelling. Although having said that, while the methodology itself seemed to be at odds with the scientific aspirations of this research, the idea of working backwards from a known endpoint (in this case food security) is one that fitted well with this research's inductive approach. This latter aspect of Earp and Ennett 's approach was adopted as the overall stance of the author's approach.

Another more structured approach, made use of a soft systems methodology (SSM). Originally designed as a management modelling tool by professor Peter Checkland in the late 1960's, Kotiadis and Robinson (2008) later successfully applied the SSM method to the creation of conceptual models (Williams 2005; Kotiadis and Robinson 2008). Although their use was in the creation of conceptual models that were translated into computer programs, the same principles could be applied in social science. Their approach considered a twofold methodology; knowledge acquisition and extraction, figure 4.6. This approach was particularly useful in the inductive design of this study and, by observing real world phenomenon, it became possible in theory to extract from this an observable reality. From here, observations could then be elucidated and described to formulate a final conceptual model.

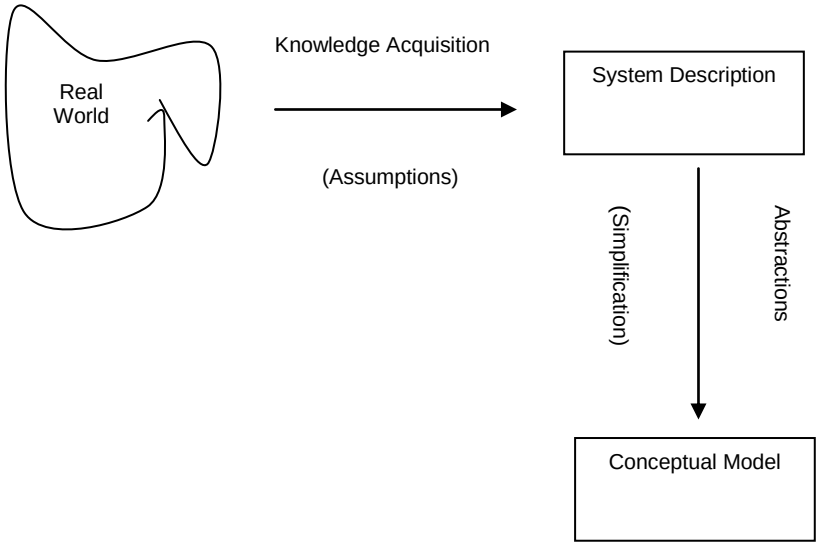


Figure 4.6 Conceptual Modelling Structure
Source: Adapted from (Kotiadis and Robinson 2008).

However, while a useful starting point this system seemed to ignore the feedback element required in the iterative process of this research. That is, it did not allow for the evaluation of the model in terms of quality and applicability and, ultimately, the subsequent re-working of any elements within. Furthermore, there was is no methodology outlined for 'abstracting' or translating the observed reality into a cogent model.

In addressing these shortfalls this research employed two extra methods. The first, utilised Wand's (1999) ontological propositions, which aimed to properly operationalise constructs and determine the models' practical construction. In this endeavour and aided by the literature, the following concepts or keywords were noted and defined or operationalised.

- Concept is a general notion or idea which may or may not be observable. In this research it refers to the concept of food security.
- Constructs are ideas of the mind and by their nature are not directly observable. In this research constructs make up the sub-units of the concept such as hunger and poverty *etcetera*.
- Entities can be physical things or concepts.
- Livelihoods approach or entitlements sets becomes a function of 'access to food'.
- Stability of supply and access are related to vulnerability in terms of environment and governance.
- Vulnerability in turn can be thought of as risk.
- Malnutrition is interlinked with many entities and as such becomes a function of access, availability and utilisation.

- Relationships can be uni, bi or multi-directional however the model is less to do with showing causality as inferring relationships. As such the use of lines of connection do not infer causality or strength of relationships

The secon,d built on Holweg and Donk's (2009), as well as Tashakkori and Teddlie's (1998), iterative processes and used feedbacks in the form of expert interviews to strengthen the final model.

As a result applying these additional methods to this research it became possible to formalise the structural process of conceptual model making, adding a sense of validity and academic rigour as summarised in figure 4.7.

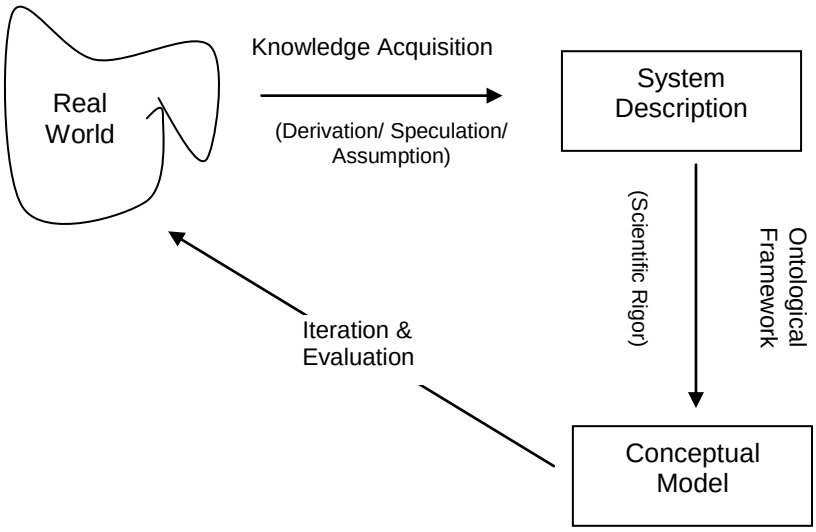


Figure 4.7 This research's Conceptual Modelling Structure
Source: Adapted from the principles of SSM, Earp and Ennett, Lave and March, Tashakkori and Teddlie, and Wand.

Final Author's Model Guidelines

In utilising these combined methods, it allowed the author to follow a defined set of methodological procedure's in constructing the second of the concept models for later evaluation. This can be summarised in the following procedural methods.

- In the first step knowledge acquisition about the food security concept was abstracted from the literature review, as well as the focus group discussions and evaluated in a tentative system description. This aspect of the methodology derived from Earp and Ennett's approach of, starting at the endpoint and working backwards and took the form of keywords and phrases, which acted as the foundation of ideas in the author's model.
- From here, converting this into a conceptual model involved using the Visual Understanding Environment (VUE); amind mapping software package that allowed easy translation of thoughts into diagrams. Stage's 1&2 adopted the principles of the soft systems methodology based on Checkland, Kotadis and others (2008) ideologies .

- This research then added academic rigour, based on Wand's specific ontological constructs, which observed clear delineation between physical entities, conceptual notions and relationships and so on. Further rigour was also added in the use of open, transparent and formalised procedure's.
- The resulting mind map was then interpreted and translated into a conceptual model, observing the lessons learnt from Holweg and Donk's evaluative criteria, as well as Tashakkori and Teddlie's iterative procedure's.
- Further iteration, strengthened and improveed the author's model, through the use of expert/ specialist interviews that sought advice and evaluation.

Target Output of Stage 9

The creation of the second concept map of food security for consideration at the expert interviews.

4.6 Stage 10: Specialist Interviews

The penultimate stage of the research involved open-ended interviews based on guidance from Saunders (Saunders, Lewis *et al.* 2007) and Wengraf, (2001). The aim of these interviews, was to draw out specialist insight into the food security phenomenon from their perspectives and secondly, to evaluate the final three food security frameworks for quality and possible improvement. From here, any ideas or improvements would then be incorporated into the single, final framework.

Interviews were selected primarily because in-depth information around a specific topic could be used to explore meaning and veracity, particularly in follow-ups to other primary data. It was also felt, due to the esoteric nature of the food security field, expert or specialist interviewee's would be best suited to offer this kind of insight (Audenhove 2007). This had many advantages over non-expert interviews, the most important of which was that it became possible to obtain a more detailed analysis (Romney, Weller *et al.* 1986; Guest, Bunce *et al.* 2006).

With regard to the non-consensual nature of the term 'experts' in the literature review, this research prefers the term 'specialists'. This was because it was felt the term denoted all the relevant credentials of experience and qualification but with perhaps, less stringent and exacting connotations. In this respect it became necessary to define what an expert or specialist was.

Experts/Specialists

There is no general consensus as to what constitutes an 'expert' in the literature (Bray and Storch 1999). Some, define them simply by distinguishing them from lay people on the basis of experience or heuristics, while others have "status of authority in a subject by reason of

special training or knowledge" (Bray and Storch 1999). Yet others still, accept reputation as sufficient qualification. Whichever the criteria, according to Lowe and Lorenzonia (2007), it can reasonably be expected that experts have:

> "…the ability to proffer a coherent and well-judged opinion of what may be, based upon a vast wealth of experience and knowledge." (Lowe and Lorenzonia 2007, pg 133).

With this in mind, and for the purpose of this research, food security related experts or specialists were considered to be those specialising in their particular field, whether practical or academic, fulfilling one or more of the following criteria:

1) Their credentials – relevant qualifications or experience in the areas explicitly referred to in this research.

2) Previous or current work experience in the field of food security taking into consideration length and suitability of experience.

3) Contributing member of a food security related network, charity or Non-Governmental Organisation *etcetera*.

The next step was to identify the type and medium of interview.

Interview Type

Modern approaches to interviewing have expanded to include not only the traditional face to face or telephone communication techniques, but also now encompass electronic audio-visual conferencing as well as e-mail. From this selection, it was felt that the latter two options could potentially bring to this research a worldwide network of experts or specialists that, through time and financial reasons might otherwise have been unavailable previously.

The difficulty arises, given their growing importance as research tools, in that academic research on such methodologies is scarce (Guest, Bunce *et al.* 2006; Selwyn and Robson 1998). Having said that, what little data there is suggests that using e-mail as an interview tool avoids conventional constraints of spatial and temporal proximity. Moreover, low administration costs and its unassuming and 'friendly' nature to respondents, provides an enviroment, free of internal or external coercion and equality of opportunity (Boshier 1990). Furthermore, e-mail and video-conferencing are not constrained by geographical location or time-zone. An added advantage is that, this technique can also help transcend traditional biases that plague other interviewing techniques, such as interviewer effect (visual and non-verbal cues), or status differences between the interviewer and the interviewee (Guest, Bunce *et al.* 2006).

There are limitations of this medium too; the main drawback concerns the notion that this medium, is perhaps limited or biased towards populations in terms of user groups adopting

this form of technology. This might in turn unintentionally discriminate on the basis of age, income, gender and race (ibid).

However, on balance it was felt despite the limitations, expert/specialist interviews through email, forum and video and audio conferencing would provide a rich source of participants well suited to this research. These would take the form of purposive, non-probabilistic sampling techniques. This sampling type was specifically adopted because, it allowed this research control over the sampling process, particularly when the need was clear, to choose participants with a particular set of attributes (Barbour 2001; ONS 2008).

Number of **Interviews -** With regard to the number of interviews needed to establish some form of consensus or saturation; after very little guidance on this in the literature Guest *et al*, (2006), provided clarity in an article that aimed to answer this very question. It was argued that, while sufficient probabilistic sampling methods were relatively straight forward to calculate mathematically, non-probabilistic sampling numbers were almost impossible to determine. Studies in literature it seemed, up to this point, were offering sample sizes of anywhere between 5 and 36, few of which, according to Guest *et al*, offered any evidence to support such figures. In conclusion, Guest and colleagues suggested that the type and use of interviews largely dictated how many would be sufficient. When dealing with experiences and perceptions they suggest, 6 interviews are usually adequate, with 12 reaching saturation. On the other hand, when considering expert interviews, they defer to Romney *et al's* consensus theory whereby, experts ideas tend converge and agree more so than do novices; and as a result as few as four interviews would suffice (Romney, Weller *et al.* 1986; Guest, Bunce *et al.* 2006).

Putting it Together

In order to choose the specialists for this research, it was necessary to gather a population group from which a sample frame could be taken. This was achieved through the UN's Food and Agriculture Organisation's Global Forum on Food Security and Nutrition Network (FSN). A forum where experts (specialists) and non-experts alike came together to discuss the various aspects of the phenomenon.

To start, this research opened an online world-wide discussion on the topic of food security models, with participation open to members and by special invitation from FSN moderator Max Blanck. The online discussion was designed to attract responses from experienced professionals within the field, which not only provided background supporting material for the literature review, but also provided a cohort from which specialists could be chosen.

Specialists were chosen based on previously discussed criteria. Collaboration was then sought with the most suitable respondents in the form of e-mail and video-conferencing

interviews. This involved asking the specialists the same open-ended questions focusing on their perception of food security models in general and specifically, regarding those of this study. Any clarification needed was pursued through further correspondence.

In connection with the numbers of interviews, it has been mentioned that Romney and Guest (Romney, Weller *et al.* 1986) propose four expert individuals can render very precise information to a high degree of confidence (0.999). In light of such confidence levels this study too adopted Romney's consensus theory however, having access to a worldwide network of suitable respondents this study was able to undertake 6 such non-probabilistic specialist interviews (Romney, Weller *et al.* 1986).

Analysis

In terms the analysis of the interviews the majority of the interview data was analysed using the contrast and comparison analysis technique (CCA). Originally developed by Glaser and Strauss for use with grounded theory (Glaser and Strauss 1967). CCA strategy involved comparing data (interview, statements and themes) with others for similarities or differences, in order to develop theories about the relationships between the data. CCA is well suited to grounded theory and this study in particular, as the experts interviewed provided a rich source of important data that benefitted this research enormously.

In practice, this was achieved using coding techniques based on Strauss and Corbin's open, axial and selective coding methods (Strauss and Corbin 1994; Strauss and Corbin 1998). Open coding allowed this researcher to look for general themes and concepts whilst further iterative analysis of the same data sought to find linkages between these data (axial coding) between and among specialists. In this way CCA facilitated the analysis of this research's emergent findings in a structured and cohesive fashion (Strauss and Corbin 1994; Strauss and Corbin 1998). This process was further facilitated by the use of Nvivo computer software as a tool of managing the data.

Target Output of Stage 10 – To generate qualitative data about the suitability of the models in their representation of the food security concept.

4.7 Stage 11: Final Author Generated Concept Map

The final stage of this research took the interview results and applied the lessons learned to the author's final model. This involved the careful consideration of multiple opinions and where necessary follow up questions which sought to clarify or seek further analysis. Also at this stage any elements that came to light from the first two branches that was felt to enhance the final model was also considered. In this way both the specialist interviews and the

experiential knowledge gained from all three branches of this research along with the literature review came together in the final model of food security.

4.8 Ethical Considerations

With reference to ethical considerations within this research, there were potentially a number of items that could have lead to breaches if not properly evaluated. Although there appears to be little in the way of guidelines for judging the ethics of qualitative research, some literature has made special attempts at elucidating the dangers of ill-conceived ethical approaches. A paper by Helen Richards and Lisa Schwartz, albeit geared towards health practice, do draw some generalisable conclusions in the undertaking of ethics in research (Richards and Schwartz 2002). They noted several areas of concern, particularly when dealing with interviews and other similar forms of surveys. Noticeably, they recognised the potential misgivings of interviewee's and categorised them as falling into three types: anxiety and distress; exploitation; and misrepresentation. As a result, careful consideration was given to ensuring the participants of the focus groups were comfortable and under no pressure. It was also made explicit that their contribution would be in confidence and used appropriately. Other concerns included the Data Protection Act of 1998 and the re-use of data. For instance, at the data collection stage it might not always be known by the researcher exactly how that data may be used and if indeed, any secondary analysis might be required. With regard to misrepresentation Helen Richards offers that while the researcher attempts to be 'value-free' or as unbiased as possible, novice researchers working in isolation benefit from having experienced researchers playing the role of 'devil's advocate' thus reducing any unintentional conflicts on this level (Richards and Schwartz 2002). In this regards the questions to be used were either pilot-tested or referred to the supervisory team for consideration.

There were also cautionary notes from other quarters regarding making any specific promises implicit or otherwise, with regard to such things as promising a lift home to participants, or any other unpublished inducements that might facilitate cooperation (Saunders, Lewis *et al.* 2007). All in all, careful consideration was given to the researcher's needs, explicit and implicit and the use of collected data was undertaken within these strict guidelines. Also, with regard to these concerns it is noted in this research that, pre-amble to any focus groups, pilot studies and interviews included such assurances. Informed consent was sought and confidentiality was assured, as was the sensitive use of personal data. It was also acknowledged that if further later stage analysis was required then future informed consent would be sought. In this way a level of confidence in this researcher's intentions was given.

Other Considerations

As mentioned previously, much of the secondary data used came from the United Nations, various US and EU agencies and others. With regard to the ethics of using these data, all of the information was either anonymised or properly in the public domain therefore considerations of informed consent or the data protection act were not applicable.

4.9 Validity and Reliability: Defending the Work

Several steps were taken to assure reliability and validity in this research in order that any assessments or any conclusions drawn from this research were valid and scrutable. There are several threats common to social science research and these pertain to threats of reliability, validity and methodology. These were addressed as follows.

4.9.1 Reliability

Reliability issues were concerned with the consistency of any measurements taken, that is to say, reliability in this study ensured that such measures could be reproduced using the same methodologies that would give the same or similar results. In particular, this study was concerned with ensuring that the focus group and evaluative question's dimensions of comprehensibility, selectivity *etcetera* were adequate measures of their chosen group of questions.

In achieving this there were two methods available, these were the test/re-test and internal consistency approaches. The test of internal consistency was considered the best approach in this research. Thus, the internal reliability within this study employed a commonly used measure for this purpose; Cronbach's Alpha. Essentially Cronbach's alpha, using SPSS, split all the questions in this research, into every possible combination and computed a single number which, as with correlation coefficients, the closer to 1 the score, the higher the reliability. In this research the measure of Cronbach's alpha of the 5 dimensions of the questionnaire ranged between 0.72-0.8 all of which were considered significant values.

4.9.2 Validity

The second and more involved threat came from validity. In this case it referred to the validity of whether this research had in fact measured what it set out to measure. Effectively, guarding against the threat of validity would determine the strength of any conclusions, inferences or propositions and ultimately their applicability in the real world. Validity itself is commonly attacked in four ways: conclusion validity; internal validity; construct validity; and external validity. Each type of validity aimed to test the different aspects of the relationship between this research's treatment of the data and its observed outcome. Consequently it became prudent to consider these individually.

Conclusion validity - questioned the relationship between the programme of research of this study and the observed outcome. Or more specifically it tested whether there was actually a connection between the new framework and that which it purported to represent – the concept or phenomenon of food security. However, taking into account the observed methodological paradigm of this research, it was noted that being an inductive study this research was not attempting to accept or reject a null-hypothesis therefore, threats of false positives or negatives (type I, ll errors) were not applicable. Instead, and in the absence of statistical inferences, and in an attempt to avoid erroneous conclusions, three things were considered necessary to strengthen construct validity. Firstly, the strong measure of internal consistency of Cronbach's Alpha helped strengthen the conclusions drawn from the questionnaire. Secondly, the thorough use of focus group and interview data served to reinforce the findings of the questionnaires and the literature review. Lastly, a strong, open and transparent methodological process aimed to build confidence and trust, which also further strengthened confidence in the conclusion or outcome of this research.

Internal Validity - while the above conclusion validity aimed to determine whether there was a relationship between the chosen conceptual frameworks and reality; internal validity of this research sought to test whether any assumptions were valid. Similar to construct and conclusion validity (next section), this was aided by the use of Cronbach's Alpha and open and transparent methods. With regards to the relationships of the variables themselves in two of the three models; the focus group generated model and the author's model, relationships were decided at an individual level. While it is recognised that such measures were largely subjective, it was also stipulated that causation was not inferred. Moreover, the final relationships were compared back to the literature review and any significant differences were highlighted. With the iterative nature of this process, along with the open and transparent methodology used throughout this study, a good measure of internal validity was created. Also of interest in the threat of internal validity was the possible threat of **social desirability response bias,** where people might act in ways that make them look good to others. Guarding against this, focus group participants were asked to perform their tasks as well as they could in an effort to encourage them to focus on their actions rather than the groups.

Construct Validity – this aspect questioned the relationship between the research design and the resultant model. In other words, whether the research logically and legitimately arrived at the resultant framework. It could also be seen as a validation of the design integrity of the study which, once again being predominantly qualitative, relied on logical analysis. This included not only validation of the measures themselves but also the operationalisation of the many constructs used. This involved the following considerations.

- Face Validity was concerned with the operationalisation of the constructs and whether or not they were accurate and a good reflection of the realities. In this sense repeated reference to multiple sources aimed to consolidate and finalise such concepts.
- Content validity sought to determine whether the many constructs collectively outlined the food security concept. This was tested at the interview stage whereby comments on the three frameworks verified that the final three frameworks did adequately represent the concept.
- Predictive validity determined whether this model could be used to accurately predict food security variables as they were related on the framework. This was accomplished through the specialist interviews, who determined that all three had both strengths and weakness that gave them various degrees of predictability in a real life environment.
- Convergent and Concurrent validity suggested that similar frameworks worked in similar ways and that these should be distinguishable from other frameworks that tested, for instance, poverty or risk assessments. Once again, the interview stage addressed these notions with many similarities being drawn across the three frameworks against those in current use today.

Overall it can be said that construct validity of this research, through the use of multiple processes of construction and analysis involving: case studies; concept mapping; and interview assessments, collectively provided sufficient and adequate confidence in the findings so as to reject any potential threats.

External Validity - questioned whether or not these results could be generalised to the larger group or population. In the context of this study, there was some measure of generalisability based on the successful defences of validity and reliability however, to further strengthen this there were two more complementary analyses undertaken. The first was the use of sampling and the second employed the theory of proximal similarity.

- Sampling - The goal of this sampling procedure was to answer the question of the smallest number of cases that would give reliable data about the population. That said, while in true random sampling, the reliability or chance that this was representative of the population (the sample or margin of error) can be quantified in confidence interval terms, this research cannot claim such inferences. This study instead relied on non-probabilistic convenience and purposive techniques and such methods in themselves precluded the measurement of sampling error. In this respect, projecting generalisability beyond the sample was statistically inappropriate. Further, non-random sampling techniques also opened this study to charges of non-sampling error; specifically selection bias where certain types of samples are favoured more than the others. Despite these concerns the potential systematic bias was considered secondary to the acknowledgement that the techniques chosen were the most appropriate for the research design. While this might be detrimental to the external validity of the study it did not

lessen the in-depth analysis and valuable new insight that has been gained through its analysis.

- Proximal similarity – suggested that similarities in this research's population sample were reflected in the population who are engaged in food security. This is to say that while the sampling method was non-random, certain similarities in cognitive ability are expressed in job requirements as evidenced by the predominant degree entry criteria of the sector. This effectively goes some way to reducing the threat of external validity.

Lastly, in the final analysis and drawing on the underlying principles of this research, reliability and validity of this research's findings were strengthened by the open and accountable methodologies used throughout. Within quantitative and some qualitative analysis, certain inferential and descriptive statistics allow the testing of strengths of correlations or the confidence intervals of sampling techniques. In predominantly qualitative research, such as this however, this was not so clear cut. Consequently, several techniques, that if followed rigorously, added validity and reliability on which these results were strengthened. These included the proper use of sampling (described above), triangulation and transparency.

- **Triangulation** - Triangulation is a powerful technique that facilitates validation of data through cross verification from more than two sources. Throughout the literature review data triangulation has been accomplished with the liberal cross referencing of multiple sources. Methodological triangulation too, utilised multiple methods from qualitative interviews and focus groups to quantitative analytical software techniques which between them strengthen both validity and reliability.

- **Transparency -** It has been said however, above and beyond the measures of triangulation and sampling in predominantly qualitative studies, that perhaps the most important means of strengthening both validity and reliability is through transparency. Apart from being a basic requirement, transparency allows the reader the means to observe the processes involved and to infer or make judgments as to the appropriateness and suitability of both the research design and methodology within the data collection and analyses. Demonstrating such transparency allows for the examination of the study's logical and intuitive relationship between its research questions, procedures, analyses and results. In doing so, it can be reasonably assumed that similar prudent studies following the same criteria would arrive at the same or similar conclusions. In this way the reader can assess for themselves the degree of confidence in the findings and of any generalisability. It also offers a means to replicate the research and further strengthens internal and construct validities.

In summary then the generalisability of the above research, while strictly speaking cannot be inferred beyond the immediate sample, proximal similarity opened up the possibility that these results might in fact be more relevant than simple non-sampling methods would normally have allowed. Furthermore, improving the notion of externality, the use of expert interviews drew on their wealth of knowledge and experience satisfying this research that such findings were of sufficient rigour as to be representative of the wider population.

5 Case Studies

These case studies were an investigation into the 6 highest scoring frameworks of food security from the 25 studied in the literature review (described in section 2.5). The aim of this was to reduce these to a more manageable number - three. These three were then taken into the focus group stages which further reduced this number to one overall model that best represented the concept. Consideration of the initial 25 models can be found in section 2 of the literature review and section 16 of the appendices (Appendix F: Food Security Framework Evaluation). The main criteria in determining the framework's overall representability of the food security concept was determined by its quality. This in turn was based on 6 dimensions as articulated by Holweg, Donk and others (section 2.3).From these analyses the final 6 case study frameworks were chosen on the basis of highest scores of quality. These were:

- FAO Four Pillar Construct;
- US Agency for International Development (USAID) (2 models);
- Human Resources and Skills Development, Canada;
- Polly Ericksen Model of Food Security 2008;
- Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS);

The following case studies evaluates these 6 models in detail.

5.1 Model 1: Food and Agriculture Organisation (FAO)

After years of analysis the FAO determined that food security was built on the four pillars of availability, access, stability and utilisation. It is viewed as the foundation upon which further associated constructs are built (FAO 2008). These pillars have come to be widely accepted and underpin many of the frameworks in use today (ibid).

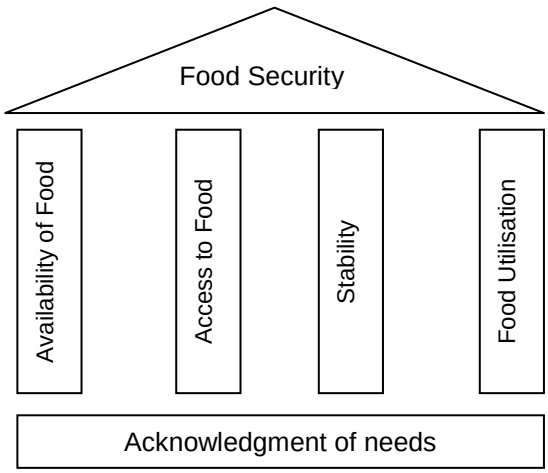


Figure 5.1 The FAO 4-Pillar Model of Food Security.

This is demonstrated in the above model figure 5.1, which shows the 4 supporting pillars of food security. In applying the evaluation criteria a measure of the quality of the framework can be determined. Considering comprehensiveness; this is very straight forward as this was

the first model that introduced the concepts of availability, access, utilisation and stability. However, with regards to whether the model is new or novel against the definitions of the FAO and US, the findings are mixed. This model itself introduces 5 concepts; access availability, utilisation, stability and acknowledgement of needs. In respect of the FAO definition, the concepts of access and availability as well as 'nutritious' or utilisation is evident. However, stability in the FAO's description is not made explicit, instead it can be considered implicit in the use of "at all times". This is also borne out in the US definitions, although their interpretation of stability is more explicit in the phrase "…without resorting to emergency food supplies, scavenging, stealing, or other coping strategies.". Acknowledgment of needs, according to the FAO framework, while somewhat vague in the model, is well represented within the actual FAO definition. So, while all these concepts are evident in the definitions, it can be said that in regards to the model itself it does not provide any new or extra insight. In determining the selectivity of the model the relationships are very well articulated with availability, access, utilisation and stability all appearing to support the notion of food security. Acknowledgment of needs on the other hand, referring back to Wand's operationalisation guidelines, seems more of a statement than any real thing or concept (entity). When it comes to any entities that are left out or omitted from the FAO model, unlike many others, this particular model lacks the macro supporting environment. Whether this is meant to be encompassed in the 'Acknowledgment of needs' is unclear and as such scores low on this evaluation criterion. In answer to specificity, it can be seen that the individual pillars are sufficiently all-encompassing to allow for various relationships and correlations to be postulated, tested and altered. Although, as far as boundaries are concerned, while food security appears to be the goal, once again 'Acknowledgment of needs' alludes to externalities which are unclear and unspecified. Considering comparability of the food security definition to the model gives an adequate representation although as previously mentioned, further elucidation of the externalities of underpinning factors, would benefit this framework. This is particularly evident when comparing this model against the US definitions. A summary of this model's evaluation scores can be seen in the table 5.1.

Table 5.1 Evaluation of Model 1 (results are highlighted)

Quality Criteria	Final Questions	Scale
Comprehen-siveness	A. The model fully reflects the pillars of availability, access, utilisation and stability	Disagree 1 2 3 4 5 Agree
	B. Most of the pillars of food security are clearly present (not ambiguous)	Disagree 1 2 3 4 5 Agree
	C. The model does not adequately portray the aspects of access, availability, utilisation & stability	Disagree 1 2 3 4 5 Agree
New or Novel	D. The framework does not bring anything new to the concept	Disagree 1 2 3 4 5 Agree
	E. The model introduces new insights into the food security definition	Disagree 1 2 3 4 5 Agree
	F. The model redefines traditional relationships	Disagree 1 2 3 4 5 Agree
Selectivity	G. The relationships between the entities are clear and precise	Disagree 1 2 3 4 5 Agree
	H. There are some entities that seem non-relevant	Disagree 1 2 3 4 5 Agree
	I. There are entities noticeably left out	Disagree 1 2 3 4 5 Agree
Specificity	J. The overall concept is properly elucidated/ clear	Disagree 1 2 3 4 5 Agree
	K. The boundaries of the concept are properly defined	Disagree 1 2 3 4 5 Agree
	L. The boundaries are blurred and need defining	Disagree 1 2 3 4 5 Agree
Comparabi lity	M. There are things that could be added to make the model clearer	Disagree 1 2 3 4 5 Agree
	N. The model compares well to the food security definitions	Disagree 1 2 3 4 5 Agree
	O. The definition is not reflected in the model	Disagree 1 2 3 4 5 Agree
Simplicity	P. The overall concept is easily understood	Disagree 1 2 3 4 5 Agree
	Q. There are quite a few variables but they work really well in a simple way	Disagree 1 2 3 4 5 Agree
	R. The framework is unnecessarily complex	Disagree 1 2 3 4 5 Agree

5.2 Models 2 & 3: US Agency for International Development (USAID)

USAID's early model of 1995 by Riely and Mock figure 5.2, aims to elucidate relationships among several factors and in the process clarify the mechanisms or pathways by which food security itself is undermined. In their model Riely and Mock recognise that a well-defined framework is crucial, not only for comprehension but also as an aid in the identification of appropriate indicators in the analysis of insecurity. In this endeavour this model is based on the interaction of the accepted three pillars of food access, availability and utilisation and certain of the underlying determinants that affect these outcomes (Riely and Mock 1995; USAID 1995).

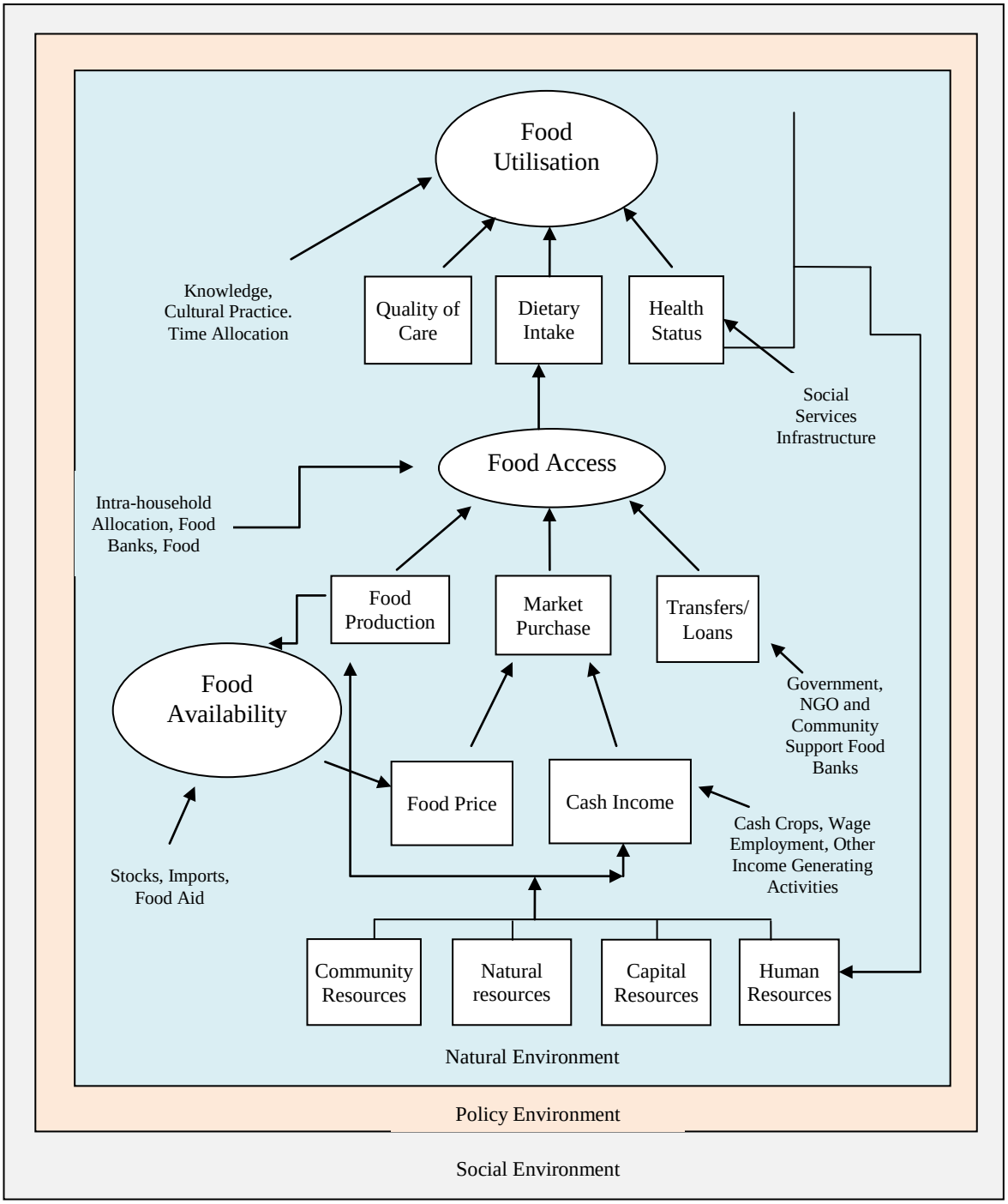


Figure 5.2 USAID Framework 2 by Riely *et al* 1995/9

Source: (Riely and Mock 1995).

In terms of comprehensiveness, Riely's model is separated into 3 distinct environments; the natural, policy and social. Although having done this, the model then fails to elucidate anything beyond the natural environment, moreover, by closing off the boundaries between these three aspects it places the whole concept within the natural environment. This in turn does not help clarify how the other dimensions are involved beyond just existing. This is unless, one is represented to exist inside the other *etcetera*, however it is not clear whether this is the case or not.

Three of the constructs, access, availability and utilisation are well represented with many underlying relationships exposed. In this model both access and availability are considered functions of food productivity. In turn access is supported with an elaborate resource base consisting of community, natural, capital and human. In this case access and presumably availability by association, appears to support the utilisation of food. Despite this, this model does not introduce anything specifically new and some of the relationships are not particularly clear with one relationship in particular (health), not connecting to anything in particular and as a result seems to be left hanging.

Further confusion arises with the added descriptions outside certain entities. These appear to be a mix of further descriptions and entities themselves, which while to the initiated might be understood, to the uninitiated, these might cloud or confuse the model. Further, it is not apparent just why some of these entities merit such 'add-ons' while others do not. In considering these entities themselves, there are many more supporting variables of all aspects of access, availability and utilisation. This helps further the understanding of these constructs and the relationships to them. That said some of the constructs such as access receive more attention than for instance food availability. By introducing this level of expansion to some constructs and not others, the model appears weighted in favour of certain elements and lacks a much needed holistic perspective. Lastly, there appears much thought given to causality but relatively little towards stability, risk or vulnerability.

The second framework used by USAID's Food for Peace (FFP) programme expanded on their 1995 framework above by adding a dimension of vulnerability to the concept. This is shown in figure 5.3. This addressed a recognised shortcoming of the original concept (USAID 2007). With this newer, fuller version, the USAID accept that the idea that food security can be: "lost as well as gained" (USAID 2007). In this way, the ability to reduce the exposure to risk becomes integral to any proposed solutions.

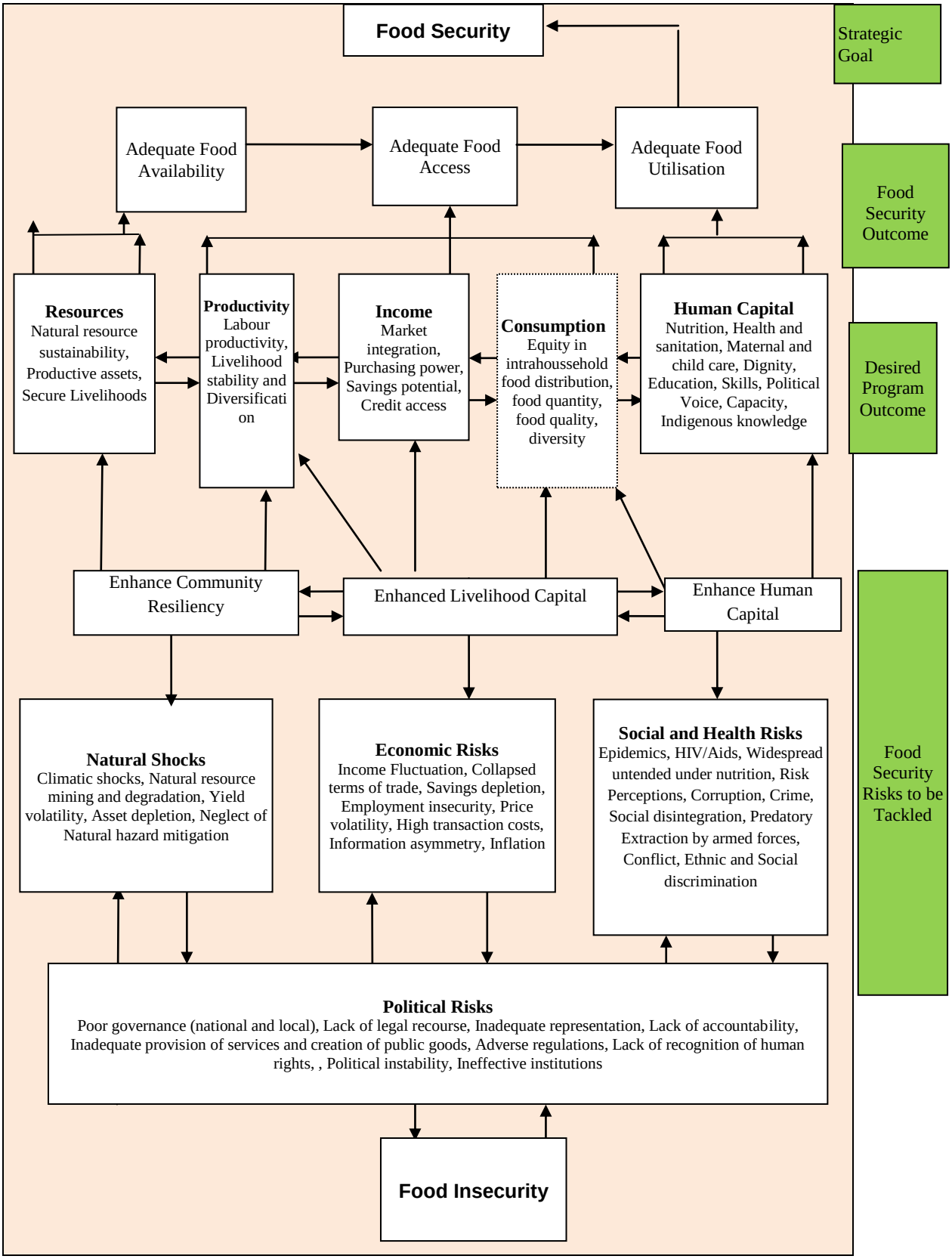


Figure 5.3 USAID's Expanded Conceptual Framework 3 of Food Insecurity

Source: (USAID 2007).

The first impression of USAID's second model is initially one of complexity. Closer examination however, reveals a well thought out framework showing a continuum of insecurity through to security. The structure of the framework is clear with relationships apparent and unambiguous. Also, while there are no non-relevant entities the model could

benefit from elucidation of certain constructs such as malnutrition, poverty *etcetera;* this might help frame or contextualise the food security concept. The model compares well against both the FAO and US definitions of food security incorporating the 4 pillars, while liberally expanding on the risk or stability aspect. One criticism is that it tends to be more prescriptive of solutions than descriptive of the situation. Having said that, where one stops and the other starts is one of subjectivity and beyond the purview of this study.

Another point to consider is the complexity of this model and the potentiality to overwhelm novice readers with too many textual cues. With regards to novelty, although this model shares similar properties to the FAO framework, there are certain new or novel elements exclusive to this model. In this framework, the notion of vulnerability is implied by the risk factors outlined,moreover, the whole framework in general places greater emphasis on a livelihoods approach, with assets and the associated social, economic and political infrastructure. This approach to understanding, places the focus, once again, on prevention (USAID 2007).

A summary of these model's evaluation scores is shown in table 5.1.

Table 5.2 Evaluation of Models 2 & 3 (results are highlighted)

Quality Criteria	Final Questions	Model 2 Scale	Model 3 Scale
Comprehen-siveness	A. The model fully reflects the pillars of availability, access, utilisation and stability	Disagree 1 2 3 **4** 5 Agree	Disagree 1 2 3 4 **5** Agree
	B. Most of the pillars of food security are clearly present (not ambiguous)	Disagree 1 2 3 **4** 5 Agree	Disagree 1 2 3 4 **5** Agree
	C. The model does not adequately portray the aspects of access, availability, utilisation & stability	Disagree 1 2 3 **4** 5 Agree	Disagree 1 2 3 **4** 5 Agree
New or Novel	D. The framework does not bring anything new to the concept	Disagree 1 2 **3** 4 5 Agree	Disagree 1 2 3 **4** 5 Agree
	E. The model introduces new insights into the food security definition	Disagree 1 2 3 **4** 5 Agree	Disagree 1 2 3 4 **5** Agree
	F. The model redefines traditional relationships	Disagree 1 2 **3** 4 5 Agree	Disagree 1 **2** 3 4 5 Agree
Selectivity	G. The relationships between the entities are clear and precise	Disagree 1 2 **3** 4 5 Agree	Disagree 1 2 3 **4** 5 Agree
	H. There are some entities that seem non-relevant	Disagree **1** 2 3 4 5 Agree	Disagree **1** 2 3 4 5 Agree
	I. There are entities noticeably left out	Disagree 1 **2** 3 4 5 Agree	Disagree 1 2 **3** 4 5 Agree
Specificity	J. The overall concept is properly elucidated/ clear	Disagree 1 2 **3** 4 5 Agree	Disagree 1 2 3 **4** 5 Agree
	K. The boundaries of the concept are properly defined	Disagree 1 2 **3** 4 5 Agree	Disagree 1 2 3 **4** 5 Agree
	L. The boundaries are blurred and need defining	Disagree 1 2 3 **4** 5 Agree	Disagree 1 2 **3** 4 5 Agree
Comparability	M. There are things that could be added to make the model clearer	Disagree 1 2 3 4 5 Agree	Disagree 1 2 3 4 5 Agree
	N. The model compares well to the food security definitions	Disagree 1 2 3 4 5 Agree	Disagree 1 2 3 4 5 Agree
	O. The definition is not reflected in the model	Disagree 1 2 3 4 5 Agree	Disagree 1 2 3 4 5 Agree
Simplicity	P. The overall concept is easily understood	Disagree 1 2 3 4 5 Agree	Disagree 1 2 3 4 5 Agree
	Q. There are quite a few variables but they work really well in a simple way	Disagree 1 2 3 4 5 Agree	Disagree 1 2 3 4 5 Agree
	R. The framework is unnecessarily complex	Disagree 1 2 3 4 5 Agree	Disagree 1 2 3 4 5 Agree

5.3 Model 4: Human Resources and Skills Development, Canada

In order to understand food security within their own borders, the government of Canada's Human Resources and Skills Development department developed the following conceptual framework; figure 5.4.

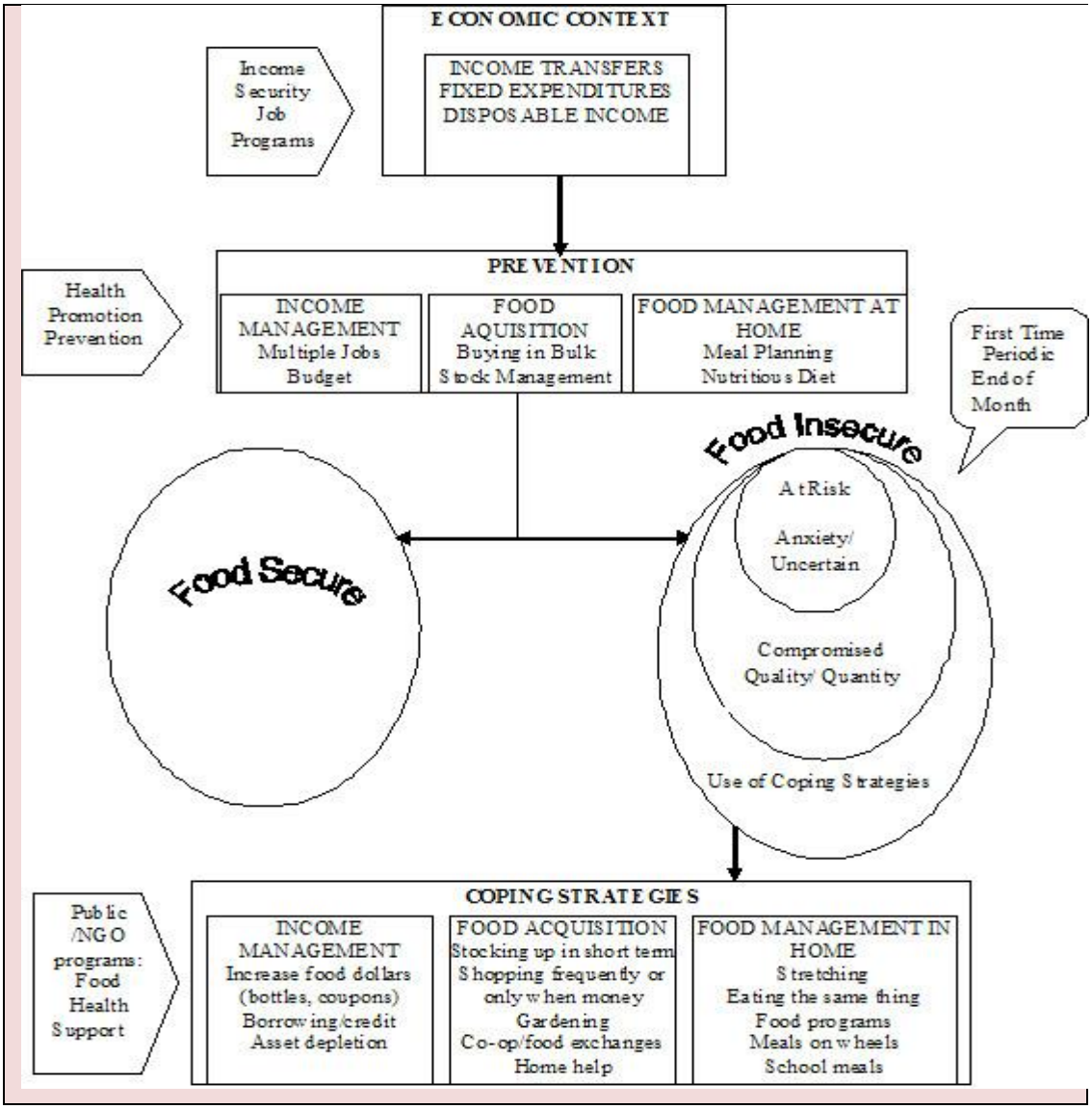


Figure 5.4 Human Resources and Skills Development Framework of Food Security

Source：(Rainville and Brink 2001).

The model determines that food security can be tackled from two perspectives; prevention and coping strategies. This is a novel approach, particularly in a prescriptive manner. However, in terms of description and the understanding of food security; this novelty does not add any great insight. Although having said that, this model does establish an income based strategy as prescriptive in preventative or coping strategies. This clear separation also involves health promotion and management yet, despite these advantages, the model seems unwieldy and in need of closer scrutiny.

Within the food secure - insecure continuum for instance, it is not clear what 'Compromised Quality/ Quantity' refers to. This could refer to reduced quantity and quality of the foods consumed as a result of food insecurity; eating cheaper, less desirable and maybe food of reduced safety. However, this is not clear. Such speculation clouds clarity and the reader is left with a degree of uncertainty over what is meant or implied. Furthermore and once again, this model takes a narrow approach to food security, highlighting some of the aspects of access, stability and utilisation, but with little consideration of availability. In this regard, the boundaries are not particularly clear, with many aspects missing and presented in a confusing way. While the model can be considered simple it is felt this has been achieved at the cost of clarity and, by extension, suffers in any comparability to the food security definition.

A summary of this models evaluation scores is shown in table 5.3.

Table 5.3 Evaluation of Model 4 (results are highlighted)

Quality Criteria	Final Questions	Scale
Comprehensiveness	A. The model fully reflects the pillars of availability, access, utilisation and stability B. Most of the pillars of food security are clearly present (not ambiguous) C. The model does not adequately portray the aspects of access, availability, utilisation & stability	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
New or Novel	D. The framework does not bring anything new to the concept E. The model introduces new insights into the food security definition F. The model redefines traditional relationships	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
Selectivity	G. The relationships between the entities are clear and precise H. There are some entities that seem non-relevant I. There are entities noticeably left out	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
Specificity	J. The overall concept is properly elucidated/ clear K. The boundaries of the concept are properly defined L. The boundaries are blurred and need defining	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
Comparability	M. There are things that could be added to make the model clearer N. The model compares well to the food security definitions O. The definition is not reflected in the model	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
Simplicity	P. The overall concept is easily understood Q. There are quite a few variables but they work really well in a simple way R. The framework is unnecessarily complex	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree

5.4 Model 5: Polly Ericksen, 2008

Ericksen, like others before her relies on a two part model that combines to form an overview of food security, figure 5.5.

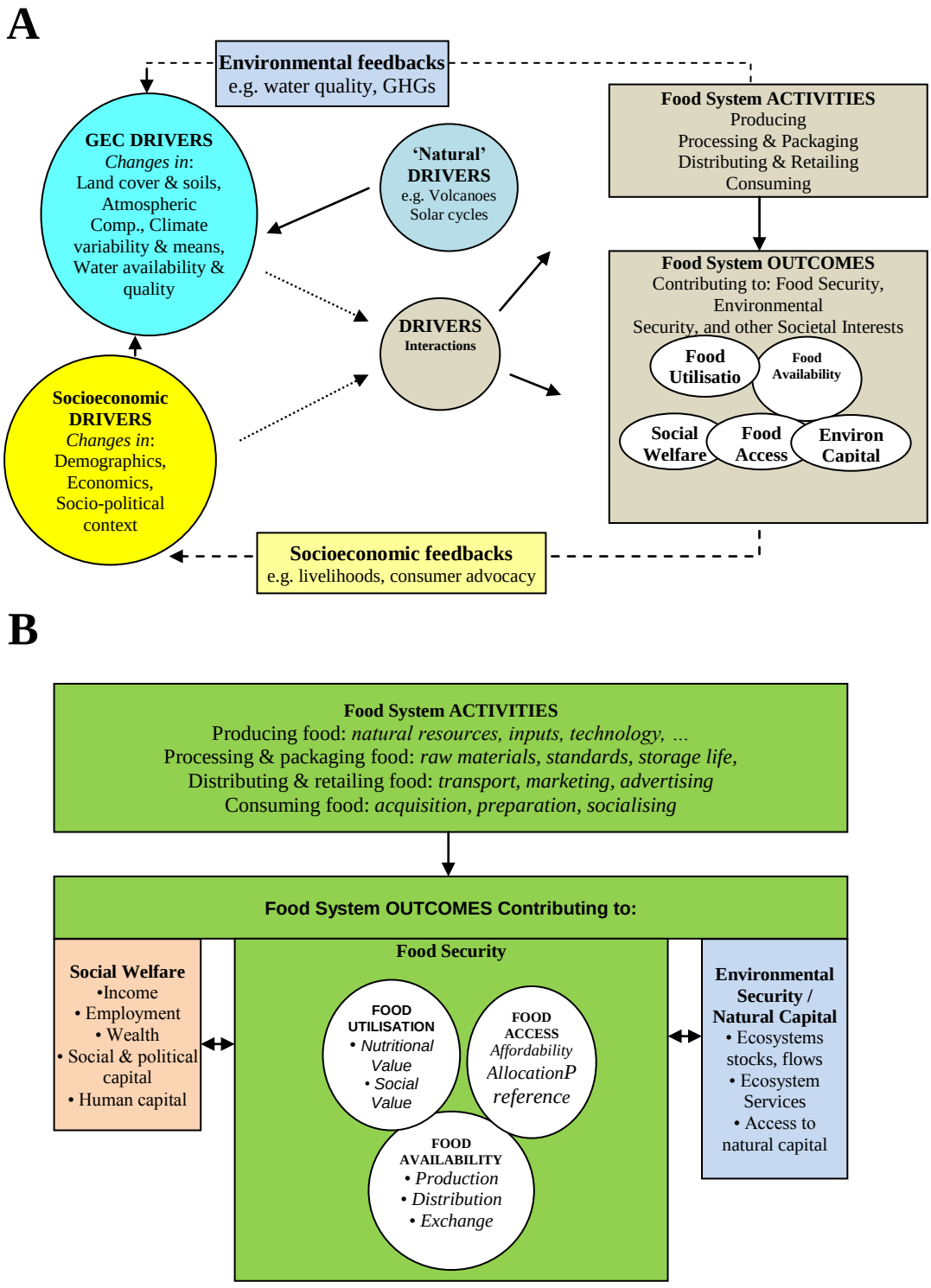


Figure 5.5: Ericksen's Food Security Framework

Source: (Ericksen 2008).

A new or novel approach exemplified in this model is the notion of feedbacks. This goes further than being suggestive of a two way relationship to depict a cyclic relationship. An example, as in the model, might be water, where improperly treated industry waste water might be used for the irrigation of crops. This in turn needs to be seen in context where

improperly treated water, risks adversely affecting future crop growth and ergo – food production factors. This model is replete with such feedback loops and is seen to come in two forms - environmental and socioeconomic. This is a sophisticated view of the macro environment of food security highlighting the risks inherent in the vulnerability or stability of the concept. Importantly too, Ericksen notes the expanding concept of the food system and links it to wider societal interests.

Model 'B' attempts to expand on the concept. The relationships of food access, availability and utilisation, although not explicitly connected, is satisfactorily implied by their enclosure and close proximity. While this might seem to go against the principles of lucidity expressed in previous models, in this instance the model does not appear to be adversely affected. All other relationships are clearly expressed and leave little room for conjecture; although the use of dotted lines (without a legend) might imply a tenuous link. Further extraneous variables are present, particularly the natural volcanic drivers *etcetera*, which are not out of place in its original context, but is superfluous from the food security perspective of this study.

It could be argued that the food security boundaries are actually well delineated; this is despite it being an environment based model. However, having said that, both models lack clear distinction between causality, influence and stability. While these, it could be asserted are inherent in the 'drivers', it could also be posited that in a general sense this would entail more than a passing knowledge of food security principles. This goes against the principles, as highlighted in this research, of having frameworks that can be used by novices and experts alike.

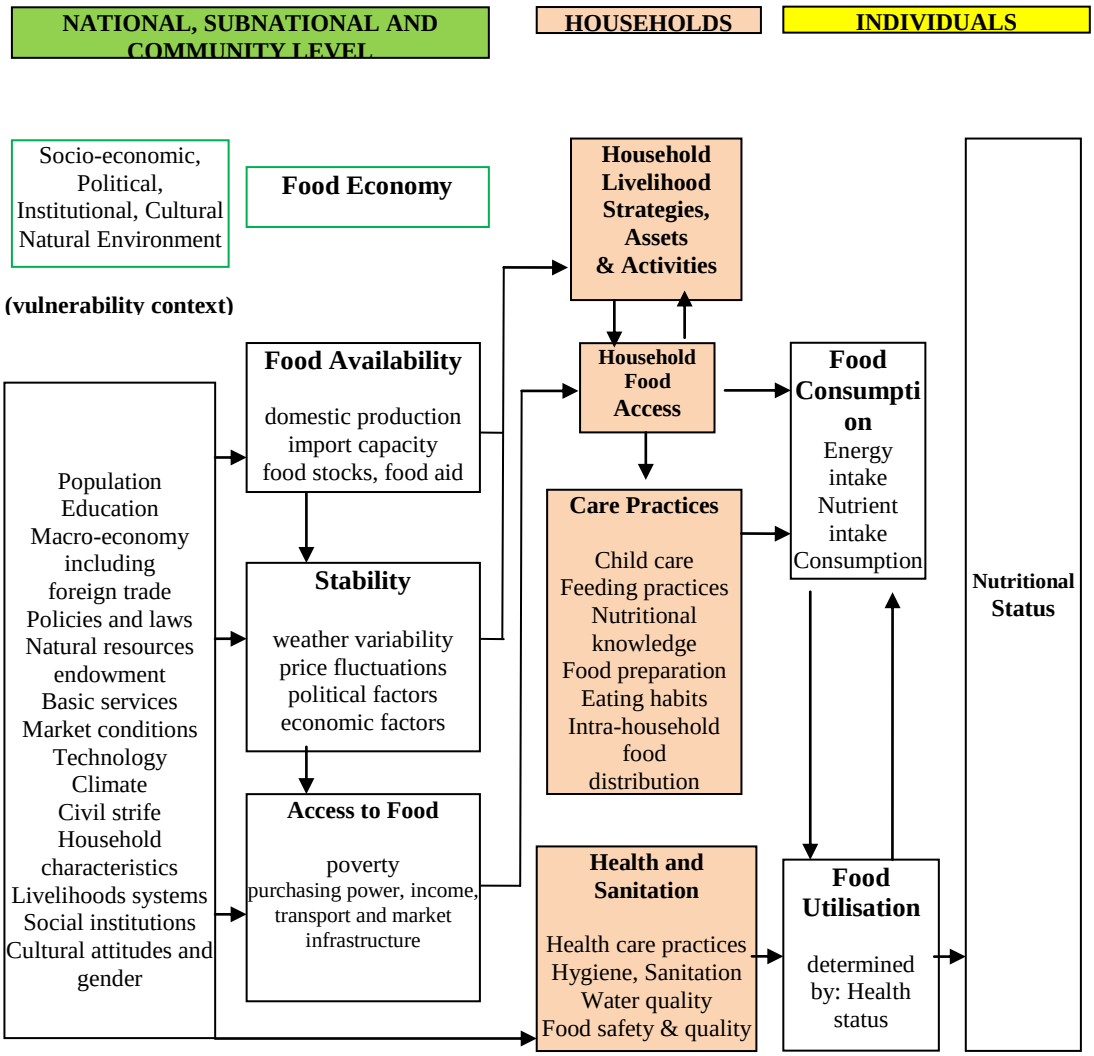
A summary of this models evaluation scores is shown in table 5.4.

Table 5.4 Evaluation of Model 5 (results are highlighted)

Quality Criteria	Final Questions	Scale
Comprehensiveness	A. The model fully reflects the pillars of availability, access, utilisation and stability B. Most of the pillars of food security are clearly present (not ambiguous) C. The model does not adequately portray the aspects of access, availability, utilisation & stability	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
New or Novel	D. The framework does not bring anything new to the concept E. The model introduces new insights into the food security definition F. The model redefines traditional relationships	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
Selectivity	G. The relationships between the entities are clear and precise H. There are some entities that seem non-relevant I. There are entities noticeably left out	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
Specificity	J. The overall concept is properly elucidated/ clear K. The boundaries of the concept are properly defined L. The boundaries are blurred and need defining	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
Comparability	M. There are things that could be added to make the model clearer N. The model compares well to the food security definitions O. The definition is not reflected in the model	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
Simplicity	P. The overall concept is easily understood Q. There are quite a few variables but they work really well in a simple way R. The framework is unnecessarily complex	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree

5.5 Model 6: Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS)

While semantically, stability and vulnerability, are clearly different things, separating them is almost superfluous. Vulnerability, in the context of the next model of food security figure 5.6, tends to be the result of risk, or exposure to liability ergo stability.



Source: (FIVMS 2008)

Figure 5.6: FIVIMS Model of Food Security

Having said that, the model chooses to split the national and community level vulnerability components of the concept into two distinct parts; socio-economic, political *etcetera* and the food economy. This is a new approach which for the first time clearly illustrates causality between the macro environment and the constructs of access, availability and stability. Another novelty, sees the separation of these constructs from utilisation; choosing instead to treat it as a function of health and sanitation, and food consumption. This clarifies the role of utilisation of food as being the end goal of nutritional status and, in doing so, redefines some of the classic previously held relationships. The relationships are clear with no seemingly extraneous variables and referring to its simplicity, the model is intuitive and easy to follow. The boundaries too, are clearly identified with the aid of subject divisions while referring the

model back to the definitions of food security it is a good representation of both the US and UN descriptions.

A summary of this models evaluation scores is shown in table 5.5.

Table 5.5 Evaluation of Model 6 (results are highlighted)

Quality Criteria	Final Questions	Scale
Comprehensiveness	A. The model fully reflects the pillars of availability, access, utilisation and stability B. Most of the pillars of food security are clearly present (not ambiguous) C. The model does not adequately portray the aspects of access, availability, utilisation & stability	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
New or Novel	D. The framework does not bring anything new to the concept E. The model introduces new insights into the food security definition F. The model redefines traditional relationships	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
Selectivity	G. The relationships between the entities are clear and precise H. There are some entities that seem non-relevant I. There are entities noticeably left out	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
Specificity	J. The overall concept is properly elucidated/ clear K. The boundaries of the concept are properly defined L. The boundaries are blurred and need defining	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
Comparability	M. There are things that could be added to make the model clearer N. The model compares well to the food security definitions O. The definition is not reflected in the model	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
Simplicity	P. The overall concept is easily understood Q. There are quite a few variables but they work really well in a simple way R. The framework is unnecessarily complex	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree

The results are discussed in the next section.

6 Findings

This research collected and analysed data regarding issues surrounding the food security concept *vis-à-vis* progress in the goals of facilitating understand as well as articulating an overarching perspective.. This was undertaken with the ultimate aim of introducing an updated conceptual model that would improve food security analysis. This chapter presents the findings of the research and as such, it is worth reiterating the research methodology flow diagram in figure 6.1. This also acts as a guide in the unfolding chapter.

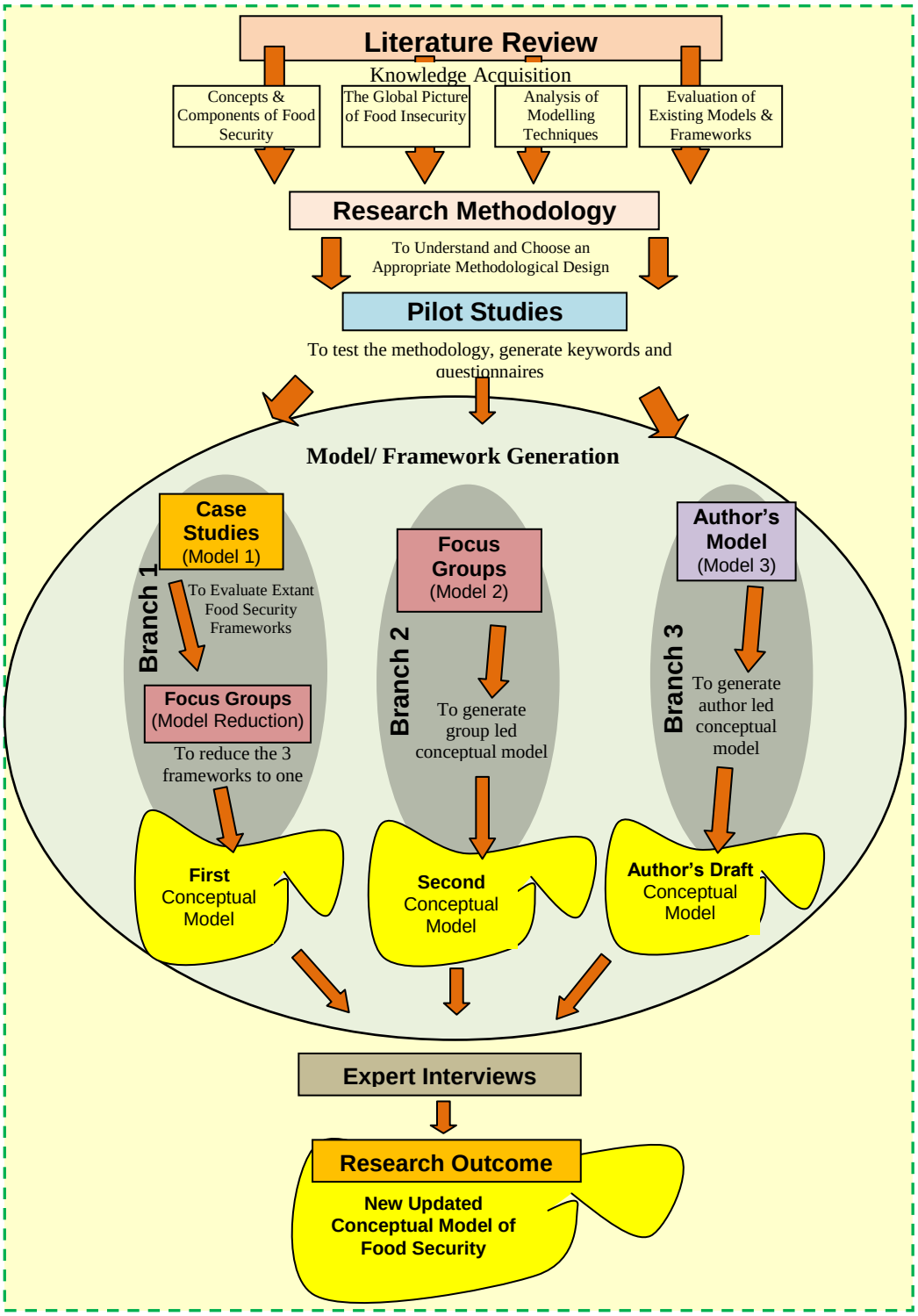


Figure 6.1 Flow Diagram of Research Methodology

6.1 Literature Review Findings

In the critical analysis of the literature, the first sections sought to bring a full overarching understanding of the concept of food security to this research. Moreover, only with this knowledge could the rest of the research be placed in context. That is to say any models created to successfully conceptualise the holistic phenomenon required a detailed analysis of the many issues involved. In this way, by examining the global picture of who was affected, how and, to what degree, the first few sections of this research were fully able to appreciate the concept's breadth and scope. Following this, the review then introduced some of the more fundamental and underlying issues surrounding the concept. This involved critical evaluations of the various determinants of food security as detailed by the multitude of stakeholders.

All in all findings from this review suggested that food security overwhelmingly exists as a complicated phenomenon, hampered by non-consensus and disagreement in many areas. Not only are many of the issues in contention, so too are the many proffered solutions. As a result, the literature provided this research with some fundamental understanding of the food security concept as one that is hard to precisely articulate or elucidate because:

- it exists on several planes both physically and temporally;
- is viewed differently by the many diverse groups of stakeholders;
- it involves matters of food and non-food issues;
- the breadth and scope of the issues to be included are difficult to elucidate;
- the issues themselves are dynamic and constantly changing with new drivers of insecurity intermittently emerging;
- the concept is beset with inherent problems of conceptualisation with interchangeable terminology and poorly defined concepts;
- food security cannot be directly measured;
- it lacks cohesion and consensus on the importance on certain points of causality and issues of solutions;
- food insecurity is widespread while progress continues to be slow

Armed with these findings the literature review then turned to the use of conceptual frameworks in understanding the phenomenon; how they were used and whether or not they were effective. From this analysis, one of the most important findings showed that the difficulties inherent in the topic itself, were also translated into the frameworks themselves. It also transpired that there was no single, overarching conceptual model that was universally accepted as being representative of the modern concept. In this absence, a much needed gap was identified which this research sought to fill. However, while literature on both modelling evaluation and creation techniques in social science was scarce this research found sufficient literature that enabled an effective assessment of the various methodologies involved in

model creation and analysis. Using the various methodolgies and, along with the single case study model (next section), two new models were created. Collectively these three models formed the basis of this research's findings. This are discussed along the lines of the three branches that were initially used to determine the frameworks.

6.2 Branch One – Existing Model Analysis Findings

Branch one of this research aimed to take 6 conceptual models from the literature review and analyse them to find a single overall existing model that best represented the food security concept. This was to be done in branch one using three stages; firstly the 6 models were subjected to case study analysis to determine the three highest scoring models. Secondly and thirdly, the three models were taken to focus groups to establish the best example of these existing models available which in turn was then taken forward (as one of three) to the expert interview stage of analysis

The six models were: 1) Food and Agriculture Organisation (FAO); 2) and 3) US Agency for International Development (USAID); 4) Human Resources and Skills Development, Canada; 5) Polly Ericksen, 2008; and 6) Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS).

6.2.1 Case Study Findings

Referring to the literature review the following 6 criteria of a model's quality; comprehensiveness, novelty, selectivity, specivity, comparability and simplicity were adapted in the form of an evaluative questionnaire containing eighteen questions in total. The suitability of these questions were piloted in the first stages of this research. Internal consistency in the form of Cronbach's Alpha had also been determined at the pilot stage and the resultant outcome gave a significant median value of 0.764 across the domains. Collectively, both tests were indicative of the suitability and strong internal reliability of the questionnaire. This ultimately strengthened confidence that the findings did indeed measure what it set out to measure. Table 6.1 summarises the individual model scores.

Table 6.1 Summary of Model Scores

Criteria	Question	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
1.Comprehensiveness	A	5	4	5	3	4	5
	B	5	4	5	4	4	5
	C	4	4	4	3	4	4
2.New or Novel	D	1	3	4	2	4	4
	E	1	4	5	1	5	4
	F	1	3	2	1	1	4
3.Selectivity	G	4	3	4	2	4	5
	H	4	5	5	1	4	5
	I	4	4	3	5	3	4
4.Specificity	J	4	3	4	2	4	5
	K	4	3	4	2	4	5
	L	4	2	3	2	4	4
5.Comparability	M	4	5	5	3	4	5
	N	3	4	4	2	3	4
	O	4	3	4	4	3	4
6.Simplicity	p	3	4	3	4	3	5
	Q	4	3	4	3	4	5
	R	4	3	4	5	4	3
Model Score		63	64	72	49	66	80
Top Three Scoring Models				2		3	1

Note: Q's C,D,H,I,L,M,O,R scores were flipped to represent their positive corollaries in this table.

Key: The above scores are aggregate Likert Scale scores for each model

.

In taking the output or the scores of these questionnaires (the Likert Scale responses), as discussed in the methodology, and treating it as interval data, it was possible to further subject these results to parametric analysis. This further strengthened the validity of these findings. As discussed in the methodology the chosen method for this involved standardising the results and then calculating the effect sizes of each score. In this way the corresponding scores were then used to determine a hierarchical order of preference.

However, before any parametric tests were carried out a test of the fit of the data was made out using the tests of kurtosis and skewness. The results of this analysis can be found in table 13.1 in appendix 13.1 and, as can be seen, there were no questions with both skewness and kurtosis outside the acceptable range of +2 and -2. Thus, with the results clustered around a single mean, the data was considered to be normally distributed and could therefore be justifiably analysed using the statistical analysis of effect size.

Table 6.2 Analysis of Model Scores

Case Study Model No.	Case Study Model Score	Cohen's *d* Effect Size (standard deviation units)	Percentile Equivalent	95% Effect Size Confidence Interval	
				Low	High
1	63	-0.258	39.82 %	0.80	1.47
2	64	-0.161	43.6 %	-0.79	1.46
3	72	0.613	73.01 %	-0.81	1.51
4	49	-1.614	5.33 %	-0.87	1.83
5	66	0.032	51.28 %	-0.79	1.46
6	80	1.388	91.74 %	-.085	1.73

Key: Cohen's *d* using SPSS determined Effect sizes.

In terms of ranges and relativity, a small effect size might be considered as falling between 0.2 to 0.3 while a medium effect size is approximately 0.5-0.8, while 0.8 and above can be thought of as large effect sizes. It can be seen that the difference in effect sizes range from -0.032 to 1.4 standard deviation units. While only one model. Model 6 was indicative of a large effect size the other models were be categorised as:

Large effect size – **model 6**;

Medium effect size – **model 3**;

Small effect size – **none**;

Minimal effect size – **models 5, 4, 2, 1**.

Further evaluation in the form of effect size confidence intervals, highlighted the significance of these scores and allowed for further insight into the relative strengths. By calculating the confidence intervals of all 6 models using Hedges and Olkin's formula, it was

seen that all bar one model (model 4), had CI values within the 95% significance ranges. Thus, taking into account the effect sizes and their corresponding percentile equivalents as well as ensuring the CI values were acceptable, it was noted that models 6, 3 and 5, from table 6.1, in that order scored the highest overall marks of quality.

These corresponded to:

Case study model 6 - Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS);

Case study model 3 - US Agency for International Development (USAID);

Case study model 5 - Polly Ericksen, 2008.

These findings are discussed in chapter 7.

6.2.2 Focus Groups – Literature Review Model Reduction Findings

The second stage of branch one invovled This round of numbered 3 focus groups in total, each with 6 participants giving a total of 18 datasets. Taking the three highest scoring models of the case studies above, these groups were asked to evaluate the remaining models, with the intention of reducing these to the one model displaying the best attributes of quality. After a brief PowerPoint introduction of the food security topic as suggested by the pilot study, respondents commented on the four pillars of access, availability, stability and utilisation. The PowerPoint proved useful in this endeavour with the majority, if not all, over the three groups, easily comprehending the basic premises.

Findings of this stage took two forms; the first was in the qualitative analysis method of Comparative Analysis using Nvivo software while the second was in the form of quantitative analysis using both parametric and non-parametric examination.

At the end of this stage the resultant chosen models by the group were renumbered from the case study outcomes in the following manner:

Model 1= Original case study model 3 - US Agency for International Development (USAID);

Model 2= Original case study model 6 - Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS);

Model 3= Original case study model 5 - Polly Ericksen, 2008.

Qualitative Analysis

Transcripts of the discussion can be found in an electronic addendum to this report (Focus Group Transcripts.doc) while discussion of the findings are reported in chapter 7.

Quantitative Analysis

The results of the three groups were subjected to two forms of analysis, parametric and non-parametric tests.

Non-Parametric Analysis - The non-parametric tests treated the data as ordinal and table 6.3, table 6.4, and table 6.5 detail the individual descriptive frequency analysis of the final three model scores. Note too, that in all three models the negative questions C,D,H,I,L,M,O,R scores had already been flipped to represent their positive corollaries. That is to say question C for example: 'The model does not adequately portray the aspects of access, availability, utilisation & stability', becomes – 'The model adequately portrays the aspects of access, availability, utilisation & stability'.

Table 6.3: Summary Descriptive Analysis of Model 1 - US Agency for International Development (USAID)

	Question	Model 1	Strongly disagree - number (%)	Disagree - number (%)	Undecided - number (%)	Agree - number (%)	Strongly agree - number (%)
Comprehensibility	A. The model fully reflects the pillars of availability, access, utilisation and stability	1	3 (17%)	1 (6%)	6 (33%)	1 (6%)	7 (39%)
	B. Most of the pillars of food security are clearly present (not ambiguous)	1	5 (28%)	2 (11%)	3 (17%)	3 (17%)	5 (28%)
	C. The model does not adequately portray the aspects of access, availability, utilisation & stability	1	3 (17%)	2 (11%)	4 (22%)	3 (17%)	6 (33%)
	Comprehensibility		**16 (30%)**		**5 (9%)**	**25 (46%)**	
New or Novel	D. The framework does not bring anything new to the concept	1	6 (33%)	4 (22%)	2 (11%)	2 (11%)	4 (22%)
	E. The model introduces new insights into the food security definition	1	3 (17%)	6 (33%)	3 (17%)	1 (6%)	5 (28%)
	F. The model redefines traditional relationships	1	6 (33%)	1 (6%)	4 (22%)	2 (11%)	5 (28%)
	New or Novel		**26 (48%)**		**11 (20%)**	**19 (35%)**	
Selectivity	G. The relationships between the entities are clear and precise	1	3 (17%)	6 (33%)	3 (17%)	4 (22%)	2 (11%)
	H. There are some entities that seem non-relevant	1	3 (17%)	2 (11%)	5 (28%)	4 (22%)	4 (22%)
	I. There are entities noticeably left out	1	3 (17%)	7 (39%)	2 (11%)	4 (22%)	2 (11%)
	Selectivity		**24 (44%)**		**15 (28%)**	**20 (37%)**	
Specificity	J. The overall concept is properly elucidated/ clear	1	6 (33%)	5 (28%)	3 (17%)	1 (6%)	3 (17%)
	K. The boundaries of the concept are properly defined	1	2 (11%)	4 (22%)	3 (17%)	5 (28%)	4 (22%)
	L. The boundaries are blurred and need defining	1	2 (11%)	4 (22%)	1 (6%)	5 (28%)	6 (33%)
	Specificity		**23 (43%)**		**13 (24%)**	**24 (44%)**	
Comparability	M. There are things that could be added to make the model clearer	1	8 (44%)	0 (0%)	4 (22%)	2 (11%)	4 (22%)
	N. The model compares well to the food security definitions	1	4 (22%)	2 (11%)	2 (11%)	5 (28%)	5 (28%)
	O. The definition is not reflected in the model	1	4 (22%)	6 (33%)	2 (11%)	4 (22%)	2 (11%)
	Comparability		**24 (44%)**		**8 (15%)**	**22 (41%)**	
Simplicity	P. The overall concept is easily understood	1	3 (17%)	6 (33%)	5 (28%)	0 (0%)	4 (22%)
	Q. There are quite a few variables but they work really well in a simple way	1	7 (39%)	4 (22%)	2 (11%)	3 (17%)	2 (11%)
	R. The framework is unnecessarily complex	1	3 (17%)	3 (17%)	3 (17%)	2 (11%)	7 (39%)
	Simplicity		**26 (48%)**		**13 (24%)**	**18 (33%)**	

Key: Frequency Analysis

Table 6.4: Summary Descriptive Analysis of Model 2 - Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS)

	Question	Model 2	Strongly disagree - number (%)	Disagree - number (%)	Undecided - number (%)	Agree - number (%)	Strongly agree - number (%)
Comprehensibility	A. The model fully reflects the pillars of availability, access, utilisation and stability	2	1 (6%)	4 (22%)	3 (17%)	3 (17%)	7 (39%)
	B. Most of the pillars of food security are clearly present (not ambiguous)	2	4 (22%)	4 (22%)	5 (28%)	3 (17%)	2 (11%)
	C. The model does not adequately portray the aspects of access, availability, utilisation & stability	2	6 (33%)	3 (17%)	3 (17%)	4 (22%)	2 (11%)
	Comprehensibility		**22 (41%)**		**11 (20%)**	**21 (39%)**	
New or Novel	D. The framework does not bring anything new to the concept	2	4 (22%)	3 (17%)	4 (22%)	3 (17%)	4 (22%)
	E. The model introduces new insights into the food security definition	2	2 (11%)	5 (28%)	3 (17%)	4 (22%)	4 (22%)
	F. The model redefines traditional relationships	2	2 (11%)	7 (39%)	3 (17%)	3 (17%)	3 (17%)
	New or Novel		**23 (43%)**		**15 (28%)**	**21 (39%)**	
Selectivity	G. The relationships between the entities are clear and precise	2	2 (11%)	4 (22%)	5 (28%)	4 (22%)	3 (17%)
	H. There are some entities that seem non-relevant	2	1 (6%)	3 (17%)	7 (39%)	2 (11%)	5 (28%)
	I. There are entities noticeably left out	2	1 (6%)	1 (6%)	6 (33%)	5 (28%)	5 (28%)
	Selectivity		**12 (22%)**		**8 (15%)**	**24 (44%)**	
Specificity	J. The overall concept is properly elucidated/ clear	2	0 (0%)	4 (22%)	4 (22%)	3 (17%)	7 (39%)
	K. The boundaries of the concept are properly defined	2	2 (11%)	5 (28%)	6 (33%)	3 (17%)	2 (11%)
	L. The boundaries are blurred and need defining	2	0 (0%)	3 (17%)	4 (22%)	4 (22%)	7 (39%)
	Specificity		**14 (26%)**		**12 (22%)**	**26 (48%)**	
Comparability	M. There are things that could be added to make the model clearer	2	1 (6%)	4 (22%)	6 (33%)	4 (22%)	3 (17%)
	N. The model compares well to the food security definitions	2	1 (6%)	0 (0%)	6 (33%)	7 (39%)	4 (22%)
	O. The definition is not reflected in the model	2	0 (0%)	5 (28%)	6 (33%)	3 (17%)	4 (22%)
	Comparability		**11 (20%)**		**9 (17%)**	**25 (46%)**	
Simplicity	P. The overall concept is easily understood	2	0 (0%)	5 (28%)	6 (33%)	4 (22%)	3 (17%)
	Q. There are quite a few variables but they work really well in a simple way	2	2 (11%)	2 (11%)	7 (39%)	4 (22%)	3 (17%)
	R. The framework is unnecessarily complex	2	1 (6%)	2 (11%)	8 (44%)	3 (17%)	4 (22%)
	Simplicity		**12 (22%)**		**9 (17%)**	**21 (39%)**	

Key: Frequency Analysis

Table 6.5: Summary Descriptive Analysis of Model 3 - Polly Ericksen, 2008

	Question	Model 3	Strongly disagree - number (%)	Disagree - number (%)	Undecided - number (%)	Agree - number (%)	Strongly agree - number (%)
Comprehensibility	A. The model fully reflects the pillars of availability, access, utilisation and stability	3	2 (11%)	5 (28%)	7 (39%)	1 (6%)	3 (17%)
	B. Most of the pillars of food security are clearly present (not ambiguous)	3	2 (11%)	4 (22%)	5 (28%)	2 (11%)	5 (28%)
	C. The model does not adequately portray the aspects of access, availability, utilisation & stability	3	6 (33%)	1 (6%)	3 (17%)	5 (28%)	3 (17%)
	Comprehensibility		**20 (37%)**		**10 (19%)**	**19 (35%)**	
New or Novel	D. The framework does not bring anything new to the concept	3	7 (39%)	1 (6%)	3 (17%)	4 (22%)	3 (17%)
	E. The model introduces new insights into the food security definition	3	6 (33%)	0 (0%)	3 (17%)	4 (22%)	5 (28%)
	F. The model redefines traditional relationships	3	5 (28%)	3 (17%)	4 (22%)	4 (22%)	2 (11%)
	New or Novel		**22 (41%)**		**4 (7%)**	**22 (41%)**	
Selectivity	G. The relationships between the entities are clear and precise	3	3 (17%)	3 (17%)	3 (17%)	2 (11%)	7 (39%)
	H. There are some entities that seem non-relevant	3	8 (44%)	4 (22%)	1 (6%)	1 (6%)	4 (22%)
	I. There are entities noticeably left out	3	3 (17%)	2 (11%)	4 (22%)	3 (17%)	6 (33%)
	Selectivity		**23 (43%)**		**9 (17%)**	**23 (43%)**	
Specificity	J. The overall concept is properly elucidated/ clear	3	4 (22%)	5 (28%)	4 (22%)	2 (11%)	3 (17%)
	K. The boundaries of the concept are properly defined	3	5 (28%)	6 (33%)	3 (17%)	1 (6%)	3 (17%)
	L. The boundaries are blurred and need defining	3	4 (22%)	1 (6%)	6 (33%)	1 (6%)	6 (33%)
	Specificity		**25 (46%)**		**12 (22%)**	**16 (30%)**	
Comparability	M. There are things that could be added to make the model clearer	3	2 (11%)	1 (6%)	9 (50%)	4 (22%)	2 (11%)
	N. The model compares well to the food security definitions	3	5 (28%)	5 (28%)	2 (11%)	3 (17%)	3 (17%)
	O. The definition is not reflected in the model	3	6 (33%)	3 (17%)	1 (6%)	3 (17%)	5 (28%)
	Comparability		**22 (41%)**		**9 (17%)**	**20 (37%)**	
Simplicity	P. The overall concept is easily understood	3	3 (17%)	6 (33%)	3 (17%)	3 (17%)	3 (17%)
	Q. There are quite a few variables but they work really well in a simple way	3	4 (22%)	3 (17%)	5 (28%)	3 (17%)	3 (17%)
	R. The framework is unnecessarily complex	3	2 (11%)	2 (11%)	7 (39%)	6 (33%)	1 (6%)
	Simplicity		**20 (37%)**		**11 (20%)**	**19 (35%)**	

Key: Frequency Analysis

Parametric Analysis

The overall ‘domains of quality’ scores were generally reflected equally among models and individuals making it very difficult to distinguish any clear overall outstanding model. In light of this and, with the symmetry of scaling and assumed equidistant response values of the Likert Scale diagram shown to respondents in the focus groups, it was felt the data would benefit from further parametric analysis. As with the case study results, the first test involved determining a test of the fit of the data set for distribution and flatness (skewness and kurtosis). Results of this analysis can be seen in table 13.2 in appendix 13.2 and once again acceptable ranges of +2 and -2 were applied.

Findings from the three models are outlined in the following tables 6.6, table 6.8 and table 6.10. It can be seen from these results all values closely clustered around the average. Furthermore, both measures of kurtosis and skewness also fell within the +2,-2 ranges further showing the data were normally distributed. This paved the way for parametric tests of effect sizes and confidence intervals of the data.

Model 1: US Agency for International Development (USAID)

Table 6.6: Focus Group Questionnaire Scores for Model 1

	Question	Model 1
Comprehensibility	A. The model fully reflects the pillars of availability, access, utilisation and stability	62
	B. Most of the pillars of food security are clearly present (not ambiguous)	55
	C. The model does not adequately portray the aspects of access, availability, utilisation & stability	61
		178
novelty	D. The framework does not bring anything new to the concept	48
	E. The model introduces new insights into the food security definition	53
	F. The model redefines traditional relationships	53
		154
Selectivity	G. The relationships between the entities are clear and precise	50
	H. There are some entities that seem non-relevant	58
	I. There are entities noticeably left out	49
		157
Specificity	J. The overall concept is properly elucidated/ clear	44
	K. The boundaries of the concept are properly defined	59
	L. The boundaries are blurred and need defining	63
		166
Comparability	M. There are things that could be added to make the model clearer	48
	N. The model compares well to the food security definitions	59
	O. The definition is not reflected in the model	48
		155
Simplicity	P. The overall concept is easily understood	50
	Q. There are quite a few variables but they work really well in a simple way	43
	R. The framework is unnecessarily complex	61
		154
	Total	**964**

Note: Negative scores are already flipped - i.e. 1=5 2=4 *etcetera*.

From model 1's data the following effect sizes and confidence intervals were measured (table 6.7). It is worth mentioning that, although the Cohen's *d* effect size of standard deviation units is technically a negative correlation, this is however, an accepted statistical anomaly as effect sizes measure the distance between means and distances can only be positive. In the case of the -0.446 result in model 1, this means the participants did not sufficiently differentiate between scores. In other words, there was too much variation of chosen answers and little consensus so as to render no discernable effect size.

Table 6.7 Analysis of Model 1 Scores

Focus Group Model No.	Focus Group Model Score	Cohen's *d* Effect Size (Standard Deviation Units)	Percentile Equivalent	95% Effect Size Confidence Interval	
				Low	High
1	964	-0.446	32.78	-0.93	2.31

Key: Cronbach's d determined Effect size

Model 2: Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS)

Table 6.8: Focus Group Questionnaire Scores for Model 2

	Question	Model 2
Comprehensibility	A. The model fully reflects the pillars of availability, access, utilisation and stability	65
	B. Most of the pillars of food security are clearly present (not ambiguous)	49
	C. The model does not adequately portray the aspects of access, availability, utilisation & stability	47
		161
novelty	D. The framework does not bring anything new to the concept	54
	E. The model introduces new insights into the food security definition	57
	F. The model redefines traditional relationships	52
		163
Selectivity	G. The relationships between the entities are clear and precise	56
	H. There are some entities that seem non-relevant	61
	I. There are entities noticeably left out	66
		183
Specificity	J. The overall concept is properly elucidated/ clear	67
	K. The boundaries of the concept are properly defined	52
	L. The boundaries are blurred and need defining	69
		188
Comparability	M. There are things that could be added to make the model clearer	58
	N. The model compares well to the food security definitions	67
	O. The definition is not reflected in the model	60
		185
Simplicity	P. The overall concept is easily understood	59
	Q. There are quite a few variables but they work really well in a simple way	58
	R. The framework is unnecessarily complex	61
		178
	Total	**1058**

Note: Negative scores are already flipped - i.e. 1=5 2=4 *etcetera*.

From model 2's data the following effect sizes and confidence intervals were measured (

table 6.9). The effect size of 1.145 is above the 0.8 significance threshold indicating there was clear consensus among the chosen answers of the questionnaire.

Table 6.9 Analysis of Model 2 Scores

Focus Group Model No.	Focus Group Model Score	Cohen's *d* Effect Size (Standard Deviation Units)	Percentile Equivalent	95% Effect Size Confidence Interval	
				Low	High
2	1058	1.145	87.39	-0.95	2.57

Key: Cronbach's d determined Effect size

Model 3: Polly Ericksen, 2008

Table 6.10: Focus Group Questionnaire Scores for Model 3

	Question	Model 3
Comprehensibility	A. The model fully reflects the pillars of availability, access, utilisation and stability	52
	B. Most of the pillars of food security are clearly present (not ambiguous)	58
	C. The model does not adequately portray the aspects of access, availability, utilisation & stability	52
		162
novelty	D. The framework does not bring anything new to the concept	49
	E. The model introduces new insights into the food security definition	56
	F. The model redefines traditional relationships	49
		154
Selectivity	G. The relationships between the entities are clear and precise	61
	H. There are some entities that seem non-relevant	43
	I. There are entities noticeably left out	61
		165
Specificity	J. The overall concept is properly elucidated/ clear	49
	K. The boundaries of the concept are properly defined	45
	L. The boundaries are blurred and need defining	58
		152
Comparability	M. There are things that could be added to make the model clearer	57
	N. The model compares well to the food security definitions	48
	O. The definition is not reflected in the model	52
		157
Simplicity	P. The overall concept is easily understood	51
	Q. There are quite a few variables but they work really well in a simple way	52
	R. The framework is unnecessarily complex	56
		159
	Total	**949**

Note: Negative scores are already flipped - i.e. 1=5 2=4 *etcetera*.

From model 3's data, the following effect sizes and confidence intervals were measured (table 6.11). The Cohen's *d* effect size of -0.700, as in model 1 highlighted that model 3 responses too, did not sufficiently differentiate between scores and registered no discernable effect size among mean scores.

Table 6.11 Summary Analysis of Model 3 Scores

Focus Group Model No.	Focus Group Model Score	Cohen's *d* Effect Size (Standard Deviation Units)	Percentile Equivalent	95% Effect Size Confidence Interval	
				Low	High
3	949	-0.700	24.2	-0.93	2.38

Key: Cronbach's d determined Effect size

It can be seen from these findings that model 2) FIVIMS framework had the highest effect size meaning there was clear consensus over the groups answers. The findings of both these and the above qualitative data are discussed in chapter 7.

6.3 Branch Two – Trochim's Conceptual Model Generation Findings

Branch two of the research aimed to generate the first of this research's two new concept maps based on the established methodology of Trochim and others.

6.3.1 Focus Groups – Trochim's Conceptual Model Generation

The second round focus groups were tasked with generating a new conceptual map based on the information they were given and which they came to understand as food security. The goal was to take novices of the subject and after a brief 10 minute PowerPoint presentation and discussion, take the ideas subsequently generated and formalise them in an intuitive concept map. As mentioned in the methodology (section 4.4), novices were chosen in this stage of the research to reflect the non-experienced demographic component of food security stakeholders. This provided both perspective and contrast to both the experienced literature review and this research author's generated models.

The novice generated map involved several steps properly described in the methodology but which can be summarised as Trochim's social scientific group led concept mapping process. The process comprised the generation of ideas; the structuring of ideas; the representation of statements; and the interpretation of the resulting maps. Altogether three focus groups of 6 individuals each from the sampling frame produced 18 individual sets of data that allowed for quantitative analysis using the methods outlined.

The first part of the session involved a PowerPoint demonstration followed by a brainstorming session on the variables associated with food security. In all three groups the PowerPoint presentation seemed to adequately outline the overall concept. This was strengthened in the proceeding brainstorming session that allowed individuals to discuss the various aspects of the ideas.

Findings

Transcripts of the above discussion can be found in an electronic addendum to this report (Focus Group Transcripts.doc) while discussion of the findings are reported in chapter 7.

Further findings included the actual generation of the model itself. This produced the following primary data.

Idea Generation

The above discussion was followed by the introduction of 100 separate keywords that the researcher had generated from the literature review, (appendix 14). These keywords were chosen as being representative of the multiple dimensions of the food security concept and were to be used as the basis of the concept maps to be generated. Further discussion allowed

for the group generation of extra statements or keywords. In the first group, an extra 4 statements were produced; the second saw 6 keywords deleted; while a further 3 more were added; a the third group decided there were sufficient keywords present. All individuals of the groups were then given copies of these ideas and asked, as individual's, to group these items as they saw fit. In accordance with Trochim's methods only two rules were applied; there could not be one pile of 100 statements nor could there be 100 piles of one statement. All 18 people over the three groups identified different groupings. Participants then rated each keyword or statement in order of importance in each pile. A numerically ordered rating with the most important item rated as number one and so on was adopted. After this, the named piles were identified by order of importance at the individuals discretion along the same lines as before. The results can be seen in Appendix 14.

Structuring Ideas

Once again following the strict procedure's outlined by Trochim, analysis of this data involved determining how these statements were related to each other. Initially the data was organised into individual similarity matrices representing the number of similarly sorted the statements. These relational groupings were identified using binary notation as in the example of one participant in table 6.12 .

The full 18 matrices for each participant in the focus groups are provided the electronic supplement to this thesis (Individual Similarity matrices for all participants' keywords.xls).

Table 6.12 Similarity Matrix of Participant A1 (part)

	Agricultural Investment	Agricultural Practices	Agricultural Yield /Productivity	Agrochemicals	Atmosphere	Balanced Food Intake	Biodiversity	Biotechnology	Carbon footprint	Care Practices	Changing Cropping Seasons	Climate change	Commodity Speculation	Crop rotation Practices
Agricultural Investment	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Agricultural Practices	0	1	1	1	0	1	0	1	0	0	0	0	0	1
Agricultural Yield /Productivity	0	1	1	1	0	1	0	1	0	0	0	0	0	1
Agrochemicals	0	1	1	1	0	1	0	1	0	0	0	0	0	1
Atmosphere	0	0	0	0	1	0	1	0	1	1	1	1	0	0
Balanced Food Intake	0	1	1	1	0	1	0	1	0	0	0	0	0	1
Biodiversity	0	0	0	0	1	0	1	0	1	1	1	1	0	0
Biotechnology	0	1	1	1	0	1	0	1	0	0	0	0	0	1
Carbon footprint	0	0	0	0	1	0	1	0	1	1	1	1	0	0
Care Practices	0	0	0	0	1	0	1	0	1	1	1	1	0	0
Changing Cropping Seasons	0	0	0	0	1	0	1	0	1	1	1	1	0	0
Climate change	0	0	0	0	1	0	1	0	1	1	1	1	0	0
Commodity Speculation	0	0	0	0	0	0	0	0	0	0	0	0	1	0

Key: n=1, Binary Matrix of Similarity

The table highlights the binary groupings in which individuals' associated keywords are categorised as belonging together. For instance, agricultural yield/productivity was associated, in this participants view, with agricultural practices, agrochemicals, balanced food intake and biotechnology. Matrices like these, were compiled for each of the 18 participants. The next step involved combining these 18 data sets to form an aggregated similarity matrix, representing the combined statements' groupings of all participants. A sample of the full table can be seen in table 6.13, while the full matrix are provided in the electronic supplement accompanying this research (Aggregate Similarity matrices for all participants' keywords.xls).

Table 6.13 Aggregated Similarity Matrix for 18 participants (2nd round Focus Groups)

	Agricultural Investment	Agricultural Practices	Agricultural Yield /Productivity	Agrochemicals	Atmosphere	Balanced Food Intake	Biodiversity	Biotechnology	Carbon footprint	Care Practices	Changing Cropping Seasons	Climate change	Commodity Speculation
Agricultural Investment	18	2	1	2	0	6	0	2	0	2	0	0	6
Agricultural Practices	2	18	8	16	0	6	0	14	0	0	0	0	0
Agricultural Yield /Productivity	1	8	18	10	0	5	0	9	0	0	0	0	1
Agrochemicals	2	16	10	18	0	6	0	16	0	0	0	0	0
Atmosphere	0	0	0	0	18	2	18	0	16	6	15	18	0
Balanced Food Intake	6	6	5	6	2	18	2	6	2	3	2	2	3
Biodiversity	0	0	0	0	18	2	18	0	16	6	15	18	0
Biotechnology	2	14	9	16	0	6	0	18	0	0	0	0	0
Carbon footprint	0	0	0	0	16	2	16	0	18	6	13	16	0
Care Practices	2	0	0	0	6	3	6	0	6	18	6	6	0
Changing Cropping Seasons	1	1	0	1	15	2	15	1	13	6	16	15	0
Climate change	0	0	0	0	18	2	18	0	16	6	15	18	0
Commodity Speculation	6	0	1	0	0	3	0	0	0	0	0	0	18

Key: n=18, Binary Matrix of Aggregated Similarity

This then became the input data for the multidimensional scaling analysis where the relational structure of the conceptual domain began to take shape.

Representation of Statements

Point Map

The multidimensional scaling (MDS) or multivariate analysis of the above data was achieved using the PROXSCAL function of SPSS (version 16) which calculated the monotonic weighted least-squares regression analysis of the statements values in a low-dimensional space. This produced a single value for each statement calculated from all the variables, indicating each statement's 'position' on a single axis. In this case within the 2-dimensional Euclidian space. These were then plotted on an X,Y graph (point-map); figure 6.2. In this way it can be seen from the data that statements which were sorted together more frequently appeared closer together on the map and also those that appear further from each other tended to be sorted together less frequently. The data was validated using PROXCAL's goodness of fit algorithm, represented by the normalised raw stress where 0 was considered a perfect fit while 1 was thought of as a poor fit. For these data the raw stress value, after 18 iterations was 0.05332 which strongly suggested that the monotonic transformation was a good fit to the original data.

From the following scatter graph then it was possible to see the beginnings of certain groupings of perceived related statements. However, while this map was suggestive of certain relationships (through their clustering) further analysis helped to elucidate these even more precisely.

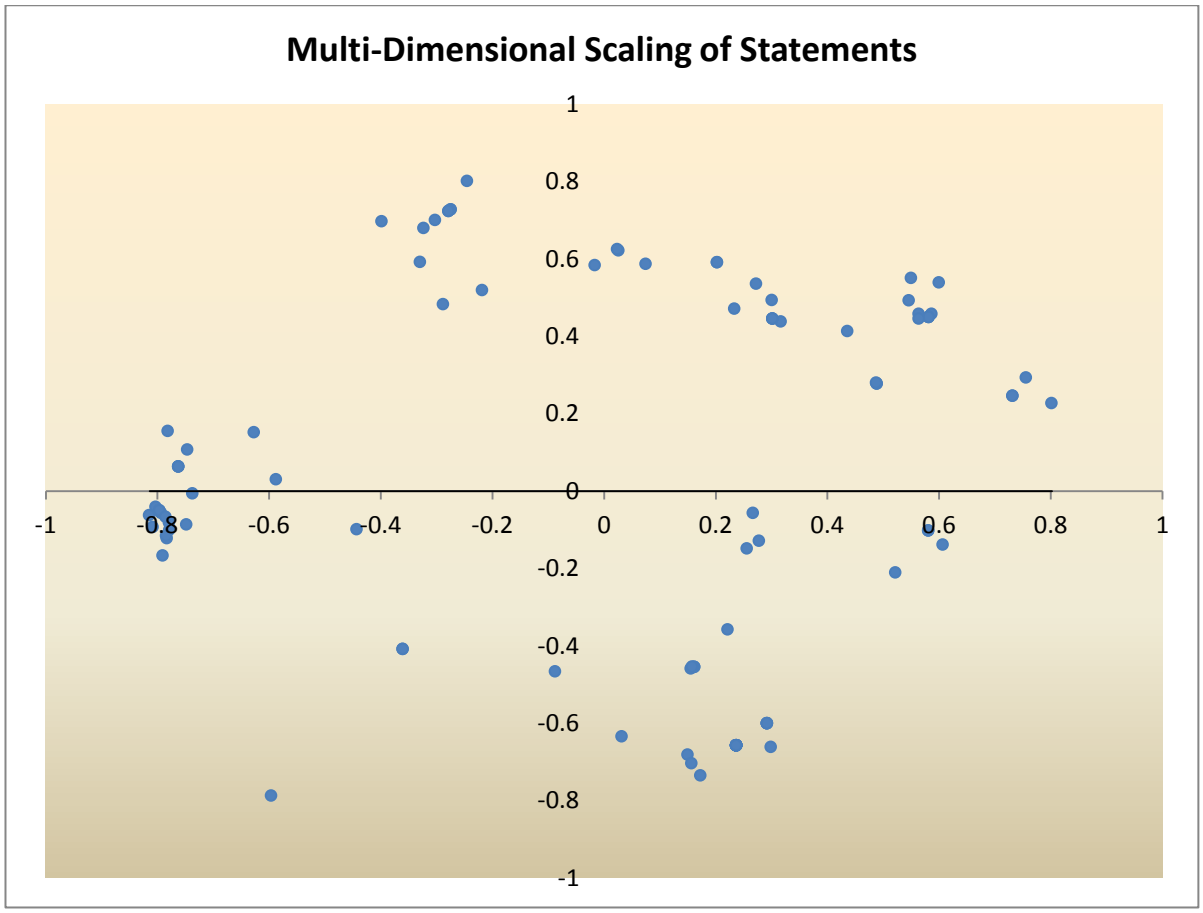


Figure 6.2 Multidimensional scaling or Point Map of Aggregated Similarity Matrices

Key: n=103, weighted least-squares regression analysis (MDS) was used to plot general clustered arrangements

This was achieved using the hierarchical cluster analysis (HCA) technique. As with MDS this aimed to group individual statements. As described in the methodology, this process involved using the X,Y bivariate data rather than the original similarity aggregates as input for the cluster analysis.

Cluster Analysis

Ward's hierarchical cluster analysis was employed using SPSS which, using the analysis of variance approach, analysed the matrix of squared Euclidean distances of hypothetical clusters. However, this method partitioned the point-map into several alternative combinations, or groups of clusters based on potential degrees or strengths of the relationships. With each potential number of clusters, so the clustering combinations were different. At this point, it was up to the researcher to determine the number of groups based on the most appropriate clusters. As a result it was tackled, as suggested from the literature

review, through the process of iteration, until such time as the best-fit became clear. This involved examining the output dendogram of all potential cluster formations and determining the most appropriate agglomerations. The initial dendogram can be seen in Appendix C Annex 2: Hierarchical Cluster Analysis. The analysis came up with 6 group solutions based on an increasing hierarchical tree, the total number of clusters in each group from 1-6 were 1,2,3,4,5 and 7 respectively. After examining the clustered groups it was felt that the solution containing the 7 clusters would be more appropriate as the smaller clustered groups contained too much variety, which as a result were considered too vague in their relationships. The final 7 clustered groups are shown in the table 6.14.

Table 6.14: Group Results for the Cluster Analysis Using Ward's Algorithm

Cluster 1
Environment and Natural Resources
Water footprint
Carbon footprint
Early Warning Systems
Energy in Agriculture
Scarcity of Freshwater
Soil erosion
Atmosphere
Pollution Greenhouse gases
Poor Land Management
Land Use Changes
Overgrazing
Energy Fossil Fuels
Genetically Modified Organisms
Deforestation
Economical Sustainability
Climate change
Debt and Structural Adjustment
Biodiversity
Changing Cropping Seasons
Inefficiency Wastage of water
Food Wastage
Dietary Guidelines
Care Practices
Desertification
Safe Water
Environmentalism
Green Revolution

Cluster 2
Macronutrients Lipids Proteins Carbohydrates
nutrients
Productivity
Humanitarian Intervention

Cluster 3
Crops used for seeds
Health Services
Sanitation
Population Sustainability
Sustainability
Environmental/Ecological Accounting
Natural Resource Allocation

Cluster 4
Agrochemicals
Pesticides Manufacture
Existing Health Status
General Political Enabling Environment
Science and Technology
Biotechnology
Food Aid
Government Politics
Intensive/Extensive agriculture
Irrigation
Crop rotation Practices
Agricultural Practices
Employment
Monoculture Practice
Agricultural Yield Productivity
Food for Biofuels
Food for Industrial Usage
Food Available For Human Consumption
Food Prices
Food for Livestock feed
Healthcare
Peoples Changing Diets
Balanced Food Intake

Cluster 5
Agricultural Investment
Physical Infrastructure
Individuals Livelihoods Entitlements
Market Integration
National Economy
Poverty Wealth
Cultural Traditions
Food Price Rises
Emergencies Crises
Inflation
Ecological footprint

Cluster 6
Commodity Speculation
Fertiliser Manufacture/Use
Gender Equality
Economic Development/Wealth
Shocks Natural Disasters
War Conflict and Social displacement
Political Will
Rights and Human Capital Development
Institutional Infrastructure
Fossil Fuels
Food for Seed
Political Stability
Social Stability

Cluster 7
Financial Stability
Human Rights
Policy Oversight
NGOs CSOs Charities Other Stakeholders
Land Rights
Safety Nets
Global Water Resource
Governance
Ecosystems
Freedom and Democracy
Human Food Consumption
Welfare Politics
Rural Urbanisation
Diseases Affecting Nutrition Utilisation
Education
Monitoring Measuring Food Security
Refugees

When transposed onto a scatter plot graph the above groupings become much clearer to see.

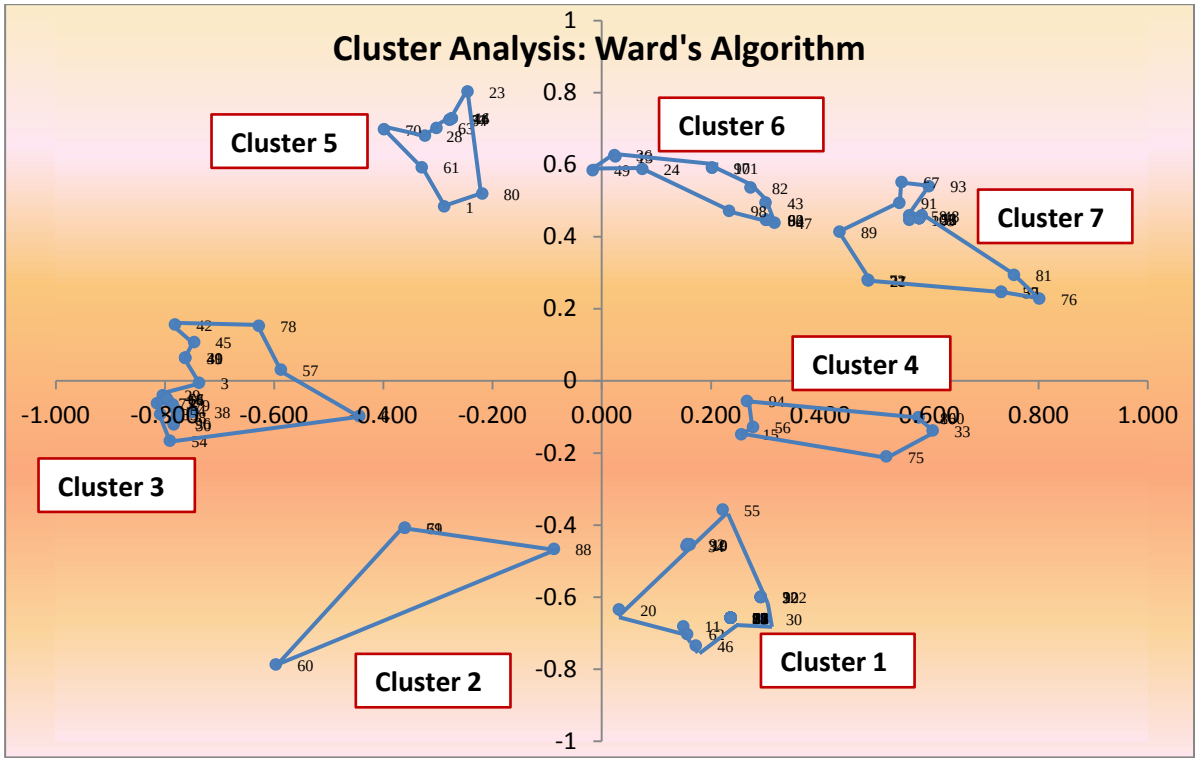


Figure 6.3: Scatter graph of Group Results for the Cluster Analysis

Key: n=103, Ward's algorithm used ANOVA to determine final cluster arrangement.

The fourth and final focus group in this round sought to name these groupings and establish consensus about any relationships that might have existed. An initial explanation outlined how the data had been analysed and what was expected of the group. The first part of the discussion focused on the clusters themselves, the naming of them and the suitability of the statements contained within.

The final clusters names were decided as follows:

Cluster 1 - Environment and Natural Resources

Cluster 2 - Food Intake/Availability

Cluster 3 - Sustainability

Cluster 4 – Agriculture and Food Production/Use

Cluster 5 - Economics

Cluster 6 – Politics and Stability

Cluster 7 – Governance and Responsibility

The next step involved organising these clusters into relationships. Cards were marked individuating each cluster and the group were specifically asked to elucidate any relationships to each other and to the food security concept in particular. Lines connecting any clusters were drawn and where necessary, arrows showed direction of influence or causality. No distinction was made between either influence or causality and nor were the

group asked to denote any perceived strength of relationship. The group were given the option to add, if they felt it was needed, any further conceptual boxes or annotations that might be needed or was lacking.

As a result, the group decided (agreed upon by all ten participants) that their final model, figure 6.4 spoke for itself and no further additions were needed

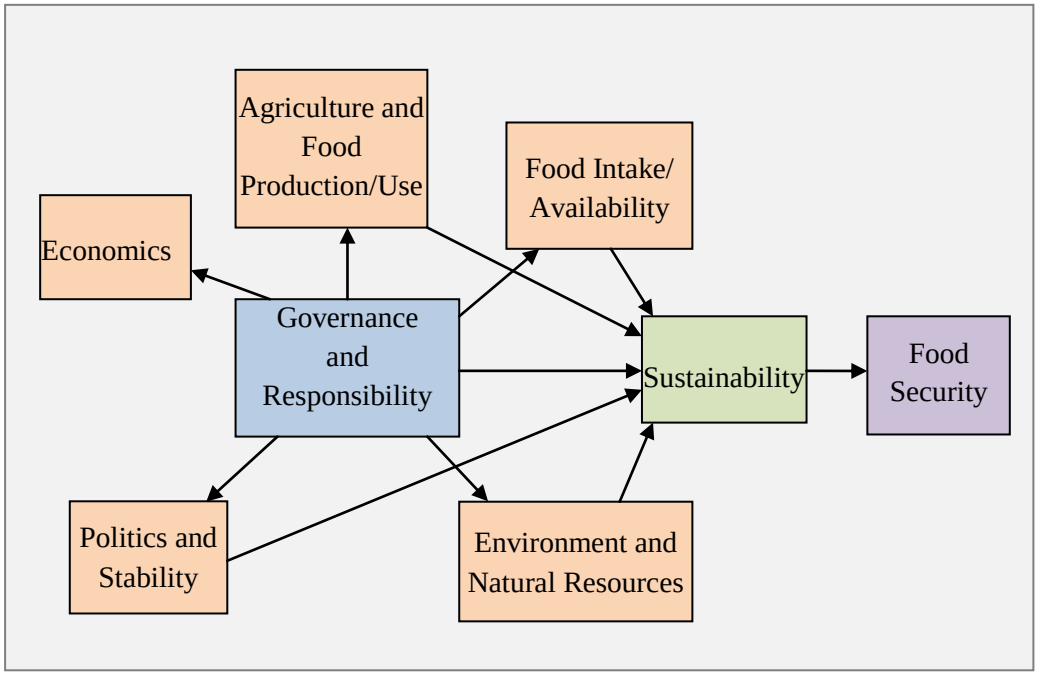


Figure 6.4: Focus Group Generated Conceptual Model

Key: n=10, focus group generated final relationships

Finally through insight and consultation a simple intuitive framework was proposed. This model (focus group generated) was then ready for use in the expert interview stage of this research.

A discussion of these findings is presented in chapter 7.

6.4 Branch Three – Author's Model Findings

Branch three of this study aimed to generate the second of the two new concept maps. This model was based on the author's experience. In determining the author's first draft model, a great deal of information was considered. In general, the literature review showed that despite some good work by a few practitioners there was still a distinct lack of direction, regarding a suitable scientific approach to social science model making. To compensate, this research built on what direction there was to develop a set of guidelines for use in the construction of its framework. This involved the compilation of a single methodology based on several existing ideologies and approaches; these are outlined in the methodology.

Keywords

The first step entailed a thorough literature review of the concept which highlighted many important concepts. This was translated into distinct keywords or phrases that best described the phenomenon. These numbered 153 and are displayed in Appendix E: Author's Models Keywords.

Mind Mapping the Ideas

The second step involved organising these data. This involved categorising this data according to perceived or assumed relationships. The data was organised into a mind map of generalised relationships and associations. Little attempt was made to organise the data at this point. The goal instead was simply to aggregate as much of the data as possible into approximate relationships. For this the Visual Understanding Environment (VUE) software was utilised as it was intuitive to use and offered sufficient technical assistance were it required. The results can be seen in Figure 6.5 Authors Mind Map of the Food Security Concept.

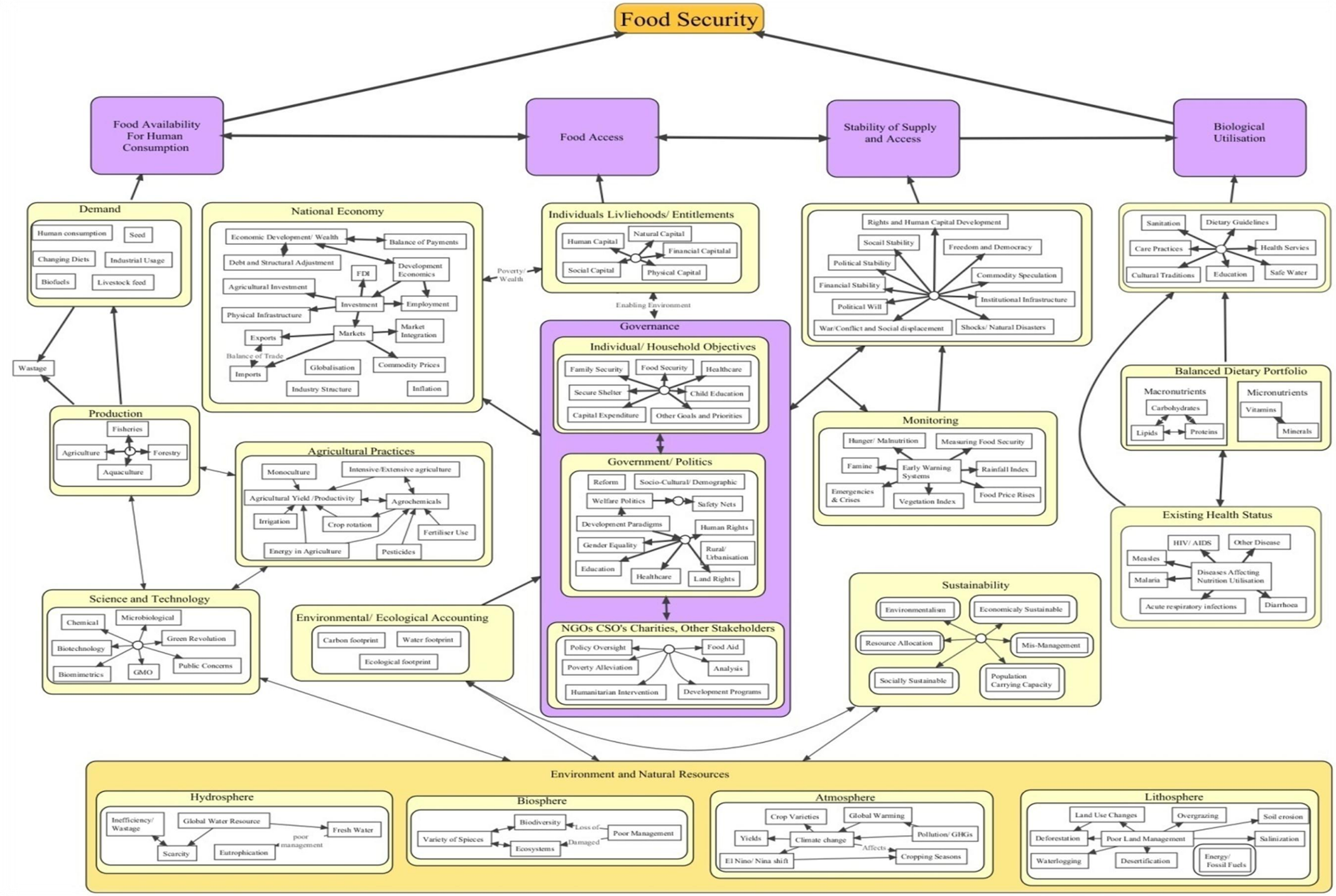


Figure 6.5 Authors Mind Map of the Food Security Concept

Key: n=153, literature review generated keywords plotted against perspective groups and relationships

It can be seen from the above map that the general base structure of the 4 pillars of food security as denoted by the FAO and others was duplicated here. This was because after a thorough analysis and, bearing in mind the goal of this model was not to redefine food security but simply attempt to best represent the existing concept, it was felt that these four principles stood up under scrutiny as still current and relevant to the modern concept.

It can also be seen from the above mind map, that as a model there was too much going on which violated an important principle of model quality – simplicity. Importantly then, the next stage concerned taking this map and translating it into a more coherent and simplified conceptual framework. Two things were considered important in this endeavour. Firstly, the quality criteria of the evaluative questions were taken into account when considering which variables, how many to use, as well as the scope and breadth of the intended final framework. Secondly, Wand's ontological principles of consistent elucidation and rigorous application of variables and relationships was to be observed throughout the process.

In achieving this, the first goal was to overlay the constructs involved in the debate onto the variables themselves. This helped identify which variables belonged to which construct and helped formalise the relationships of influence or causality. This process also aided in distinguishing constructs and concepts from entities or variables. The results are shown in figure 6.6.

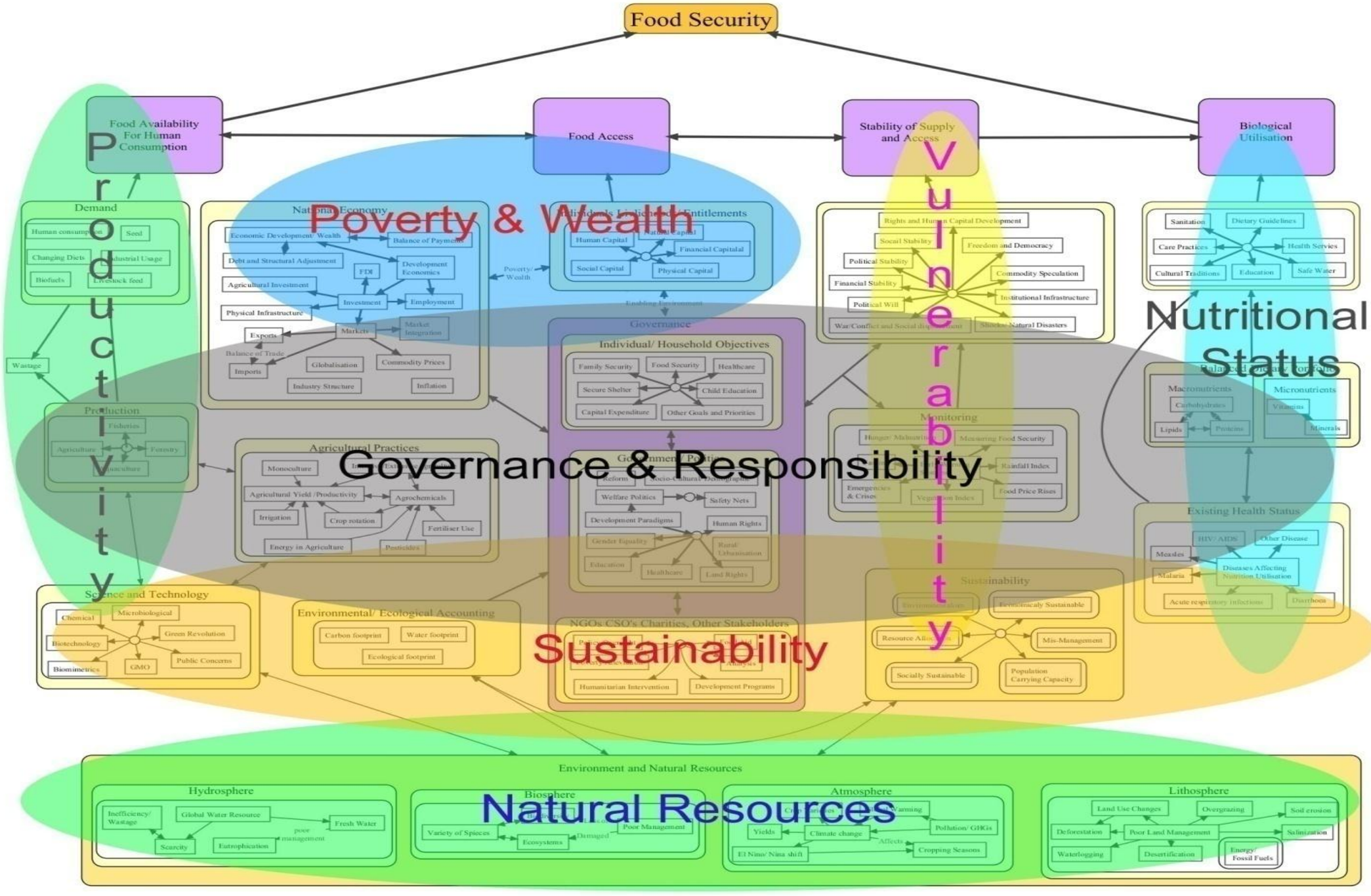


Figure 6.6 Mind Map with Constructs

Key: n=153, literature review generated keywords super-imposed with generalised concepts

Note that in this representation the size of each construct is not reflective of its relative importance rather it simply serves to visualises the many different variables each construct touches upon.

The next stage involved translating this mind map into a conceptual framework that could be understood more readily.

Interpreting the Mind Map

In taking these ideas and condensing them into a framework involved determining which of the variables to use, omit or expand upon. It was felt that many variables existed as sub-units of other variables which could then be used as representative headings. Using this idea the following tentative framework was drawn up.

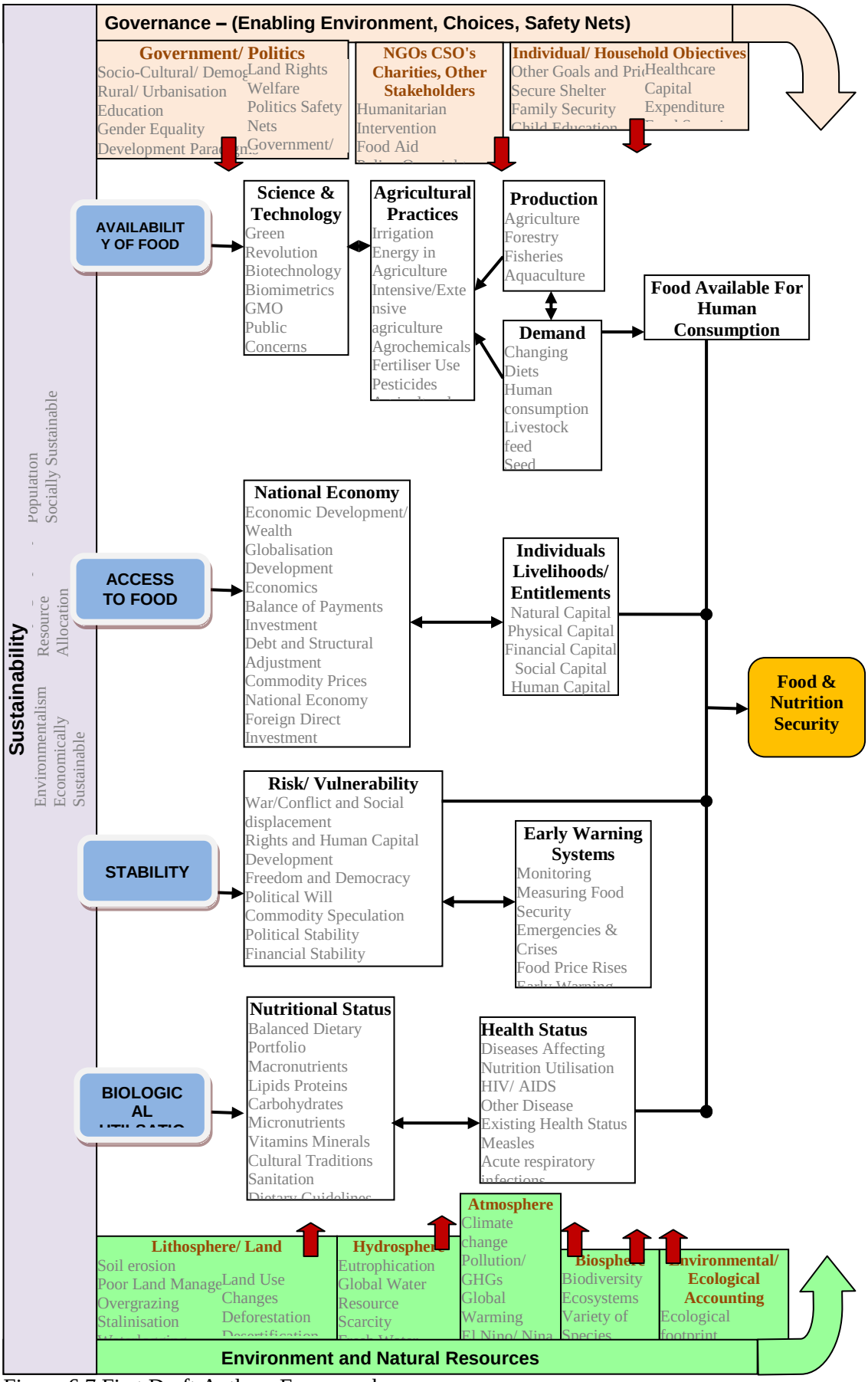


Figure 6.7 First Draft Authors Framework

Key: first draft interpretation of mind map

While this first draft helped elucidate the relationships or associations, it was felt there was still perhaps too much in the way of textual information. However before this was could be addressed or finalised, the above model, along with the other two models was evaluated at the interview stage.

6.5 Specialist/Expert Interviews

The role of the specialist interviews in this study was threefold. Firstly, to bring to the research valuable insight of the factors behind the food security concept; secondly to comment on conceptual frameworks in general; and thirdly to evaluate the three specific conceptual frameworks of this study.

To refresh, the three frameworks comprised: Model One, the framework evaluated as the best example from the literature review; Model Two, the focus group generated food security concept map using Trochim's methodology; and third this research author's own model of food security. These are summarised in the figure 6.8.

Model One

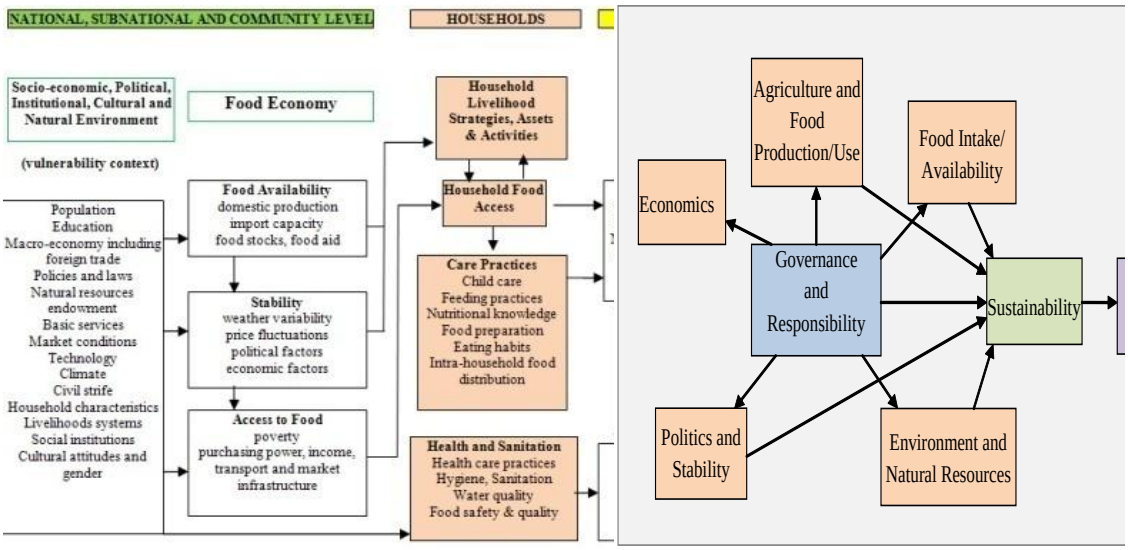
Literature Review Model Reduction:

FIVIMS – *Food Insecurity and Vulnerability Information and Mapping System*

Model Two

Trochim's Conceptual Model Generation:

Food Security Concept Map



Model Three

Author Generated First Draft Food Security Concept Map

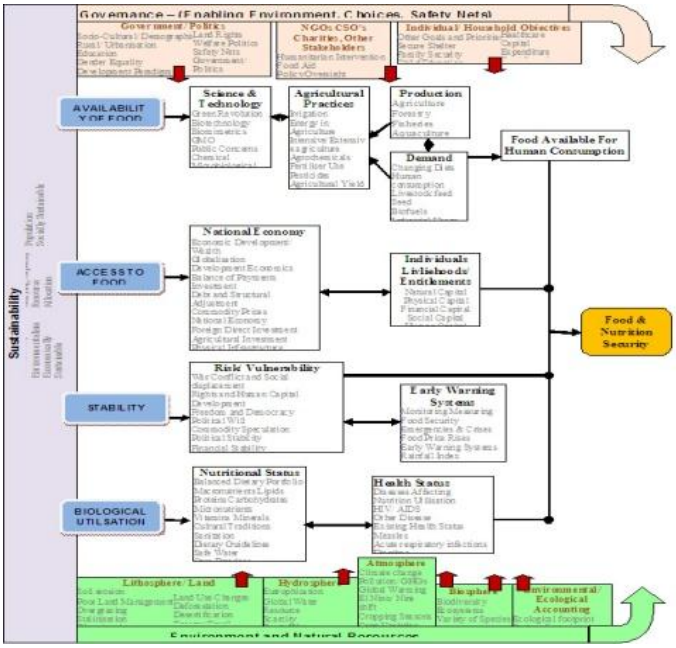


Figure 6.8 Summary of the Three Finalised Conceptual Frameworks

Findings

To determine the specialists to be used in this study an online forum was held between 10 October To 23 November 2010. The forum was conducted via the UN FAO Agricultural Development Economics Division's (ERS) Global Forum on Food Security and Nutrition (FSN Forum). This author was informed through talks with the FSN forum moderators, that this particular platform was frequented by many specialists and non-specialists alike. Through this medium a discussion was initiated, whereby participants were asked to comment on any of the following questions.

- Do the current FAO, US and other definitions of food security adequately serve the modern notion of food security?
- As well as the accepted notions of Availability, Access, Utilisation and Stability, are there any other fundamental constructs that could be further added to improve the holistic understanding of the concept?
- With regards to food security frameworks and models, particularly the diagrammatic types (DFID livelihoods; FIVIMS food security; FAO livelihoods *etcetera*): are these easy to understand, do they portray a good idea of the concept?
- are there any common or recurring errors, omissions or ambiguities?
- if you could improve on any of these how would you do so?
- Is there sufficient understanding of the concept of food security: is there one website or book that teaches all about food security in a simple intuitive fashion?

The participants were informed that their responses might form part of this research and that, by engaging in the research approval was implied. Secondly, the respondents were also informed that further assistance might be asked of those willing to participate in further discussion. The above questions were designed to open a wide ranging conversation, attracting as many different viewpoints as possible in an environment was friendly and non-intimidating. It was open to members of the FSN (numbering many thousands) and through special invitation from discussions held between Max Blanck (forum administrator) and myself. The responses served two purposes, the first was to provide further insight into the dynamics of food security and associated issues and the second to act as the cohort from which the population and sample of the needed experts could be determined.

Total respondents numbered 23 of which 14 were considered specialists against the following criteria:

- Their credentials – relevant qualifications or experience in food security
- Previous or current work experience in the field of food security
- A contributing member of a food security related network, charity or Non-Governmental Organisation *etcetera*

These were:

E1 - A Consultant of the FAO Sub-regional Office for Southern Africa, Harare, Zimbabwe.

E2 – An FAO Food Security, Nutrition and Livelihoods Advisor, Afghanistan.

E3 - Purpose Group International's director of international programs, India.

E4 - A former National Coordinator for the Food Security Bureau of Canada, Canada.

E5 – A retired FAO agricultural economist.

E6 - An Information and Communication Officer for the Food Security Information for Action Programme FAO, Italy.

E7 - A former chief statistician at FAO Mauritius.

E8 - Founder & Executive Chair, Adjunct Professor of Sustainable Agriculture at Himalayan College of Agricultural Sciences & Technology (HICAST), Nepal.

E9 – A Senior Economist with FAO Food Security and Agricultural Projects Analysis Service.

E10 – An Alternative Development Consultant, FAO Italy. Rome FAO, Cambodia.

E11 - Visiting Scholar at the Population Reference Bureau in Washington, DC, adjunct, an associate professor of Population and Development, Institute of Population Studies, Addis Ababa University, Ethiopia.

E12 – A member of the Knowledge and Communication Department,. Knowledge Exchange and Capacity Building Division, Italy.

E13 - Head, Monitoring and Evaluation Specialist National Programme for Agriculture and Food Security, Nigeria.

E14 - The Deputy Chief of WFP's Food Analysis Service.

The above population group were all invited to participate in the follow-up interview. Six of the above group responded and agreed to further interview questions. The specialists who responded were **E3, E4, E11, E7, E12** and **E14**.

The full transcript of this forum is provided in the electronic addition (Proceedings of global forum food security network discussion.doc) to this research while discussion and analysis can be seen in chapter 7.

6.6 Author's Final Improved Model

Both the forum and the interviews offered much relevant feedback providing a rich seam of experience in the overview of both food security in general and in conceptual frameworks in particular. These comments are reviewed in the discussion in chapter 7. Suffice to say the feedback led to the uncovering of several idea's for the improvement of the models both

specifically and in general. This research amalgamated several of these idea's and through iteration, applied these to the author's original first draft. After seeking clarification in a couple of incidents regarding the improved framework the final draft model was created.

The Three Model Approach

One of the main concerns was of the complexity of the original author's first draft model. Aiming to elucidate the concept for all levels of food security stakeholders was always a difficult task. However, thinking back to Polly Ericksen's two-in-one model there were comments made regarding the usefulness of having more than one model. The idea of separating the model into different levels of complexity seemed a novel and potentially useful approach. As a result, improvements were made to the original author's model reworking it into three models starting at the simple and increasing in complexity and coverage with each incarnation. This final draft it was felt (following three figures), adequately captured most of the essence of the specialists comments and provides a good representation of the overall phenomenon of food security.

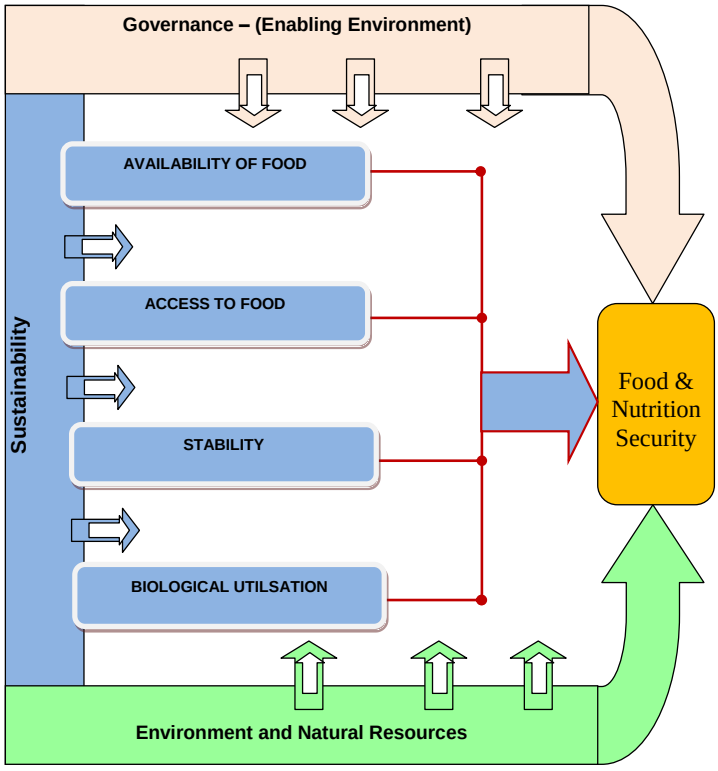


Figure 6.9 Author's Final Conceptual Model of Food Security: Part 1

Key: final draft author's interpretation of mind map produced through iteration of ideas, part 1

It can be seen that part 1 of the trio (figure 6.9) is not too dissimilar to the basic FAO framework although it does elucidate the surrounding sustainability, environment and governance constructs. It is felt as an introduction to the concept this model is both simple and intuitive and offers the best abbreviation of the food security concept for beginners. The following model is part 2 and builds on the above part 1.

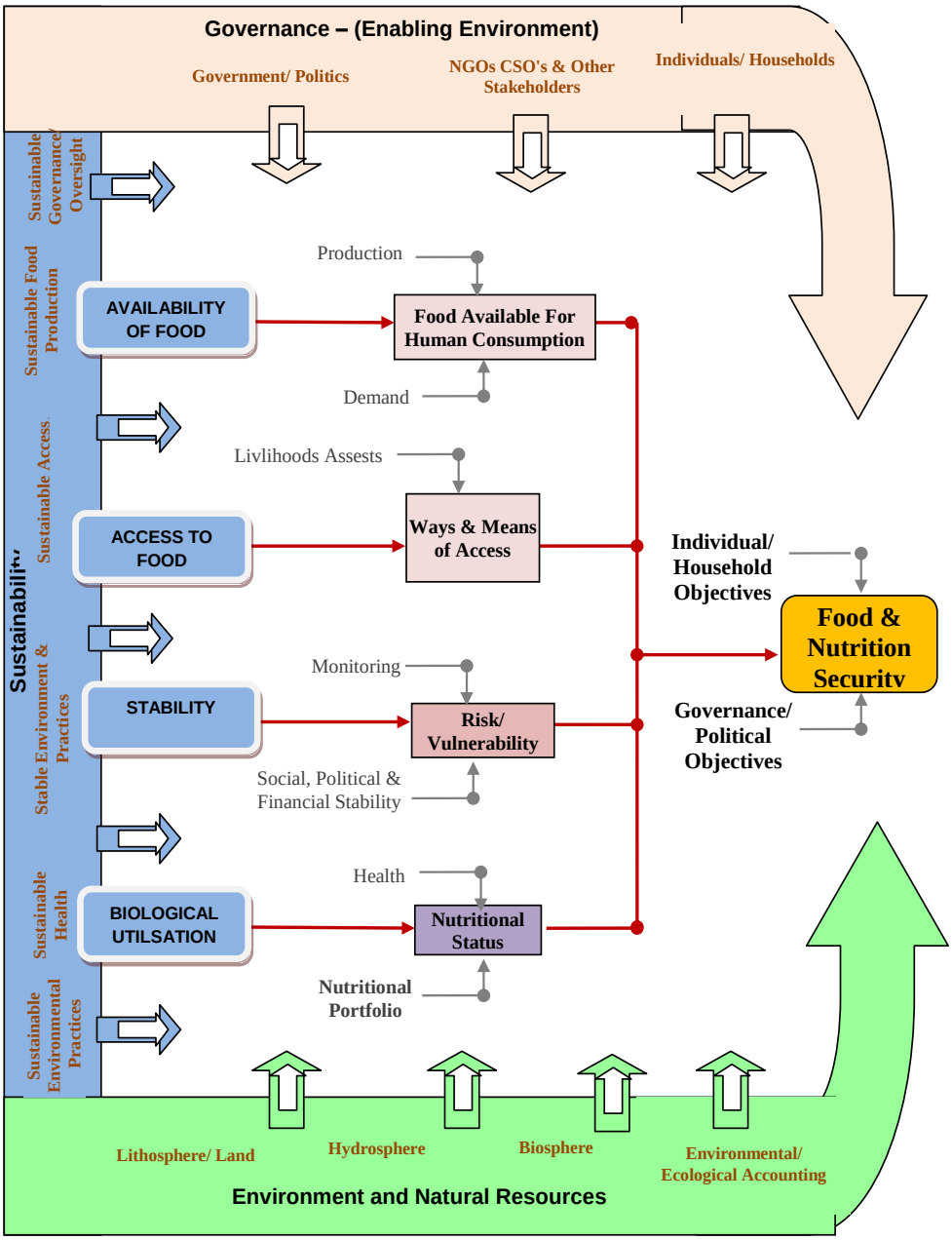


Figure 6.10 Author's Final Conceptual Model of Food Security: Part 2

Key: final draft author's interpretation of mind map produced through iteration of ideas, part 2

Building on Part 1, the above model (figure 6.10) adds a level of detail, specifically an extra layer of information between the 4 pillars and the final food security outcome. This highlights, in a very simplified way, the variables involved in bridging the gap between the 4 pillars to the end goal of food security. The various colours solely aim to show clusters of similar variables and do not necessarily highlight relationships.

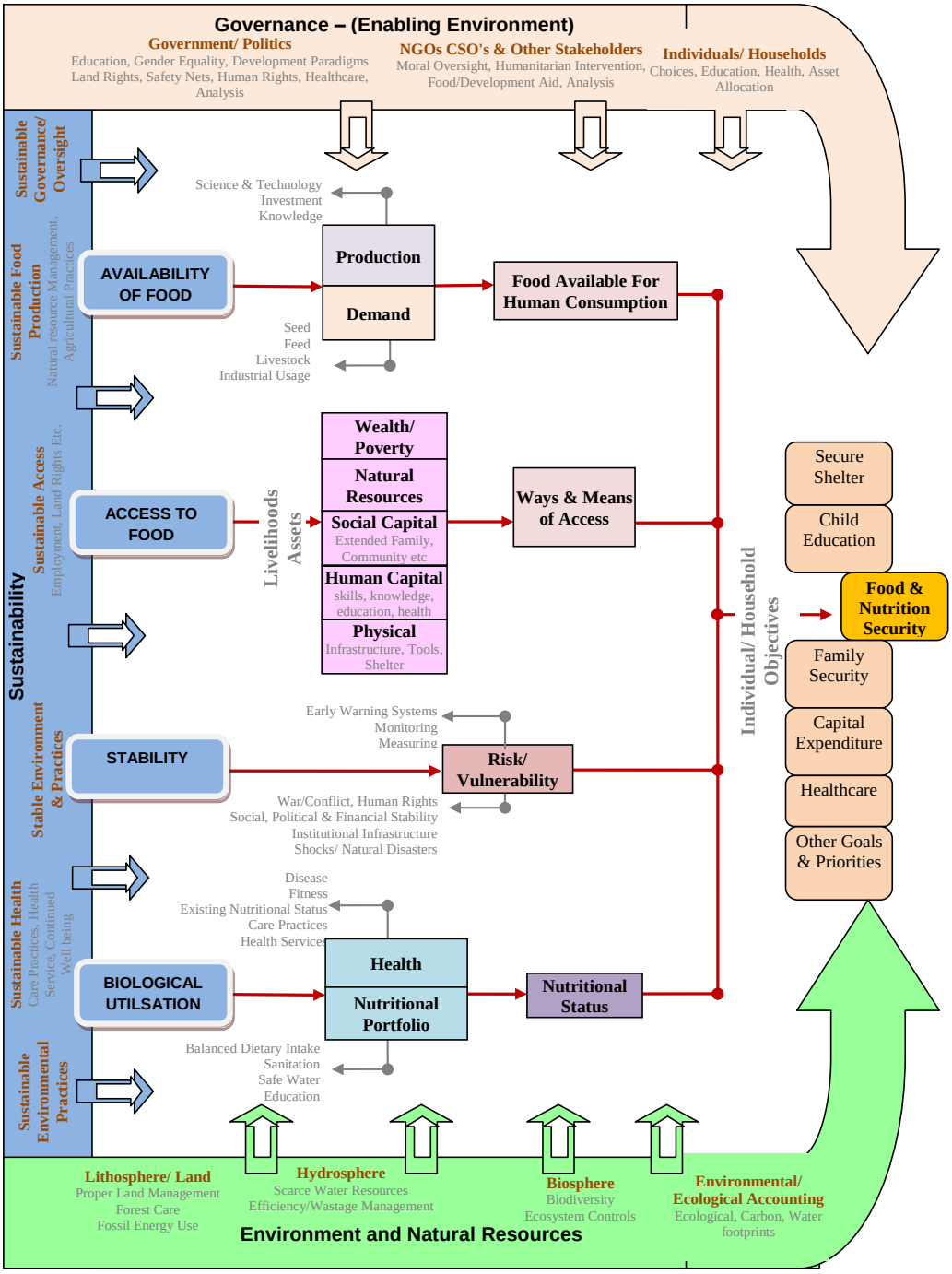


Figure 6.11 Author's Final Conceptual Model of Food Security: Part 3

Key: final draft author's interpretation of mind map produced through iteration of ideas, part 3

The final part is part 3 (figure 6.11) and is the most detailed of the frameworks and attempts to show the food security concept in its entirety.

The main thrust of all of the above models elucidates the relationship between the end goal (food security) and the means by which it is achieved. Moreover all these models take into account both the macro and the micro perspectives in one intuitive model.

7 Discussion and Analysis

This research brought together much information about the concept of food security and how this has been developed into conceptual models. Importantly this was not confined to the literature review, as a great deal of supporting material was gleaned from this research's various primary data studies. With this in mind the discussion of the findings of this study follows the general outline of the methodology, before bringing together the core fundamental results into the conclusion.

7.1 Literature review – Food Security Discussion and Analysis

In satisfying the first two aims of this research, the collation and rationale of food security fundamentals was assimilated in a thorough literature review. One of the first things to emerge from this evaluation, was the sheer complexity of the food security concept itself. This was a point that was well laboured in the literature and one that was also echoed in the specialist interviews. Food security it seems, despite its deceptively simple definitions (of which Maxwell and Frankenberger over 200), is far from straightforward. It seems that the fundamental core precept; ensuring adequate food for all, belies a more intricate mix of wider societal issues. This according to some specialists, is further exacerbated by the divergence of opinions regarding the implicit or explicit inclusion of the definitions' many facets. This was also highlighted in the comment of the FAO, when it suggested that on occasion food security is often either given too narrow a definition; serving as little more than a proxy for chronic poverty; or the opposite tendency, with international committees tending to negotiate an all-encompassing definition that is unrealistically broad yet politically acceptable and morally unimpeachable.

In reality however, this research has shown that the true nature of food security lies somewhere in between. Yet, despite this almost dichotomous approach to the subject, the literature generally agreed that whatever definition was implied, the concept affects, and is affected, by numerous variables not least of which include: human rights; social and economic development; nutrition; economic principles; agricultural science; political philosophy; crisis management; the globalisation of commodities as well as environmental and natural resources considerations.

It is not surprising then that there exists widespread confusion, a point incidentally that was also expressed in several of the expert interviews and focus group meetings. In sum, it can be said that while many of the potential causes of food insecurity might be well known, this tends to come across in the literature review in piece-meal fashion. That is to say, there is a distinct lack of an overarching, holistic 'big picture' to the notion of food security. Backing this up, was the fact that in the course of this study this research was unable to locate a single

publication, website, or other medium of information dissemination, that properly articulated or elucidated the phenomenon in all its complexity. Instead, this research had to undergo an extensive literature review in order to piece together the all the disparate information. Such a missing 'overview' is not a new concern either, as it would seem that this has been, and continues to be the calling of many stakeholders over the years.

Thus before food security can be properly understood in all its complexities and nuances, it first needs to be properly elucidated and conceptualised. One way of attempting this is the use of conceptual frameworks. This was recognised even back in 1992, when Maxwell and Frankenberger understood the importance of clear concise conceptual frameworks, as paramount in creating a solid foundation on which to build understanding and relevant policy. However, as the literature attests, such practice is at best subjective and poorly executed. Common indictments from the literature in frameworks' general failure's are many. One such charge is that people continually fail to adequately operationalise constructs that make up such frameworks. Furthermore, as Ellis and Briggs summarised, such frameworks are also in danger of being over-simplified or worse, poorly interpreted, oftentimes with overlooked or assumed linkages and relationships. Moreover, and perhaps more importantly to this research, is that the literature frequently criticises such frameworks for being constructed in an ad-hoc fashion without regard to proper scientific rigor.

In light of this literature review, it was found that, the adequate representation of the phenomenon through the use of frameworks had been severely hampered. As a result, this research tasked itself with properly formalising three such models, with the view of creating a single final updated and academically rigorous framework of food security. By taking a seemingly ad-hoc subjective procedure and subjecting it to structured scientific methodologies, as well as rigorously defining constructs and terminologies, it became possible to add a certain scientific rigour that would allow such models better standing within the business and academic communities. While Holweg and Donk explained that there was little guidance in the literature, this research did manage to successfully isolate several methodologies that, with some manipulation, were of use in this study.

These goals then, became the central focus of the primary data phase of this research. In addressing the third and fourth aims of this study, 25 frameworks were analysed from the literature to find the best representative model, while a further two new models were created. The overall aim was to take what was learned from all the various avenues of this research and combine this into one updated model. This led to the primary data collection and analysis phase of the research through an 11-stage process as defined in the methodology. As mentioned, the first model came from the literature review; the findings are discussed in the next section.

7.2 Literature Review Model Discussion and Analysis

Twenty-five models were originally identified through the literature review. In general it can be said that there was a wide variety of models within this number, in terms of quality and scope. Of particular interest, was that many models that claimed to be representative of the food security concept, were in fact in reality, only part representations. This was a common finding among these models where many authors, it seemed, clearly viewed food security from their own specific perspectives. This can be seen as problematical and, in some cases, even detrimental. For example as this research's analysis showed, unless the reader undertakes a meta-analysis of the many available models, relying on one model that purports to be representative may end up conveying a false picture of the phenomenon. As a result, careful consideration must be exercised when using such frameworks. In this way, the author's perspective, as well as the purpose of the research in which the model is presented, must be identified if any validity or weight is to be given to the model in question.

The review of these frameworks led to the 25 models being reduced to six that displayed the best scores in terms of attributes of quality. The six models were: 1) Food and Agriculture Organisation (FAO); 2) and 3) US Agency for International Development (USAID); 4) Human Resources and Skills Development, Canada; 5) Polly Ericksen, 2008; and 6) Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS).

These models then became the subject of the case studies, which were then tested rigorously, against this research's evaluative dimensions of the food security concept. Once again. with little guidance in the literature review this research had to adequately define and conceptualise this methodology through the use of both the literature and the piloted focus groups. The case studies took these 6 models and reduced the number to three.

7.3 Case study Discussion and Analysis

The chosen models displayed a mixed bag of attributes. In several instances some of the constructs did not appear to be properly operationalised. Model 1 (FAO) and 4 (Canada) for instance, scored very low in novelty, suggesting that little new insight was brought to the attention of the reader. That said, this might seem an unnecessarily critical analysis of the FAO (model 1), as after all, it was one of the first to properly articulate the four pillar's construct. However, this low score was justified on the basis that it is still in use today and has not changed to reflect the evolving definition of food security. Moreover too, if we recall the operationalisation of the construct 'novelty' used within this study, is not so much to do with chronology, but rather to be measured against the definition of food security itself. While proponents of the FAO model could, and have argued, that this framework highlights

the very fundamental notions of food security, this research felt in light of the modern evolved concept, whilst useful, the model was no longer sufficient or adequate in this regard.

Important differences in these 6 models was also expressed depending on the focus and the understanding of the model's author's. Several focused on the macro perspective and aimed to elucidate relationships in very simplistic terms, such as that of the FAO, while the US offered a level of detail in both macro and micro perspectives, that required the model to be studied more closely. Both views were considered valuable as each had important perspectives to offer. Those models, that continued down the macro and into the micro perspective to household, community and individual levels of food security tended to draw the focus away from the simplistic toward a level of complexity. This became a fine balancing act, where on the one hand overly simplistic models, while useful for the novice did not really impart anything new to the more experienced reader. On the other hand, overly complex models in the hands of novices were equally less than useful.

On the whole, detailed models however, such as model 6 (FIVIMS) brought into sharp focus the vulnerable portions of communities such as women, children, the old and the infirm. This specificity, away from the general and towards the individual, attempted to elucidate further the needs of such groups and place them in context of the wider populace. In particular, once again model 6 achieved this very well with properly articulated boundaries and a comprehensive breadth of detail, that managed to balance this simplicity-complexity very well.

Other perspectives took a different approach and looked at the issue almost from a tangent, or attempted to illuminate specific issues within the wider context. Models that weighed heavily in favour of such issues, like the supply and demand for food, as in model 2 (USIAD), or those that included efforts to contextualise linkages from economics to politics (model 3 – USAID), whilst also useful, tended to concentrate on these variables to the detriment of others.

Overall, while making judgments as to the efficacy of such models, given the lack of direction in the literature review this was clearly difficult. However, the evaluation criteria adapted and adopted throughout this study, helped to contextualise the phenomenon and to frame the discussion. Moreover, formerly distinguishing and adequately conceptualising the different components allowed this research to confidently assign a value and rate them accordingly.

The resultant highest scoring three models from this case study were:

Case study model 6 - Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS);

Case study model 3 - US Agency for International Development (USAID);

Case study model 5 - Polly Ericksen, 2008.

These were then taken to the next stage of the research design; the focus group discussions with the purpose of reducing these to the final literature review model that best represented the concept of food security.

7.3.1 Focus Group Model Reduction Discussion and Analysis

Three sets of focus groups comprising a total of 18 participants, analysed the three literature review frameworks. Some degree of difficulty was encountered by using novices for this procedure, with several participants over the three groups initially believing that food security was a proxy for food safety. While others still, lacked even a basic concept of the ideology of food for all. Furthermore, in the use of foreign nationals whose first language was not English, there was some issue of the translatability of some of the more nuanced concepts; especially with some of the subtleties in distinguishing terms like hunger, malnutrition, undernutrition and poor nutrition. However, this research defends the decision to use novices (food security inexperienced), as after a short presentation and a brainstorming session, most of the participants were in a comfortable position to be making value judgments about the qualitative aspects of the various models. Furthermore, with regards to the use of non-native English speakers this also prudently reflects the reality of the demographic within the food security sector.

The focus group had two focal points, the first was a general discussion to familiarise themselves with the topic while the second more specific aim sought to evaluate the three literature review models.

Of interest in the discussion stage, was the fact that the various groups, although homogenous in their sampling criteria, approached the task in differing ways. Group three for instance, after the initial PowerPoint display seemed to take longer to explore the idea of the four pillars of access, availability, stability and utilisation taking 15 minutes compared to 12 and 11 respectively. The extra time could easily be ascribed to the different ways in which the groups explored each topic in turn, although what this did also highlight perhaps, was the differences in people's ability to take in and digest information. Another interesting note on the three groups, saw different groups concentrating more or less on specific areas. Group three for instance, reflected for a long while on the environmental aspects of the debate, while group one seemed to pay more attention to the poverty and wealth aspects of the phenomenon.

As the discussion progressed so each group evolved ideas on the various aspects of food security. An interesting discussion arose in the second of the first round groups concerning property and land rights. Two respondents talked insightfully about the potential ongoing corruption of officials in developing countries. Land rights in some countries, one participant commented, underpinned much of the social instability within certain regions with one respondent suggesting:

> "… you need the protection of a good judicial system [in order to fully guarantee land rights]…" (group 2, respondent 3).

Another focus of interest, also from the second group, centred around the unfolding of the concept of the utilisation of food. It was interesting to watch as the group collectively came to terms with the idea that the body might be less effective in terms of nutritional uptake when in a state of poor health. When discussing this, respondent 5 offered that the body would be less able to properly digest or adequatelyutilise nutrients from ingested food. Others (respondents 2, 3) also commented on the notion that in times of need, the food might not even in itself, be up to the required nutritional value, whether through inferior products or in volume. Further discussion followed centering on the variety and access to food and it interestingly became a circular debate where:

> "…all roads [seem to] lead back to the four pillars…" (group 2, respondent 3).

In group one, respondents 5 and 3 entered into an interesting exchange regarding the demand for food with respondent 5 adamant that:

> "…what we produce depends on the demand…" (respondent 5).

Respondent 3 on the other hand retorted that production came before demand and suggested that we, as growers, grew as much as possible to be sold at market irrespective of demand. While continuing discussion led respondent 5 to concede:

> "… we don't know what the demand is going to be till after the stuff is grown." (respondent 5).

In this, he was insistent that demand in this way was predicated on historical trend. After further exchanges though, common ground was found in the need to carefully balance both production and supply. Indeed, it was finally conceded by both parties that perhaps both sides of the debate were not so clear cut, moreover it was also concluded that both production and supply were in large part, sensitive variables that needed to be treated with care.

Overall, the discussions served to promote understanding of the topic and to create a conducive environment allowing for the free flowing exchange of ideas. This created broader comprehension within the groups in general, whilst also allowing the researcher to observe how the concept evolved and was understood. In general it can be said that all in all, the

three groups readily came to accept the multi-dimensional aspect of the concept; albeit in a relatively fundamental manner. In all three groups too it seemed, the PowerPoint presentation and a discussion of 10-15 minutes was sufficient to ascertain a basic level of understanding of the food security concept. While this clearly does not suffice for any real in-depth understanding, it did provide a foundation on which further discussion could proceed.

After having gained a reasonable understanding of the various aspects involved in food security, each group was then asked to comment on each of the three models based on the evaluative criteria. This was achieved in the form of the questionnaire (section 4.3.2). The questions were open to discussion and this researcher acted as moderator with the aim of clarifying any difficult questions, without imparting bias. Instead, any queries or ambiguity was opened to group interpretation. The majority of the questions seemed to be self evident with perhaps one exception. In all three groups the moderator found the need to explain the idea of entities or variables and relationships. Esoteric modelling language aside however, respondents in all three groups quickly came to grips with this new language and offered no further difficulties in question interpretation or understanding.

The findings of the model evaluation are looked at individually.

Model 1 - US Agency for International Development (USAID). Interestingly from the findings all three models seemed to score fairly evenly across the board however, a few exceptions are noteworthy. Participants looking at model one generally scored highest in the domains of comprehensibility, specivity and comparability. This possibly reflected the detailed textual input of the USAID's model, as well as the intuitive hierarchical layout of the framework itself. Intuitiveness aside however, the model scored lower on the domain of simplicity, where only 33% of people found the model uncomplicated and easily understood. While this might seem to contradict the previous comment, the literature review clearly saw the need for model's to be able to reflect a reasonable balance between both complexity and simplicity. On this aspect, the USAID's model suffers for being overly complex, or perhaps just too cluttered with variables.

Also of interest in the USAID's framework, is that in all domains, respondents were generally polarised falling on one side or the other of the notions of agreement or disagreement, with only the minority in all question responses sitting on the fence. This is a good thing as while it might not engender consensus at least there was sufficient polarity of opinion to draw strong conclusions one way or the other.

Model 2 - Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS).

With the exception of comparability and novelty the FIVIMS model scored quite highly on the other four domains. This consistency reflected the intuitiveness of the model in following the theme of food security throughout. Interestingly though while many respondents considered that the model did not adequately portray the four pillars of access and availability *etcetera,* others (39%) thought the framework fully reflected such pillars. How such differing conclusions could be drawn from the same model is not difficult to see, as throughout this research it has been repeatedly shown that the topic was understood differently by many diverse people. It is for reasons like this too, that 6 domains of quality were used to evaluate the various dimensions of the framework. In this way, by exploring multiple aspects through these different lenses, a triangulated measure of qualtiy of the framework could be drawn that did not rely on one particular aspect or dimension.

Model 3 – Polly Ericksen, 2008.

In the case of Polly Ericksen's model, respondent's scores were spread much more evenly across the three scales of positive, negative and neutral. However, in answering the question whether anything could be added to make the model clearer, 9 people out of 18 (50%) neither agreed nor disagreed. This was surprising as with most other questions, participants responded quite favourably to the other domains of quality . Were this not isolated to this group, such results might have warranted further analysis of the 'comparability' domain's questions. What was also noteworthy in this model's scores, was the 41% positive result in the domain of novelty. This possibly reflected the two part approach to Ericksen's framework, where part B is a more detailed version of part A. That said, an equal amount of people voted in the negative on this issue suggesting that this approach worked well for some, while others were either non-plussed by this or simply found it counter-intuitive.

In the parametric analysis of the models the effect size of the scores, as stated in the methodology, contextualised the size of the difference between outcomes and was used in the final hierarchical scoring. In this analysis, the larger the spread of effect size (Cohen's *d*), the greater the difference in results.This study this represented the measure of the model's quality. The following highlights the important findings:

- US Agency for International Development (USAID): Model score **964** - Effect Size (Cohen's *d*) of -**0.446** and a 95% confidence interval between -0.93 and 2.31;
- Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS): Model score **1058** - Effect Size (Cohen's *d*) of **1.145** and a 95% confidence interval between -0.95 and 2.57;
- Polly Ericksen, 2008: Model score **949** - Effect Size (Cohen's *d*) of -**0.700** and a 95% confidence interval between -0.93 and 2.38.

It can be seen from this, that while model the FIVIMS framework had the highest effect size (meaning there was clear consensus over the groups answers), this research also acknowledged that in all three models, these 95% significant confidence intervals crossed zero. This indicated that despite such high confidence levels, there was a chance that the observed effect sizes could have in fact occurred by chance. This had implications as to the generalisability of these findings however, in keeping with the methodological stance this was acknowledged as a limitation.

Taking into account the model scores for the moment, rather than the effect sizes, the scores themselves showed just how close each model was valued in the eyes of the participants. This suggested one of two things was perhaps happening. Firstly, it could be argued that different people could well have had very different views on the quality aspects of a single model, or it could have perhaps been that the models across the board were of equally sufficient quality so as to merit similar high scores. However, factoring back in the effect sizes, the reality seemed to be more likely that the high scores observed by the two runner up models were in fact misleading. This was because while the high scores were representative of high values of certainty in participants' specific and individual responses, they did not actually reflect consensus among individuals. That is to say, consistent high scores in different domains by different people could have in fact led to an aggregate high score in itself. Hence the result's scores and effect sizes needed to be considered in conjunction with each other.

Taking this into account, from the results of this stage of the research it was seen that Model 2; the Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS) framework had by far the strongest support from the particiepents as being representative of a good quality model. Interestingly though, having said that this model scored lower in the domain of comprehensibility than both the USAID and Ericksen's models. It is difficult to determine why this might have been; especially as the researcher (during the case study phase) scored these attributes quite highly. Nevertheless in all other dimensions of quality the FIVMS model had come out in front. Of not too, is the fact that this researcher, as with the focus group particiepents, had independently placed the FIVIMS framework at number one in the case study phase. Such independent findings strengthened each other and highlighted the fact that in terms of quality, the FIVIMS model adequately and properly represented the modern notion of food security. This model was then ready for evaluation in the expert interview stage of this research.

After reducing the above three models to one, the second round of focus groups involved creating the first of the two new concept maps based on Trochim's conceptual mapping methodology. Trochim's structured conceptualisation approach employed brainstorming

sessions and statistical analysis in a series of steps to yield the concept map. Importantly too Trochim's method of generating concept maps allowed university graduates with little or no experience of food security to reach an approximation of the concept.

7.4 Trochim's Conceptual Model Generation Discussion and Analysis

As before, the focus groups at this stage also employed the use of a PowerPoint presentation, as well as a period of discussion, before Trochim's methodology was followed in full. Overall from the transcripts it can be seen that, while most of the big ideas involving Access, Availability, Stability, Utilisation were readily understood and agreed upon, some of the discussion highlighted the gap in understanding of how such notions related to food security. This was particularly evident in the second and third focus groups who both seemed to focus solely on access via poverty. In both groups, the moderator guided the discussion back to the overall overarching picture and further understanding was sought via more discussion and question. Common to all groups however, was the apparent difficulty coming to terms with two aspects of the concepts' pillars; utilisation and stability. In isolation, these terms seemed to be misleading, but after further clarification from the moderator and inputs from other participants, there was eventual consensus over the adequate conceptualisation.

After discussion, each group was tasked with organising and generating keywords into groups or clusters of their own choosing. The last focus group in this stage of the research was then responsible for the naming and organising of the data of the final group generated model. This involved discussion of the clusters, their suitability and relational status. This process elicited general agreement that, the statements contained within the model were indeed suitable and closely related. One person (participant 2) however, commented on the rational for including 'debt and structural adjustment' in the cluster and although admitted not being sure what structural adjustment was, still regarded it as "odd". Others agreed and questioned the moderator on its inclusion. The moderator however re-iterated that it was not a subjective choice, but rather the statistical analysis of the groupings that they, the focus group had previously carried out. Although not fully understanding of the process the group accepted this, albeit reluctantly. It was further universally felt that, although the cluster which contained environment and natural resources, as a statement, this would in fact be a suitable group name and as such was adopted. It was also agreed that cluster 2, apart from the inclusion of 'productivity' was largely concerned with the food and nutrient intake of the individual and was named in accordance.

Cluster three on the other hand seemed to be a little problematical. Participant 3 felt the whole grouping was just a "mishmash", while two people (participant 4 and 7) thought the grouping was predominantly concerned with environmental sustainability. Irrespective of individual perspective however, there was eventual, unanimous agreement that, not all the

items contained in this particular cluster could be accounted for. After more elaboration though, it was finally agreed that with one or two exceptions the cluster was concerned with population, environmental accounting and sustainability.

More discussion led to the final group generated concept map. All in all this map's strength was in its simplicity, a simplicity that incidentally belied the underlying clusters contents. This is perhaps the caveat in this particular method. That is to say, with the focus group generated clusters it becomes immediately obvious for anyone familiar with the concept of food security that several of certain clusters' contents were misplaced. This essentially could have arisen for several reasons. Firstly, the use of single words or short phrases to represent ideas, such as productivity or safe water *etcetera*, might have potentially been misleading to those unfamiliar with the concepts. Secondly, was the possible use of focus group participants unfamiliar with the concept of food security beyond the 10 minute PowerPoint display and the subsequent follow–up discussion. Another potential failing, and perhaps of greater significance, is the inherent failing in a method that seeks to look for consensus and statistical relationships over common sense. in this way, while statistical analysis dictates that certain variables might be spatially related, in reality placing for instance, genetically modified organisms and carbon footprinting or agrochemicals and balanced food intakes in the same clusters is clearly not the best combinations.

In summary, this would suggest that while concept mapping is a tremendously useful and widespread tool in information dissemination, when creating maps or assimilating complex data based on group-led consensus requiring esoteric knowledge, there are no substitutes for expert input. This might seem an obvious conclusion however, the literature review is clearly concerned that far too many people working in the field of food security are ill-informed of the full concept themselves, while being in positions of information gatekeepers. This is clearly a worrying development and one that requires addressing. However, that said, on the flip side of this is the idea that even without the full knowledge underpinning the concept of food security, individuals with minimal training can effectively approximate the concept using this methodology.

The third model in this study was this research author's generated model using a combination of methodologies informed by the literature review.

7.5 Authors Model Discussion and Analysis

In executing the author's first draft, this research aimed to encapsulate as many of the variables of food security within the framework, to not only elucidate the flow of associations, but ultimately to clearly define boundaries and associations. With regards to the general structure of the model, as mentioned previously the aim of this research was not to

redefine the construct, simply to best represent the elements of the phenomenon as it is seen to exist. In this way, it was felt prudent to continue the theme of the four-pillars - availability, access, stability and utilisation, as this provides a solid foundation upon which much of the debate rested. Of use too, and as had similarly been attempted with varying degrees of success in other models, was the notion of bounding this concept within the many feed-in and feed-back relationships associated with the phenomenon. After careful consideration of the literature, as well as the many models, the three major external influences were identified as those of the environment, sustainability issues and governance.

This then provided the platform for the construction of the rest of the mind map. After much deliberation of the keywords and variables, not only from the literature review, but also from the focus group discussions, this research attempted to incorpororate the full complement of keywords into the mind map. This was done, not in an attempt to provide a final model, but simply to comprehend the big picture from which the final model could then be taken. From this point, an attempt was made to superimpose the several important constructs of sustainability, malnutrition and others *etcete,a,* to help draw together any associated variables. This was necessary, but not always easy, as many of the variables quite easily could have been allocated to several of the constructs. Iteration and constant reference back to the source material, helped determine the final clustering of variables. From this mind map, the author transferred the key elements into a tentative first draft model. This initial process was dynamic in that the author attempted several different perspectives until it was felt a good approximation of the concept was formed. Also of great help in this approach, was the evaluation criteria used to determine the strength of the models' quality. This was applied to this model in a sort of critical self-analysis and where necessary, adjustments were made that might improve the overall framework.

In terms of selectivity and specivity the framework drew on all of the keywords from the literature review and grouped these according to similar or associated variables. Once again, the flow of such variables was dictated by the 4 pillars, however, it was achieved in such a way that appropriate and sufficient variables were used to form the relationships and no more. The dimension of novelty in this model, highlighted several points. Firstly, concerning livelihoods; this is traditionally viewed in isolation as one aspect of food security however, in this model the construct was shown to be an integral part of the overall concept. Moreover, by treating livelihoods as one aspect of access it demonstrated the contextual role of this important construct, which is so often lacking in other models. A second aspect of within this model's dimension of novelty, recognised the actual goal of food security itself at the individual or household level, as being only one of many objectives or choices to be made. While this notion in itself is not new, there are no frameworks that visually take into consideration this fundamental consideration. A third novelty in this model, also saw the role

of the individual as being partly responsible in the governance of their own food security. This is not to say they always have full control over food access or availability, instead it ties in to the above point about people and families having command over the choices they make. Also new in this model, is the elucidation of the availability of food as a function of production and demand; a point that is not always made clear in similar frameworks. Thus food for human consumption, factors in such demands as feed for animals, seed and other industrial uses.

With regard to keywords or variables ultimately left out, it was felt these were adequately portrayed in the remaining associated variables. Comparability to the food security definition, is thorough although one caveat concerns the time dimension. The difficulty here is that all definitions of the concept explicitly suggest food security at 'all times', in the model however, this cannot be visualised so is in fact, implied.

This provided the first draft model and it was acknowledged that there was still work to be done however, in keeping with the inductive nature of this research the author sought to evaluate the model thus far. By taking advice from the experts in the following stage this it was felt, would ultimately improve the model and strengthen the validity of the final draft.

7.6 Specialist/Expert Interviews Discussion and Analysis

The forum discussion and specialist interviews, as with the focus groups, served the dual purpose of providing supporting material to the literature review as well as specifically evaluating the frameworks of food security themselves.

General Food Security Issues

Note – When referring to the participants of this discussion, the prefix **E** denotes expert while the prefix **NE** implies Non-Expert.

With the number of specialists and non-specialists there was no shortage of diversity of perspectives ranging from philosophical views to data quality. However, expanding on the general issues of food security, several themes were seen to be repeated, these evolved around the ideas of population and natural resource sustainability. As in the literature review, one of the non-experts argued for more consideration of population growth check and citing Boserup, asserted that humanity, as with all other creatures, tended to naturally increase their number to the limits of the current food supply. This, she contended was unlikely to change either at least until such times as the:

> "…economic costs of having more children will overcome the powerful evolutionary drives encouraging parents to have as many as they can." **NE1.**

This point can be directly related to the experiences of the Western or industrialised countries, whereby education as well as convenient, safe birth control measures colluded with economic forces to stabilise, and in some instances, contract population growth. **NE1** too, cleverly elucidated this link with the growing strain on natural resources and openly wondered whether the population would stabilise itself, in time to render our efforts on sustainability worthwhile. This sparked comments from others, regarding the recent evolvement of ecological based accounting systems that placed the natural resource base on par with a country's National Accounts. This was seen by many as a welcome development and one that could only prove to be beneficial on the health and vitality of the environment (**E2, E5, NE4**).

There was also appreciation of the renewed global interest in food security issues, although one participant thought this was more to do with recent price rises than anything else (**NE7**). This opened discussion on the social aspect of the phenomenon, the most germane of which was poverty and the subsequent need for social safety nets. Which, as **E4** pointed out were depressingly under-utilised. Energy too, with the supposed realisation of global peak oil was raised with one specialist observing the possibility of a 6% annual decline from now on of "cheap sweet crude" oil **NE1**. On this point, while it was agreed that the importance of oil could not be ignored in the industrial and green revolutions, this over-reliance had come at a price. At this point, the conversation moved on to climate change and the acknowledgment that further degradation of the earth had indeed taken a major toll. This united many of the elements that was evident in the literature and neatly served to draw the notion of environmentalism and sustainability firmly inside that of the food security concept. This led another specialist to wonder whether, the idea of food security was just becoming too big and unmanageable **E3.**

Not everyone thought in terms of the environment and sustainability. **NE3** for instance concentrated on market fundamentals within the food security debate. He wondered whether by ignoring the basic economic principles of trade such as Ricardian comparative advantage, developing world farmers were risking the opportunity of market based gains in the fight against food insecurity. This is a contentious view and one in the literature that has both proponents and detractors in equal measure. This view of course would need to be balanced with the benefits of self sufficiency which is also tied in with the opposing view of a global trade based food security model. This point was not lost on **NE3** and he adequately acknowledged that, in trading the market-based system, for one of self-sufficiency rarely, had this resulted in people actually climbing their way out of poverty. Instead, the benefits of global trade, suggested **NE3** was surely to create market surpluses that could be traded, and this in his view, was the best way out of the poverty trap. A discussion on surpluses also raised the notion that surplus stock for food aid was a relatively recent phenomenon ,which

in turn if we were not careful would result in over-dependence **E8**. In this **E8** offered from personal experience that such intervention policies of the likes carried out in Nepal had in fact left indigenous people reducing their own native crop cultivation, relying instead on World Food Programme food aid.

On another tangent a cautionary note from one specialist, **E11**, urged us in the face of great expectation, to consider the limitations of institutional abilities, within the food security debate, in terms of reach and finance. This is perhaps a wise recommendation and one which is also reflected in the literature. This view advocates the idea that individuals, governments as well as the institutions must share joint responsibility for the provision of food security. Only by mutual governance suggested **E11**, extending from the government to the institution to the individual, will food security ultimately be achieved.

Interestingly too, **E10** made reference to growing urbanisation within the developing world and the dichotomy that sees much migration to the cities in the hope of a better lifestyle. This was problematical on many fronts, not least of which he suggested, as it was perpetuated by the poor reasoning that proposes:

> "Poverty is associated with rural living and only by moving to the towns is it possible to create wealth." **E10**.

While he further offered that such movement, if handled correctly, did in fact bring with it a multitude of benefits including increased food choice, he wondered whether such perceived affluence did not bring with it its own set of idiosyncrasies to the debate. Taking this to its logical conclusion, **E10** brought to the discussion another dimension; that of choice and potential over-nutrition where:

> "...therein is the pleasure of 'living to eat and not simply, the eating to live'." **E10**.

Overwhelmingly as the discussion unfolded it was noted that whatever the perspective, food security would only come to pass for the majority, if there was an overarching understanding of the concept in the first place. One that was holistic and all-inclusive and one that was underpinned by adequate political and social will. This, according to **E4**, would only be achieved with a comprehensive and participatory food system-wide agreement that took account of all stakeholders such as:

> "...farmers, fishers, consumer groups, anti-hunger advocates, food bank managers, labour representatives, members of the faith and ethnic communities, indigenous groups, food processors, food wholesalers and distributors, food retailers and grocers, chefs and restaurant owners, officials from farm organisations, community gardeners, academics e.g. involved in food policy and law, local and national officials involved in agriculture, economic development, inspections, education,

> human services, immigration, health, transportation, legislators, MPs/MPPs and municipal officials." **E4**

Collectively, it was noted that such agreements would also need to deal with issues such as the contributions and impacts from other sectors like organic foods, biotechnology/GMOs, regulation and environmental sustainability; as well as tackling fiscal and monetary policy, exchange rates, inflation, interest rates and employment. Moreover, any solution, continued **E4**, required that we addressed other things too like:

> "…gender and intra-household allocation issues, coastal communities, water and natural resource management, land policy." **E4**.

Furthermore this specialist also recognised that sufficient and adequate food was a necessary precondition to equitable welfare and good public health. In this endeavour this specialist fully supported a:

> "...moral globalization, following a global ethic ensuring a minimal commitment and obligations to meet the basic human needs and rights for all..." **E4**.

This is a succinct point, that is well made and it is one that eschewed much of the same moral force outlined in the literature review. Specialist **E4** also further touched upon the idea that all of us, businesses, individuals and governments alike, should avoid coercion and deception in the food system. It was an interesting point and the notion that we should not benefit at the expense of others in achieving food security is one that had not come up before in the course of this research. On the whole, on these broad issues **E4** had already praised the renewed interest in the subject yet he also suggested the goal of bringing together these overarching constructs into one formidable approach, had been one that had been his own personal challenge since 1996 (**E4)**. In summing up he elaborated the rationale behind the concept and offered that food insecurity presented us with many moral challenges that collectively undermined people's dignity and welfare especially, as he continued, much of this suffering was wholly avoidable in the first place (**E4)**.

In summary the above discussion proved exceptionally useful to this research. It not only served to strengthen the many variables that had been highlighted in the literature review but more than this, by bringing first-hand knowledge and experience to this discussion, the specialists supplied clarity and unique insight providing invaluable context for this research. This ultimately gave this research much material that in some instances clarified points in the literature and at others offered new insight that could be incorporated into the framework.

On this last point, it appeared, was tentative but strong and widely accepted agreement, among both specialists and non-specialists alike, of the lack of a holistic understanding of the concept of food security in general. This led one specialist to openly and apologetically admit that:

> "…I have become so used to dumbing down a complex field into one or two interesting sound bites that I am perhaps guilty of perpetuating the knowledge gap." **E14**.

Indeed this rare and valuable insight into the complex notion of the problem perhaps sums up a predicament that thus far has defied all efforts to resolve.

The general discussion aside, this research then concentrated on the 6 interviews in regards to general framework design and the three final framework analyses.

Framework Analysis

To validate and test the three conceptual frameworks, one from the literature review and two created by this research 6 specialist interviews were conducted using specialists who responded to this specific request. These were **E3, E4, E11, E7, E12** and **E14**, (see section 6.5). The aim was for the specialists to comment on the various framework design considerations in general as well as the specific suitability and efficacy of the three final models in particular. It was decided to leave this as an open-ended question interview. The reason for this was becuase the goal of these interviews was not to determine an outright favourite, rather to establish whether the three frameworks were suitably representative of the food security concept. Furthermore analysis from these interviews sought to advise on any improvements that may have been needed both specifically and in general. The frameworks were:

- Model One: Literature Review Model Reduction (FIVMS)
- Model Two: Trochim's Conceptual Model Generation:
- Model Three: Author Generated First Draft Food Security Concept Map

With regards to frameworks and their role as tools of information elucidation and dissemination, there was almost unanimous agreement that as a generalisation such frameworks often lacked clarity and were too rigid in their execution (**E4, E11 E3** and **E14)**.

There were many reasons offered for this. In **E7**'s view such frameworks were only useful if they contained elements that were measurable otherwise they:

> "remain[ed] vague and in-operational…" **E7** (personal communication).

Although this does however, fall outside the designated purpose of a conceptual framework it is an interesting point regarding the nature of the true reality being represented in the framework or model. This was partly reflected too, in several comments aimed at model two (Trochim's Conceptual Model), where three people identified it as too simplistic and of little use; or "unconvincing" as one specialist put it. Surprisingly though, all of those commenting on this over simplicity could not find an adequate reason for this. Although for one person

(**E4**), the model simply felt "uncomfortable". That said though, there was perhaps partial insight into a potential reason for such critical findings. This was hinted at by **E14,** when she wondered whether it might have been because she was a professional working in the industry, and fully understood the concept, and in that sense perhaps model two, she wondered had not shed any new light on the subject for her.

In another, specialist's opinion, **E4**'s, it was wondered whether general confusion in framework construction, arose directly from the numerous definitions (over 200), and the sheer number of potential indicators (450) involved, that served to exacerbate difficulties and confound clarity. In his experience (**E4**), the UN, the CGIAR, national governments and the private sector, all looked at food security from different angles or perspectives. Moreover, he further suggested that this was as much true with the food security workers 'on-the-ground' as it was at the institutional level too. This was a point that was also touched upon in the literature and one that served to confirm the systemic nature of the problem. This was further complicated, according to **E4,** in the huge gap in understanding and awareness of:

> "…food issues in general, let alone food security." **E4**.

Interestingly, taking the opposite view **E3** wondered if the problem lay not so much with the clarity of the concept itself, but rather the lack of commitment and will, to formailse firm decisions in tackling such issues. In his view this would not change either until leaders, organisations and nations collectively committed to action with: "...determination and perseverance." **E3.**

While in reality, this says less about the translation of the concept into frameworks, it is nonetheless a legitimate observation on the progress of the food security concept in general.

In considering other alternative dimensions to the concept of a food security model; taking a snap-shot of a single moment in time, **E12** noted the difficulty in the lack of co-ordination between the various short and long term dynamics of the concept. In commenting on the concept in general, and of frameworks in particular, he noted that seasonal and yearly fluctuations were often variables that are found lacking in both explanation and conceptual. A food security framework he suggested, that tackled this risk or vulnerability as in such examples as the Disaster Risk Reduction frameworks, would be enormously beneficial to:

> "How we understand the dynamic interaction between risks, hazards/shocks and vulnerability on the one hand, and coping, resilience, adaptation and capabilities are important to our planning both short-term and long term food security policies and programs." **E12**.

General concerns of the complexity in the models was similarly shared by **E7,** in which the concept itself had seemingly taken on greater wider societal concerns possibly, he stressed,

at the expense of the core concept itself. These sentiments were also in part echoed by **E14,** who further added that the fundamental difficulty lie with translating the relevant food security definitions into actionable frameworks, as exampled in model two of this research (Trochim's Conceptual Model). Although that said, in response to the use of frameworks in general though, she was in favour and expressed that indeed they were:

> "…valuable tools that can facilitate an easy and open exchange of ideas." **E14**.

All in all, the specialist interviews expressed a mixed bag of responses. Overall, it can be said, there was considerable consensus regarding the need for an all-inclusive or holistic approach to tackling the problem of food security. In this endeavour, frameworks were seen as important although, in this respect, there was an equally mixed response as to the proposed make-up and scope of proposed models in general. In this vein, while there was general agreement regarding the benefits of conceptual frameworks, there was less consensus concerning the form that any such model should take. This no doubt taps into the debate of perspective, brought up in the literature time and time again, where a person's personal viewpoint dictates how they see the overall concept and what priorities it takes on.

Specifically regarding the models of this study, it became clear that many felt that model two (Trochim's Conceptual Model), was a poor representation of the concept. For several of the specialists, this was not so much a failing of the framework *per-se* but rather that it was perhaps just too simplistic in design and failed to shed any new light on the subject, (**E3, E4 and E6**). There are perhaps good reasons for this, which were touched upon earlier and had to do with the use of food security novices in its construction. While it could be argued that the use of such a demographic, might have been seen as a hindrance in generating an overview of food security, this research contends that it was perhaps the process or methodology itself that is perhaps the greater limitation.

Using, as Trochim does, a strict methodology to create the clusters of food security variables in the first place, Trochim relies on group consensus of a topic. That is to say, this particular method relies on individuals collating the many variables. In this way, the process ignores the heterogeneity of the population's ideas in favour of agreement and harmony. As a result, what invariably happens in this process is that, as the statistical analysis unfolds, so people's differences are reflected in the many anomalies that see seemingly non-connected variables being tied together. Indeed this was the case in the second model of this research and it then was left up to the observer to determine out of all the potential returned clusters, the final selection. As a result in this researcher's view, the final decision then remains somewhat arbitrary, not least because in all the possible clusters there were clearly elements that didn't belong. Some might argue this might have been avoided were the use of experts made, instead of the non-experts as in this case. It is a valid argument however, in answer, one

would arguably expect experts to be able to make the connections without the use of such an elaborate methodology. That said, it is not a criticism of the methodology itself, simply an observation.

In commenting on both models one (FIVIMS) and three (Author's), **E14** found them both particularly useful representations. This expert at once recognised the FIVIMS model, describing it as comprehensive and familiar, whilst also regarding the Author's model as intriguing and "eloquent" **E14**. Interestingly on this point though, and as a result of her own experience in the field of food security, **E14** acknowledged she regularly employed a hybrid WFP framework that merged a livelihoods approach with the UNICEF nutrition framework. This was a novel approach and one that this research saw great capital in helping to contextualise the livelihoods perspective. On further examination of the authors model, **E14** questioned whether it was perhaps a little complicated to be of use to the full breadth of stakeholders. Although she did question whether in fact, one model could ever indeed be provided as to be all things to all people.

Other specialist too felt that models one and three (FIVMS and the Author's), were both favourable although, on balance, comments on model one perhaps gained more positive attention as being more fully representative (**E3**, **E4** and **E7**). The FIVIMS model did come under some criticism too, for being what one specialist described as: "…perhaps needing to be updated…" **E12**. In this sense it was acknowledged that while the model proposed a straightforward and well recognised approach to the concept, it was still regarded as being a little: "mis-contextualised". In pressing further, this was felt to be in response to the need for the widening of the concept, to include firmer governance, not just of institution and governments, but also individuals too (**E12)**. **E3** too commented in a similar vein suggesting that, while the FIVIMS model tended to give a good overall perception of the phenomenon, it was a little narrowed in its overarching perspective. Another interesting comment reflected the predominantly textual nature of the FIVIMS model, in that it lacked visual stimulus **E4**.

With regards to the author's model, it was felt it had generally good potential but to one specialist it felt "unfinished" **E7**. Another comment offered that, it perhaps tried too hard to satisfy all elements of the concept, which might have been better separated out **E3**. This was tempered however, by praise for the many inclusive elements of the objectives and choices exercised by individuals and households, as well as the inclusion of the many facets of the phenomenon **E4**, **E7**. However, concern was also expressed too, that the author's model, as with FIVIMS, also relied too heavily on textual representation **E3**, **E4**. This it was felt, worked against the intuitiveness of the model's aims, and in its interpretation as a result, required a certain "decoding" **E7**. After further consultation, it was suggested that with

modification both the FIVIMS and the Author's models could in fact, provide a much needed overview of the concept of food security.

In the above analyses it was felt that these were not unwarranted criticisms and one this research took fully on board. Furthermore, in building on the above comments made in regards to modelling in general and the frameworks of this research in particular, the author re-designed model three to fully take advantage of such insight. This became the authors final draft model which was then subjected to further scrutiny.

7.7 Author's Final Three-Model Concept Map of Food Security

After reviewing the comments of the above analyses several generalised findings could be made that was decided might help improve this research's model.
These can be categorised using the evaluative criteria used throughout this study

Comprehensibility

While praise was received for the overall breadth of coverage of both the author's and the FIVIM'S models other concerns were raised as to the attempt by the author to incorporate too much information in one model aiming to please too wide a target audience. This was a valid point and was of concern to the author at the initial construction phase. In response, and following the example of Polly Ericksen, it was decided that a similar approach would see this research's model of food security being broken down into separate models. In this way, three separate models of incrementally increasing complexity, would allow the various stakeholders, irrespective of level of experience to choose an appropriate model that best satisfied their needs.

New or Novel

With regards to the novelty of the analysed frameworks it was overwhelmingly agreed that Trochim's model, brought little new insight into the concept. The FIVIM's model on the other hand, was praised for its incorporation of the idea of food and nutrition security as opposed to the sole aim of food security. However, in many model's defence this is a point that had been raised many times before and it is one that was generally agreed to be implicit in the 'food security' outcome or goal. Nevertheless, bearing in mind these comments, it was decided to incorporate this notion fully into the revised model, as well as elucidation of two other concepts; governance and objectives. Firstly, the idea touched upon in the interviews as well as the literature review - of food security not solely being the responsibility of governments and institutions but rather the individual as well - was one that was incorporated into the new model. So too was the idea of the notion of food security being only one of many household objectives.

Selectivity

Not one of the specialists commented on the relationships between the variables nor were any suggestions made regarding any omissions. On the contrary in fact, of concern for one specialist was the over-complicated nature of the author's model in attempting to incorporate perhaps too much. This problem however, would be tackled with the ultimate separation of the model into three components and one in which a moderate balance of chosen variable would be selected in conveying the message appropriate to the complexity of each layer.

Specificity

The author's model was initially praised for its inclusion, or rather, the clarity with which the external influences of food security was bounded. By this it was acknowledged the sustainability, governance and the environment were perhaps the overriding feed-in and feed-back mechanisms affecting food security. With this in mind, it was decided to keep this similar approach in the new model. Reading between the lines too, in the criticism of Trochim's simplified model it was felt that, while such use of few variables might not be sufficient for any detailed analysis of the concept this would in fact prove beneficial in a cut-down model as proposed in the new three-tier model.

Comparability

Once again there were no comments regarding the comparability in the models to any accepted definition of food security or its many components. In this absence it was assumed that the models were sufficiently reflective of the construct; albeit to varying degrees. In this it was felt were there anything missing this would have been brought up at the interview stage. In view of this, this research is satisfied that the models provide a good reflection of the concept.

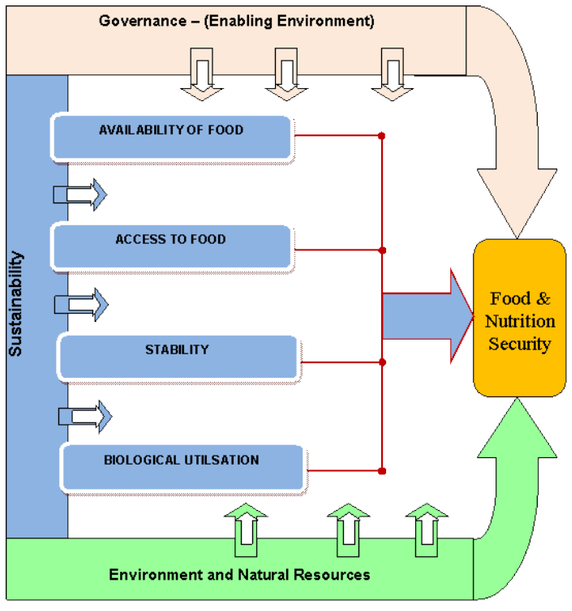
Simplicity

Comments were made regarding the over-complex nature of the author's first draft model, and when pressed further, one specialist tentatively offered that there might have been excessive use of textual 'cues'. This was a concern of the original first draft and one that was partly expected. While no-one else commented on the textual input of the model, there were other suggestions about clarifying some of the contextual information. The group led model using Trochim's methodology on the other hand, was seen as overly simplistic and of little use to specialists. A model then, or in this case a set of model's was needed to be created that would satisfy the depth of coverage required at the different levels of the concept as well as not being overly unwieldy in terms of the number of variables included or the manner in which these variables were to be displayed.

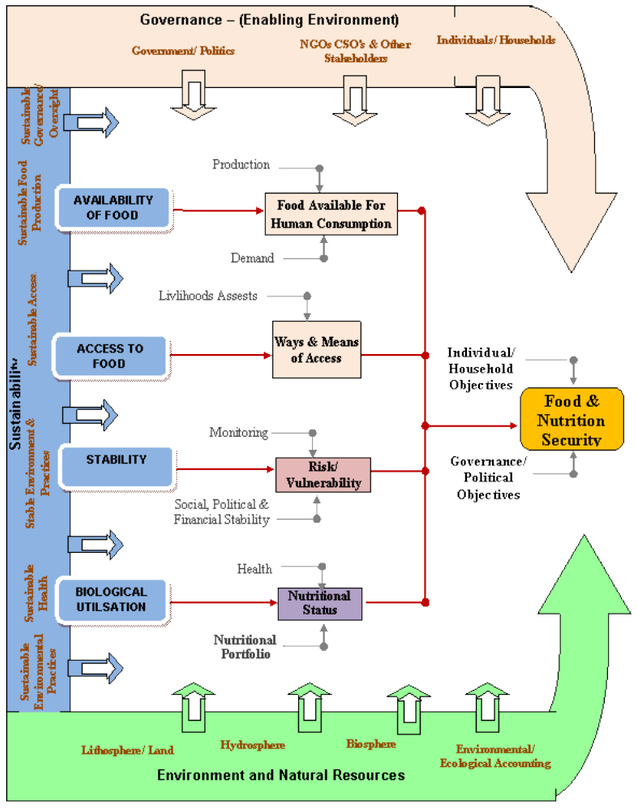
As a result of this, the study's next task was to take this input and rework the ideas to finalise this research's model of food security. Taking into account many of the ideas and comments of the previous interview set the final model hoped to reflect a fuller more complete representation of the concept of food security. The main idea to be taken on board was the notion of a three-tiered model. This was seen as a solution to the problem of a single framework that was unwieldy and aimed to satisfy all stakeholders. Another important consideration was one of visually translating the textual information in a way that was informative.

The final draft, figure 7.1 was re-presented to the specialists which elicited three responses from **E3**, **E4** and **E7**. These are discussed in the next section.

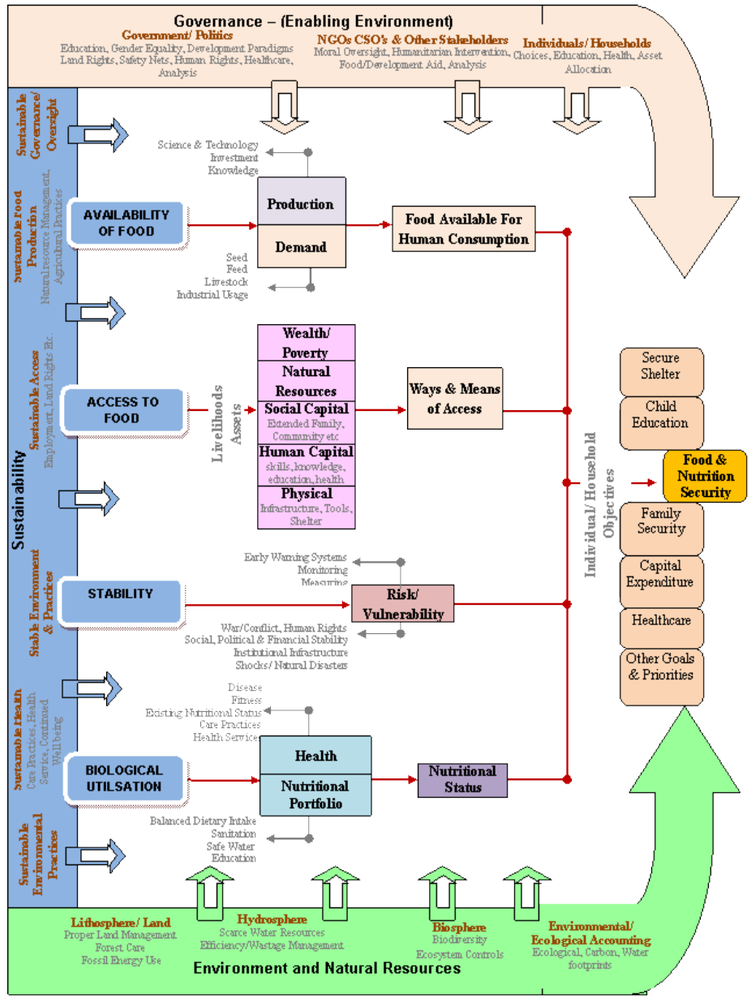
Part One



Part Two



Part Three



Key: final draft author's interpretation of mind map produced through iteration of ideas, parts 1,2,3

The new revised model was generally well received. Part one of the model was likened to the FAO's four-pillar construct by **E7,** in its simplicity and message. He also found this new model particularly "interesting", with the specific inclusion of the livelihoods aspect and the various household objectives beyond food security. In his own words he found himself:

"…pleasantly surprised to find myself warming to this particular model…" **E7.**

E3 too found the model intuitive and a great improvement on the previous attempt. It was noted that the idea of a 3-teired model of varying complexities was a novel idea which in this particular incidence worked well. There were also favourable comments over the limited use of textual cues relying instead on "…intuitive visual representation…" **E3.**

Of particular interest to **E4,** was the inclusion and contextualisation of the livelihoods construct within the overall dimension, marking it out in his words as a: "…a well proportioned and balanced model…" **E4.** In general, the comments favoured the new model over the previous example, although **E7** did wonder whether it would catch on or replace the already widely accepted FIVIM's model.

In sum, it was felt the improvements to the original first-draft were balanced and well considered. As for whether this model would 'catch on' it is felt by this researcher that the model is one that does not need to compete, but rather complement existing models. In this endeavour this research considers it has met its full aims and objectives as outlined.

7.8 Strengths and Limitations of the Research

There are several strengths and weaknesses in the adopted research, in both design and content that benefit from clarification.

7.8.1 Design

While the research design philosophy used in this study is based on a pragmatic approach, it's obvious advantages are based in its flexibility and ease with which design can be altered to accommodate needs. Careful use of this approach however, was employed to ensure transparency and consistency throughout and to avoid any possible conflict with epistemological approaches. However, the pragmatic approach's appeal is also its biggest drawback. In having an endless tool-bag of methods and philosophical stances at the researcher's disposal, the temptation to use ill-thought out design as a measure of convenience rather than needs, was carefully monitored. This was where the strength of the literature review as a source of secondary data, was of enormous benefit. It allowed this study to draw on an overwhelming wealth of previous accumulated knowledge. Providing guidance and direction in understanding the breadth and extent of research methodologies

consideration as well as providing valuable content for the research itself. As a result, it was felt that the final research design was tackled sympathetically and all of the chosen methods were carefully and rightfully chosen.

In the use of survey's, there was a number of limitations inevitable in a study of this kind. Firstly, by using focus groups, particularly the small number in this study, raised questions as to the representative nature or generalisability of the findings beyond the immediate study. Furthermore, inherent weaknesses in the survey method tend to be exploratory, and while inferences can be made, determining cause and effect with any degree of certainty is more difficult. This also tapped into the experimental versus non-experimental debate, where experimental research design permitted stronger tests of causal relations. That said, being of a non-experimental research design, the aim of this study was not to test the strength or indeed the validity of causality, simply to postulate that the relationships existed.

In respect of the of focus groups themselves, this research found them particularly useful for exploration and discovery of the food security topic. They were relatively cost effective and easy to administer and provided a very rich source of information. At the same time, the participants themselves facilitated the 'checks and balances' system of identifying factual errors and controlling for extreme views. Clearly though, one of the main downsides of focus group work were the inherent group dynamics. One or two participants of the 58 final participants, despite competent moderation, might not have felt sufficiently emboldened to express their views in a group environment, where dominant personalities might have drowned out other views. It was understood too, that such group dynamics could have also interfered with participants independent views, through peer pressure or the desire to be accepted.

When it came to comparing the food security frameworks themselves, a potential limitation was recognised in that some frameworks might be representative of one concept while others, although similar, might represent another. For example, livelihoods frameworks might be evaluated alongside hunger concepts and if not sensitive to such things, this research could have opened itself to charges of comparing 'apples with oranges'.

Also of note, were the inherent measurement errors in survey questions, which had the potential to perhaps involve systematic biases or loaded questions. While this research aimed to lessen these with foreknowledge and understanding, it was understood that there might always be room for such errors. Furthermore, in the generated concept map the initial keywords were generated by the researcher himself and albeit directly from a thorough literature review, inherent in any such choice is the risk of subjectivity. However, guarding against such charges, the focus group were allowed to rework these ideas and add their own

contribution, which hopefully lessened the threat of bias in this instance. Further weaknesses, entailed the representative nature of the sampling frame used. In this regard, given further time and financial resources, further survey data might have strengthened the validity of the study. There is also a potential weakness in the use of the Likert scales as a source of interval data, where ordinarily this might be seen as ordinal. However, in this research, using the scale as an approximation of an interval scale is defendable in the careful elucidation of the symmetrical nature of the possible answers.

The use of expert interviews in this study came with great advantages. The advanced level of insight in the food security arena allowed for the specific targeting of data collection. It was also recognised, that such specialists were often highly motivated and amenable to the interview process. Having said that, there were some important drawbacks with this method and perhaps the most important, was that experts are rarely opinion neutral. Moreover, for every expert that agreed with one point of view in this research it is understood that an equal number could have been found to disagree. Further limitations regard the selection criteria of the experts themselves, and despite a thorough selection process, the author acknowledged that there was a certain bias towards the FAO. As a result it is understood that it is not possible to draw substantial inferences beyond the immediate sampling frame.

On the use of e-mails as a means of conducting interviews, this research acknowledges that this is not comparable to verbal interaction in several ways. Most notably, a different skill set was needed to interpret what has been described by some as a less accurate "…reflection of a respondent's thoughts than verbal data…". That said, emails did allow for the wider audience, that time and financial limitations previously ruled out. Moreover, it also produced a level playing field in which interviewer and interviewee could communicate on equal terms without the potential differences that might have been induced by status or reputation.

Specifically regarding the main criticism, that the case study method comprising few cases offers little grounds for supporting reliability or generality of findings, as part of a triangulation of methodologies, it was felt this was justified and would stand up under scrutiny.

It can be seen that by using outputs of the case studies as inputs of the first round of focus groups, and second round focus groups to inform inputs of the question design for the interview stage, the methodology was in keeping with the characteristics of grounded theory and once again, built on the recursive model intuitive of inductive reasoning. Further strengthening the results of this study, was the use of the mixed method design which used various complementary approaches that triangulated findings.

Lastly, it was understood that this is but one study and as such, is recognised as a limitation by itself in generalisability. That is to say, theories only become generally accepted if multiple studies produce the same or similar results. Also, in the endeavour to provide scientific rigour, the author, in accordance with Wand *et al's,* (1999) notion of open transparency, provided operationalised constructs and clear methodological procedures at every stage, so as to impart a certain academic rigour that was so lacking in models to date. This effectively allows others, to retrospectively evaluate the methodology and ultimately the keywords and relationships employed.

7.8.2 Content

Overall the research has benefitted from a wide variety of approaches in both methodological terms and from the perspectives of many different people. In the final iterative process of this research, the three model approach was seen as a successful outcome. The model was derived using a combination of adapted methodologies, which have a long history of scientific acceptability. Wand's ontological approach coupled with Check land's Soft System methodology, appear to be well complemented to each other and, as a combined system, they were able to add a good measure of scientific and academic rigour to the conceptual model creation process. In bringing together these various techniques to create the final food security model that stood up well under expert scrutiny is perhaps this research's greatest strength.

A caveat however, concerns the limitation of this framework. That is, that any assumptions as to causality and direction were avoided as, has been previously mentioned, this framework solely detailed the conceptual associations and relationships. That is to say, rather than attempting to correlate such relationships the framework simply reflected the associations made in the literature review. In this way, many variables were linked not by empirical evidence, but through hypothesis generated from the literature review. As a result of this approach, it is acknowledged that as new evidence comes to light, so the relationships and the variables themselves can be revised, strengthened or omitted entirely as and when empirical evidence allows. This ultimately contributes to the strength of the model, as rather than being static, it fits with the fundamental precepts of modelling outlined by Shoemaker (2004), in that this model can be "poked, prodded, kicked and torn apart." in an effort to further improve its underlying assertions.

7.9 Contribution to New Knowledge

Whilst exploring the food security literature, in particular how the concept was comprehended by others, it became evident that a major gap existed in just how such knowledge was conveyed using conceptual frameworks. This gap specifically related to the

many poorly design and so called ‘ad-hoc’ models, that appeared to be little more than subjective approximation of the concept.

To fill this gap, a new model was proposed that would improve on such frameworks. This was achieved through the creation of an updated model that reflected current trends in food security analysis. In doing so, rigorous application of tried and tested methodological techniques was successfully triangulated, and which resulted in a strengthened model, that stood up under scrutiny as a good representation of the modern concept of food security. This it was hoped would also restore some of the lost credibility within the field of social science modelling.

8 Conclusion

The research set out to evaluate the breadth of the food security concept, which in turn was used to create an updated conceptual framework of the current phenomenon. In contrast to the many existing models, the particular perspective of this research was focused on the whole, or the big-picture rather than on any single one of its many sub-concepts.

As well as systematically studying the literature, this research gained detailed insight from primary survey data. In this, the results conclusively found in accordance with the prevailing feeling, that such holism or overarching understanding of the concept was severely lacking. This was evidenced in the numerous publications that, while claiming to be authoritative on the one hand, seemed to contradict, misquote or were at fault through simple omission. This was further evidenced by the numerous forum discussions and specialist interviews in which this research participated.

Perhaps one of the main reasons for such confusion as discovered in this research, was that food security was found not to be a deterministic phenomenon, in which one event led to another and so on. Instead, it was clearly seen to be a wholly dynamic experience, with multiple causalities working consecutively, separately, in parallel or in combination. In this way, the concept was more akin to complexity and chaos theory (or systems theory), which made understanding and the subsequent mapping of such a phenomenon that much more difficult. Not surprisingly then, the issues of food security are found to be complex and multi-various and consequently, it also came as no surprise to find the current overarching understanding to be lacking. Furthermore, literature that did attempt to deal with such overarching views were often, with one or two exceptions, technical in nature and delivered with dense scientific and esoteric language which, rather than clarify served only to confuse an already difficult phenomena.

As a result of such complexity, and in an endeavour to convey the food security phenomenon in a simple palatable format, many have turned to the use of conceptual frameworks. In fact as a tool in elucidating the ideas of the concept of food security, the use of such frameworks cannot be underestimated. Indeed, their use has overwhelmingly been seen as a major benefit in the transference of knowledge. This is especially so when it comes to conveying the concept to the uninitiated. This was highlighted with one specialist interviewed in this research, who succinctly summed up when he said that it was all very well for experts to be:

> "… fluent in the idiosyncrasies and nuances of food security understanding, [yet] attempting to translate such knowledge across the expertise divide is a challenge." **E14**.

This difficulty in conveying the food security concept through the use of models was also seen by this research as problematical. Indeed, it was found in general that the confusion and disorganisation expressed in the literature regarding the concept in general was also found to be replicated in many existing conceptual frameworks of food security. Such frameworks it seemed, overwhelmingly fell into two broad categories; those that were oversimplified and of little use to professionals in the field; and those that were too complex and esoteric to be of benefit to the majority of food security stakeholders. Importantly too, the majority of frameworks it seemed, seemed to share one common failing; a lack of credibility. This was related to the fact that many such frameworks were seen as being little more than simple ad-hoc representations of the concept or worse, mere subjective interpretations of a complex subject that contained little or no academic or scientific basis.

What was also learnt too from these analyses, was that this situation could very well be improved with a simple, well conceived academically rigorous generated model. This would be open and transparent and would allow for the validity of the model itself to be determined with a good degree of confidence. Following this realisation, this research generated a tentative theory that suggested the formalisation of previously considered ad-hoc frameworks would be an effective method of generating an updated real-life workable conceptual model of food security. To test this theory two models were created; one using group analysis and another based on this research author's experience but both through the rigorous application of scientific principles.

Both methods had advantages and disadvantages. The first model was created using Trochim's pre-existing method of concept map generation and, while it the final model provided a good approximation of the concept of food security, it did lack a certain clarity and cohesion that seemed to let down the overall final model. On the other hand, the strength of the second, the literature review informed Author's method, lay in the flexibility of the chosen pragmatic approach. This promoted the intelligent and intuitive generation of ideas that resulted in a final model that was well received by the specialists. As a result, this author's model was seen as easy to comprehend with a novel three-tiered format that appealed to both professionals and lay-people. Importantly too, it was also seen as successfully incorporating the latest understanding of the concept, one in which the full dimension of the phenomenon was captured.

Significantly, the author's final model is not one designed to replace numerous others, but rather to complement them. Importantly too, while some elements of this model's components still relied on certain assumptions and subjectivity, the open and transparent nature of the modelling process used allows for future improvements as a and when new information arises.

Ultimately, from these findings it was found that a good framework was not one that required too much clarification, but by definition, presupposed a certain amount of simplicity. This simplicity however, was the result of an important trade-off between the many variables of complexity, scope and coverage among others. Moreover, finding the right balance between these ideals was not easy to achieve objectively, yet it was a task that benefitted tremendously from the application of scientific rigour.

Finally, as in all good research the confidence of these findings is dependent on having chosen the appropriate methods and having employed those methods in a rigorous and equally appropriate manner. Of the many methods employed in this research the use of transparency and triangulation overwhelmingly combined to support these conclusions giving them both strength and rigidity. Consequently and as generally agreed upon in the findings of the specialist interviews, by placing the construction of these frameworks within the realms of scientific rigor, their validity and usefulness were surely advanced. Such conclusions then have implications for policy makers who may not feel adequately briefed on the complexity of the food security concept and who may well fail to visualise the overarching nature of the concept, particularly in connection with the various interrelated relationships. In this respect a good, scientifically grounded concept map is an important tool in the dissemination and understanding of the complex food security concept

9 Reflections Recommendations for Further Research

This research set out to introduce a new framework of food security. This was achieved although there were many challenges in the journey. In formalising the process of developing conceptual frameworks, there appears to be wide ranging views on the best methods in achieving this. While this research combined several competing methodologies, it was found many such proprietary techniques were indeed complementary. That said, and despite being an objective attempt at relating a complex idea, there was still a certain amount of subjectivity within the process; in particular with the author generated model. Future research aimed at introducing more formalised approaches to social scientific modelling, that reflects the sort of progress being made in quantitative fields of study would be of great benefit to future social science studies.

With regards to the complexities of food security itself, it seems the debate is set to continue. With food security taking on a more inclusive remit, encompassing wider societal issues such as sustainability and the environment for instance, the concept is only going to become more difficult to comprehend. Moreover, the concept is a dynamic phenomenon and no sooner might an understanding be achieved then variables come along that complicate matters. In this way, more holistic reviews of the concept on a regular basis would certainly keep stakeholders abreast of continual developments within the concept. Perhaps too, along the way consensus and solutions might also be forthcoming.

In respect of the methodological process within this study, there was a lot that needed to be considered, both from a practical and philosophical perspective. There is numerous literature out there covering these aspects, yet much seems to be vague, subjective and non-committal. This, in this researcher’s view reflected the non-consensual nature of research within the social scientific fields. Further research perhaps, of a meta-analysis type that collated and assess the breadth of consensus and understanding in this field would only benefit future students aiming to take on important research.

10 References

ActionAid (2003). Food Aid: An ActionAid Briefing Paper, ActionAid.

Alexandratos, N., Ed. (1995). World Agriculture: Towards 2010. Chichester, FAO & JOHN WILEY & SONS.

Andersen, S. A. (1990). "Core Indicators of Nutritional State for Difficult to Sample Populations." The Journal of Nutrition 120 (Suppl 11): 1559-1600.

Anderson, M. D. and J. T. Cook (1999). "Community food security: Practice in need of theory?" Agriculture and Human Values 16: 141-150.

Armitage, A. and D. Keeble-Allen (2008). "“Undertaking a Structured Literature Review or Structuring a Literature Review: Tales from the Field." The Electronic Journal of Business Research Methods 6(2): 103 - 114.

Ashley, C. and D. Carney (1999). Sustainable livelihoods: Lessons from early experience. London, Department for InternationalDevelopment (DFID): 64 pp.

Audenhove, L. V. (2007). Expert Interviews and Interview Techniques for Policy Analysis, SMIT Studies on Media, Information and Telecommunication.

Bacharach, S. B. (1989). "Organizational Theories: some criteria for evaluation." Academy of Management Review 14(4): 496-515.

Bajaj, J. K. (1988). Francis Bacon, the first philosopher of modern science: A non-western view. Science, Hegemony and Violence: A Requiem for Modernity. A. Nandy, Oxford University Press. Bombay, Calcutta, Madras.

Barbour, R. S. (2001). "Checklists for improving rigour in qualitative research: a case of the tail wagging the dog?" BMJ 322(7294): 1115-1117.

Barrett, C. and D. Maxwell (2005). Food Aid After Fifty Years: Recasting Its Role. London, Routledge.

Barrett, C. and D. Maxwell (2006). "Towards A Global Food Aid Compact." Food Policy 31(2): 105-118.

Beaton, G. H. and J. M. Bengoa (1976). Some Concepts and Practical Considerations in Planning and Evaluation. Nutrition in Preventative Medicine: The major Deficiency Syndromes, Epidemiology and Approaches to Control G. H. Beaton and B. J. M. Geneva, World Health organisation.

Bedford, T. and J. Burgess (2001). The focus group experience in eds Qualitative methodologies for geographers: issues and debates. M. Limb and C. Dwyer. New York, Arnold: 121-35.

Bendich, A. (1992). "Symposium: History of Nutritional Immunology: Vitamins and Immunity1." The Journal of Nutrition 3: 601-604.

Bennett, M. K. (1949). "Food and Agriculture in the Soviet Union, 1917-48." The Journal of Political Economy 57(3): 185-198.

Biraben, J.-N. (1980). "An Essay Concerning Mankind's Evolution." Journal of Human Evolution 9(8): 655-663.

Borlaug, N. E. (2000). The Green Revolution Revisited and The Road Ahead. 30th Anniversary. Lecture. Oslo, The Norwegian Nobel Institute.

Boshier, R. (1990). "Socio-psychological Factors in Electronic Networking." International Journal of Lifelong Education 9(1): 49-64.

Brandt, K. (1939). Foodstuffs and Raw Materials. War in Our Time. H. Speier and A. Kähler. New York, W.W. Norton & Co.

Bray, D. and H. v. Storch (1999). "Climate science: an empirical example of post-normal science." Bulletin of the American Meteorological Society 80 (3): 439-455.

Brill, L., G. Brown, *et al.* (2009). The Sustainable Livelihoods Handbook: An asset based approach to poverty. UK, OXFAM/ Church Action on Poverty: 52 pp.

Britannica (2009). Encyclopædia Britannica Online. Chicago, Encyclopædia Britannica, Inc. 2009.

Brown, L. (2005). Outgrowing the Earth: The Food Security Challenge in an Age of Falling Water Tables and Rising Temperatures. New York, W.W. Norton and Co.

Brown, L. (2008). "Why Ethanol Production Will Drive World Food Prices Even Higher in 2008." Retrieved 7 June 2009, 2009, from http://www.Earth-policy.org/Updates/2008/Update69.htm

Bryman, A. (2004). Social Research Methods. Oxford, OUP.

Buber, R., J. Gadner, *et al.* (2004). Applying Qualitative Methods to Marketing Management Research, Palgrave Macmillan.

Bunge, M. (1977). Treatise on Basic Philosophy: Ontology II: A World of Systems. New York, D. Reidel Publishing Co., Inc.

Burns, N. and S. K. Grove The practice of nursing research: conduct, critique, and utilization. Missouri, Elsevier Saunders.

Burrell, G. (1979). Sociological Paradigms and Organisational Analysis, Ashgate.

Carpenter, K. J. (2003). "A Short History of Nutritional Science: Part 2 (1885–1912)." Journal of Nutrition 133(April): 975 - 984.

Carruthers, I., M. W. Rosegrant, *et al.* (1997). "Irrigation and food security in the 21st century." Irrigation and Drainage Systems 11(2): 83-101.

CFS (1998). Guidelines for National Food Insecurity and Vulnerability Information and Mapping Systems (Fivims): Background and Principles. Committee on World Food Security: Twenty-fourth Session, Rome, Committee on World Food Security.

CFS (2000). Assesment of the World Food Security Situation: Suggested Core Indicators For Monitoring Food Security Status. Committee On World Food Security: Twenty-sixth Session, Rome, Committee On World Food Security.

CFS (2001). Assessment Of The World Food Security Situation. FAO Committee on Food Security, Twenty-seventh Session, Rome, Food and Agriculture Organisation.

CFS (2007). Assessment of the World Food Security Situation. Committee On World Food Security: Thirty-third Session, Rome, Food and Agriculture Organisation.

CFS (2008). "FAO: Committee on World Food Security - Indicators of Food Security." Retrieved 15th Feb 2011, 15th Feb 2011, from http://www.fao.org/unfao/govbodies/cfs/indicators_en.htm.

CFS (2008a). Agenda Item Ii: Assessment of the World Food Security and Nutrition Situation. Committee On World Food Security: Thirty-fourth Session, Rome, Food and Agriculture Organisation.

Chalmers, C. (1852). Notes, Thoughts, and Inquiries. Princes Street, Soho: London: John Churchill.

Chamberlin, W. H. (1934). "The Ordeal of the Russian Peasantry." Foreign Affairs 12(3): 495-507.

Chambers, R. (2005). Ideas for Development. Brighton, Earthscan Ltd: Institute of Development Studies,.

Charles, C. (2008) Food shortages: how will we feed the world? Telegraph online

References

ChildInfo (2009). "A world Fit for Children." Child Nutrition. Retrieved 12th Feb 2011, 2011, from http://www.childinfo.org/idd.html.

CIA Factbook (2010). "The CIA World Factbook." Retrieved 12th Oct 2010, 12th Oct 2010, from https://www.cia.gov/library/publications/the-world-factbook/geos/xx.html.

Clapp, J. (2009). "The Global Food Crisis and International Agricultural Policy: Which Way Forward?" Global Governance 15(2): 299-312.

Coe, R. (2002). It's the Effect Size, Stupid: What effect size is and why it is important. Annual Conference of the British Educational Research Association. University of Exeter.

Cohen, B. (2006). "Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability. ." Technology in Society 28(63).

Cohen, I. B. (2006). The Triumph of Numbers: How Counting Shaped Modern Life. London, W. W. Norton.

COL (2010). Manual For Educational Media Researchers Know Your Audience. New Delhi, COL: Commonwealth Educational Media Centre for Asia.

Crandall, B. (1999) To Focus Group, Or Not To Focus Group? Decision Analyst White Papers

CRED (2009). "The Centre for Research on the Epidemiology of Disasters: History." Retrieved 12th June 2010, 2010, from http://www.cred.be/history.

Croft, W. B. and X. Li (2004). An Answer Updating Approach to Novelty Detection. CIIR Technical Report, IR-359. Massachusetts, University of Massachusetts: Department of Computer Science.

Cronin, A. (2001). Focus groups. Researching social life. N. Gilbert. London, Sage: 164-77.

Cyberschoolbus, U. (2010). "UN Global Teaching and Learning Project." from http://cyberschoolbus.un.org.

Darcy, J. and C. Hofmann (2003). According to Need? Needs assessment and decision making in the humanitarian sector. London, Overseas Development Institute.

Darmawan, k. kyuma, *et al.* (2006). "Effect of green revolution technology from 1970 to 2003 on sawah soil properties in Java, Indonesia: I. Carbon and nitrogen distribution under different land management and soil types." Soil Science & Plant Nutrition 52(5): 634-644.

Davies, I., P. Green, *et al.* (2006). "How do practitioners use conceptual modeling in practice? ." Data & Knowledge Engineering 58(3): 358-380

Dawson, S. and L. Manderson (1993). METHODS FOR SOCIAL RESEARCH IN DISEASE: A Manual for the Use of Focus Groups. Tokyo, United Nations University.

Defra (2006). Food Security and the UK: An Evidence and Analysis Paper. Food Chain Analysis Group. UK, Department of Environment, Food and Rural Affairs,.

DePaulo, P. (2000) Sample size for qualitative research. Quircks

DeRose, L., E. Messer, *et al.* (1998). Case study: The importance of non-market entitlements. In DeRose, L., Messer, E., and Millman, S. Who's hungry? And how do we know? Food shortage, poverty, and deprivation. Tokyo, New York, Paris, United Nations University Press.

DeRose, L. and S. Millman (1998). Framework: Food shortage, food poverty, food deprivation. Who's hungry? And how do we know? Food shortage, poverty, and deprivation. L. DeRose, Messer, E., and Millman, S. Tokyo, New York, Paris, United Nations University Press.

DESA/CSD (2010). Achieving Sustainable Food Security: New Trends and Emerging Agenda. Multistakeholder Dialogue on Implementing Sustainable Development, United Nations Headquarters, New York, DESA: Division For Sustainable Development CSD Secretariat.

DESA/POP (2010). World Population Prospects, UN Department of Economic and Social Affairs.

Devereux, S. (2000). Famine in the twentieth century. Brighton, Istitute for Development Studies.

Devereux, S., B. Baulch, *et al.* (2004). Improving the Analysis of Food Insecurity: Food Insecurity Measurement, Livelihoods Approaches and Policy: Applications in Fivims. Rome, FAO-Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS): 52.

Dewan, M. (2008). "Malnutrition in Women." The journal Studies of Home and Community Science 2(1): 7-10.

DFID (1997). Eliminating World Poverty: A Challenge for the 21st Century. White Paper on International Development. London, Department for International Development.

DFID (1999). Sustainable livelihoods Guidance Sheets: Overview. Sustainable livelihoods Guidance Sheets. London, Department for International Development DFID.

DFID (2004). Agriculture, hunger and food security. UK, Department for International Development (DFID).

DFID (2009). Draft Terms of Reference Tackling the Neglected Crisis of Undernutrition Research Programme Consortia. London, Department for International Development (DFID).

Dilley, M. and T. E. Boudreaub (2001). "Coming to terms with vulnerability: a critique of the food security definition." Food Policy 26(3): 229-247.

Dobson, P. J. (2002). "Critical Realism and information systems research: why bother with philosophy?" Information Research 7(2).

Dyer, G. (2006) How Long Can the World Feed Itself? Energy Bulletin

Dyson, T. and C. Ó Gráda, Eds. (2002). Famine demography: Perspectives from the Past and Present UK, Oxford University Press.

Earp, J. A. and S. T. Ennett (1991). "Conceptual models for health education research and practice." Health Education Research 6(2): 163-171.

Ehrich, P. and A. Ehrlich (1990). Overpopulation. The population explosion. P. Ehrich and A. Ehrlich. New York, Simon and Schuster: 37-40.

Eifert, B., C. Galvez, *et al.* (2002). "The World Grain Economy to 2050: A dynamic general equilibrium, two sector approach to long-term world-level macroeconomic forecasting." University Avenue Undergraduate Journal of Economics (Online).

Ellis, F. and S. Briggs (2001). "Evolving Themes in Rural Development 1950s-2000s." Development Policy Review 19(4): 437.

Ellman, M. (2000). "The 1947 Soviet famine and the entitlement approach to famines." Cambridge Journal of Economics 24: 603-630.

EPA (2009). Session 2 Overview Model Evaluation: Establishing Model's Credibility, Envirnment Protection Agency: Office of Research and Development National Exposure Research Laboratory, Atmospheric Modeling and Analysis Division

Ericksen, P. J. (2008). "Conceptualizing food systems for global environmental change research " Global Environmental Change 18(1): 234-245

Ericksen, P. J. (2008). "What Is the Vulnerability of a Food System to Global Environmental Change?" ECOLOGY AND SOCIETY 13(2): 1.

ESA (2007). World Population Prospects: The 2006 Revision. New York, UN Department of Economic and Social Affairs:Population Division.

Eswaran, H., P. Reich, *et al*. (2006). Land degradation: An assessment of the human impact on global land resources. At the 18th World Congress on Soil Science. .

EU (2006). European Union Regulation (EC) No 1905/2006. E. Union, European Union.

EU (2010). "EU Development Policy: Food security." Retrieved 30th March 2010, 30th March 2010, from http://www.consilium.europa.eu/showPage.aspx?id=1662&lang=EN.

Evenson, R. E. and D. Gollin (2003). "Assessing the Impact of the Green Revolution, 1960 to 2000." Science 300(5620): 758 - 762.

FANTA2 (2010). "About Food and Nutrition Technical Assistance II Project (FANTA-2)." Retrieved 15th July 2010, 2010, from http://www.fantaproject.org/.

FAO (1989). Prevention of post-harvest losses, fruits vegetables and root crops. A training maual. Rome, Food and Agriculture Organisation.

FAO (1995). Dimensions of Need: An Atlas of Food and Agriculture. Rome, Food and Agriculture organisation.

FAO (1996). Rome declaration on world food security and world food summit plan of action. Rome, Food and Agriculture Organization of the United Nations.

FAO (2000). Handbook for Defining and Setting up a Food Security Information and Early Warning System (FSIEWS). ROME, Food and Agriculture Organisation.

FAO (2002). Report of the World Food Summit: five years later. World Food Summit: five years later, Rome, Food and Agriculture Organisation.

FAO (2003). Trade Reforms and Food Security: Conceptualizing the Linkages. Rome, Food and Agriculture of the United Nations.

FAO (2003). World Agriculture: Towards 2015/2030. An FAO Perspective. Rome, Food and Agriculture Organization of the United Nations/Earthscan.

FAO (2006). "Country Profiles: Low-Income Food-Deficit Countries (LIFDC)." Retrieved 30th March 2009, 2009, from http://www.fao.org/countryprofiles/lifdc.asp?lang=en.

FAO (2006). Policy Brief: Food Security. Rome, Food and Agriculture Organisation: 4.

FAO (2006). The State Of Food And Agriculture 2006: Food Aid For Food Security? Rome, U.N. Food and Agriculture Organisation.

FAO (2007). FAO's Role & Effectiveness in Emergencies. Rome, Food and Agriculture Organisation: 208 pp.

FAO (2007). "Good Agricultural Practices." Good Agricultural Practices. Retrieved 30th Jan 2011, 2011, from http://www.fao.org/prods/GAP/home/.

FAO (2008). Crop Prospects And Food Situation No.2: Countries In Crisis Requiring External Assistance. Rome, U.N. Food and Agriculture Organisation.

FAO (2008). Methods To Monitor the Human Right to Adequate Food: Volume I Making the case fo Rights-Focused and Rights-Based Monitoring. Rome, FAO.

FAO (2010). Food Security Statistics, Food and Agriculture Organisation.

FAO (2010). Global hunger declining, but still unacceptably high: International hunger targets difficult to reach. News Brief. Rome, Food and Agriculture Organisation.

FAO (2010). "Website of the Food and Agriculture Organisation of the United nations." Retrieved 15th Nov 2010, 15th Nov 2010, from http://www.fao.org/hunger/faqs-on-hunger/en/.

FAO (2011). "Fisheries and food security." Retrieved 5 Jan 2011, 2011, from http://www.fao.org/FOCUS/E/fisheries/intro.htm.

FAO (2011). Food Security Statistics, Food and Agriculture Organisation.

FAOSTAT (2008). Food and Agriculture Statistics, Food and Agriculture Organisation.

FAOSTAT (2008). "Production: Crops." Retrieved 1 May 2009, from http://faostat.fao.org/site/526/default.aspx

FAOSTAT (2011). Food and Agriculture Statistics, Food and Agriculture Organisation.

Fári, M. G. and U. P. Kralovánszky (2006). "The founding father of biotechnology: Károly (Karl) Ereky." International Journal of Horticultural Science 12(1): 9-12.

Fisher, H. H. (1927). The Famine In Soviet Russia 1919-1923 The Operations Of The American Relief Administration Freeport, New York, Books For Libraries Press.

FIVMS (2008). "The FIVIMS Initiative: Food Insecurity and Vulnerability Information and Mapping Systems." Retrieved 6 June 2009, 2009, from http://www.fivims.org/index.php?option=com_content&task=blogcategory&id=20&Itemid=37.

FIVMS (2008). The FIVIMS Initiative: Food Insecurity and Vulnerability Information and Mapping Systems: Tools and Tips. 2009.

Frankenberger, T. R., M. Drinkwater, *et al.* (2000). Operationalizing Household Livelihood Security: A Holistic Approach for Addressing Poverty and Vulnerability. Atlanta, Georgia, CARE USA: 34 pp.

Frankenberger, T. R., K. Luther, *et al.* (2002). Household Livelihood Security Assessments: A Toolkit for Practitioners. Tuscon, CARE USA.

Freedom 21 (2008). Meeting Essential Human Needs. 9th Annual National Conference, Dallas, Freedom 21.

Freedom from Hunger (2010). "Website of the Freedom from Hunger." Retrieved 15th June 2010, 15th June 2010, from http://www.freedomfromhunger.org/.

Freen, R. H. (1996). "Ancient Greek philosophical concerns with population and environment." Population and Environment 17(6): 447-458.

Funk, C. (1922). The vitamines. Baltimore, Williams & Wilkins Company.

G8 Summit (2009). L'Aquila Joint Statement on Global Food Security. 2009 G8 Summit, L'Aquila, Italy, L'Aquila Food Security Initiative (AFSI).

Galloway, A. (1997). Sampling: A Workbook. Edinburgh, The Tardis Project: The University of Edinburgh.

Gantt, W. H. (1936). "A Medical Review of Soviet Russia: Results of The First Five Year Plan." British Medical Journal 2(3939): 19-22.

Gardner, B. L. (2002). American Agriculture in the Twentieth Century: How it Flourished and What it Cost. Cambridge, Massachusetts, Harvard University Press

GEO (2000). Global Environment Outlook. Global Environment Outlook. Malta, United Nations Environment Programme.

GEO (2007). Global Environment Outlook 4: Environment for Development. Malta, United Nations Environment Programme.

Gerster-Bentaya, M. and N. Maunder (2008). Food Security Concepts and Frameworks: Food Security Analysis, EC-FAO.

References

GFS (2011). "Global Food Security." Retrieved 12th Feb 2011, 2011, from <http://www.foodsecurity.ac.uk/issue/global.html>.

GFS (2011). "Global Issues." from http://www.foodsecurity.ac.uk/issue/global.html.

Gibbs, A. (1997). "Focus Groups." Social Research Update(19).

Glaser, B. G. and A. L. Strauss (1967). The Discovery of Grounded Theory: Strategies for Qualitative Research. New York, Aldine Publishing.

Glass, G. V. (2000) Meta-Analysis at 25.

Göb, R., C. McCollin, *et al.* (1967). "Ordinal Methodology in the Analysis of Likert Scales." Quality and Qauntity 41(5): 601-626.

Grebmer, K. v., B. Nestorova, *et al.* (2009). 2009 Global Hunger Index the Challenge Of Hunger: Focus on Financial Crisis and Gender Inequality. The Global Hunger Index. Washington DC, International Food Policy Research Institute.

Greenway, K. (2008). Inter-Agency Task Team on Children and HIV and AIDS: Working Group on Food Security and Nutrition. Paris, IATT Food Security and Nutrition Working Group.

Guest, G., A. Bunce, *et al.* (2006). "How Many Interviews Are Enough? An Experiment with Data Saturation and Variability " Field Methods 18(1): 59-82.

Haddad, L. (2002). 2001 Assessment of the World Food Security Situation. ODI Food Security Briefings. London, Overseas Development Institute: 4.

Hahn, H. (2000). Conceptual Framework of Food and Nutrition Security. Cambodia Food Security and Nutrition website, Cambodia Government Food Security and Nutrition (FSN).

Hale, C. D. and D. Astolfi (2007). Evaluating Education and Training Services: A Primer, Saint Leo University.

Halweil, B. (2003). Grain production drops. Vital Signs. L. Starke. New York, W.W. Norton.

Hannon, B. (1985). Linear Dynamic Ecosystems *Journal of Theoretical Biology* 116(1).

Hargrove, J. L. (2006). "History of the Calorie in Nutrition." Journal of Nutrition 136: 2957-2961.

Hartmannshenn, T. (2004). FOOD SECURITY: Guidelines for the Promotion and Execution of Food Security Projects by German Agro Action. Bonn, German Agro Action.

Harwell, M. R. and G. G.G. (2001). "Rescaling Ordinal Data to Interval Data in Educational Research." Review of Educational Research Spring(71): 105-131.

Hasson, D. and B. B. Arnetz (2005). "Validation and Findings Comparing VAS vs. Likert Scales for Psychosocial Measurements." International Electronic Journal of Health Education 8: 178-192.

Haub, C. (2002). "How Many People Have Ever Lived on Earth?" Population Reference Bureau 30(8): 3-4.

Hionidou, V. (2002). "Why do people die in famines? Evidence from three island populations." Population Studies 56(1): 65 - 80.

Hoddinott, J. (1999). Choosing Outcome Indicators of Household Food Security. Washington, D.C, International Food Policy Research Institute: 29.

Hoddinott, J., M. J. Cohen, *et al.* (2008). "Renegotiating the Food Aid Convention: Background, Context, and Issues." Global Governance 14 283-304.

Hollensen, S. (2007). Global Marketing: A decision-oriented approach. Essex, Pearson Education.

Holweg, H. and D. P. Donk (2009). "When is a conceptual framework also a theoretical contribution? Operations and Supply Management Forum, July 2009." Journal of Operations Management.

Hopkins, P. E. (2007). "Thinking critically and creatively about focus groups." Area 39(4): 528-535.

Howze, Y. S. (2000). "Using Focus Groups as an Applied Research Tool." Council of Schools for the Blind (COSB) 6(2).

Hutchinson, C. F. (1998). Social Science and Remote Sensing in Famine Early Warning. People and Pixels: Linking Remote Sensing and Social Science. D. Livereman, E. F. Moran, R. R. Rindfuss and P. C. Stern. Washington D.C., National Academy Press.

IFAD (2009). "Food Security: A Conceptual Framework." Retrieved 15th August 2009, 2009, from http://www.ifad.org/hfs/thematic/rural/rural_2.htm.

IPC (2007). The Integrated Food Security and Humanitarian Phase Clasification System: Technical Manual Version 1. Rome/ Somalia, FAO/ FSUA: 47.

IPC (2007). The Integrated Food Security Phase Classification: Technical Manual Version 1.1. Rome, FAO: IPC Global Partners.

IPC Global Partners (2008). Integrated Food Security Phase Classification: Technical Manual Version 1.1. Rome, FAO.

Jackson, K. m. and W. m. K. Trochim (2002). "Concept mapping as an alternative Approach for the analysis of Open-ended survey responses." Organizational Research Methods 5(307).

Jamieson, S. (2004). "Likert scales: how to (ab)use them." Medical Education(38): 1212-1218.

Johnson, D. G. (1997). "Agriculture and the Wealth of. Nations." American Economic Review 87(2): 1-12.

Johnson, D. G. (2000). "Population, Food, and Knowledge." The American Economic Review 90(1): 1-14.

Jonsson, U. (2009) Food Security and Nutrition Security – What is the problem and what is the difference. FAO Global Forum on Food Security and Nutrition

Kalayjian, A. S., S. P. Shahinian, *et al.* (1996). " Coping with ottoman turkish genocide: An exploration of the experience of armenian survivors." Journal of Traumatic Stress 9(1).

Kaplan, S. and E. D. Beinhocker (2003). "The real value of strategic planning." MIT Sloan Management Review 44(71-76).

Karunakara, U. (2010). Haiti: where aid failed. Guardian online. London, Guardian News and Media Limited. 28 December 2010.

Kennedy, G. (2002). Measurement and Assessment of Food Deprivation and Undernutrition: Part III: Parallel contributed papers sessions - Discussion group report - anthropometric survey methods. International Scientific Symposium, Rome, FAO.

Khush, G. S. (2001). "Green revolution: the way forward." Nature Reviews: Genetics 2: 815-822.

Kincaid, H. (1996). Philosophical foundations of the social sciences: analyzing controversies in the Social Sciences. New York, University of Cambridge Press.

King, M. and C. Elliott (1996). "Education and debate: Averting a world food shortage: tighten your belts for CAIRO II." British Medical Journal 313: 995-997.

Klasen, S. (2002). Measurement and Assessment of Food Deprivation and Undernutrition: Part III: Parallel contributed papers sessions - Discussion opener - anthropometric survey methods. International Scientific Symposium: FIVIMS - An Inter-Agency Initiative to Promote Information and Mapping Systems on Food Insecurity and Vulnerability, Rome, FAO.

Knapp, T. R. (1993). "Treating Ordinal Scales As Ordinal Scales." Nursing Research 42(3): 184-188.

Kotiadis, K. and S. Robinson (2008). Conceptual modelling: knowledge acquisition and model abstraction. The 2008 Winter Simulation Conference.

Krauss, S. E. (2005). "Research Paradigms and Meaning Making: A Primer." The Qualitative Report 10(4): 758-770.

Kumar, P., M. Birthal, *et al.* (2007). Changing composition pattern in South Asia. Agricultural diversification and smallholders in South Asia. P. Joshi, A. Gulati and R. Cummings. New Delhi, Academic Foundation.

Kumar, R. (1999). Research methodology: a step by step guide for beginners. Malaysia, sage.

Latham, M. C. (1997). Human nutrition in the developing world. Food and Nutrition Series - No. 29. Rome, Food and Agriculture Organisation of the United Nations.

Lave, C. A. and J. G. March (1975). An Introduction to Models in the Social Sciences. New York, Harper & Row.

Lemke, S. (2005). "Nutrition security, livelihoods and HIV/AIDS: implications for research among farm worker households in South Africa." Public Health Nutrition 8: 844-852.

Leo Lucassen, D. F., Jochen Oltmer (2006). Paths of Integration: Migrants in Western Europe (1880-2004), Amsterdam University Press.

Longhurst, R. (1996). "Refocusing groups: pregnant women's geographical experiences of Hamilton, New Zealand/Aotearoa." Area (28): 143-9.

Love, T. and E. Cowan (1999). Towards an epistemologically more coherent view of design. The Paradigm Dialog. E. Guba. California, Sage Publications Inc.

Løvendal, C. R. and M. Knowles (2005). ESA Working Paper No. 05-07: Tomorrow's Hunger: A Framework for Analysing Vulnerability to Food Insecurity. ESA Working Papers. Rome, FAO: Agricultural and Development Economics Division.

Lowe, T. D. and I. Lorenzonia (2007). "Danger is all around: Eliciting expert perceptions for managing climate change through a mental models approach." Global Environmental Change 17(1): 131-146.

MacAuslan, I. (2009). "Hunger, Discourse and the Policy Process: How do Conceptualizations of the Problem of 'Hunger' Affect its Measurement and Solution?" European Journal of Development Research 21: 397-418.

Mack, N., C. Woodsong, *et al.* Qualitative Research Methods: A Data Collector's Field Guide Module 4: Focus Groups. USA, Family Health International/USAID.

Maire, B. and F. Delpeuch (2005). Nutrition indicators for development: Reference Guide. Montpellier, France, FAO & IRD: Institut de Recherche pour le Développement.

Malthus, T. R. (1798). An Essay on the Principle of Population, As It Affects the Future Improvement of Society with Remarks on the Speculations of Mr. Godwin, M. Condorcet, and Other Writers. London, Printed for J. Johnson, in St. Paul's Church-Yard.

Maunder, N. (2006). Food Security Information Systems and Networks: Lesson 1 - Food Security Information Systems. Food Security Information Systems and Networks. o. l. course. Rome, EC FAO: 19.

Maxwell, J. A. (2005). Qualitative research design: An interactive approach. Thousand Oaks, SAGE Publications.

Maxwell, S. and T. Frankenberger (1992). Household Food Security: Concepts, Indicators and Measurements: A Technical Review. New York, Rome, UNICEF and IFAD.

Maxwell, S. and M. Smith (1992). Household food security; a conceptual review. Household Food Security: Concepts, Indicators, Measurements: A Technical Review. S. Maxwell and T. R. Frankenberger. New York/Rome, UNICEF/IFAD.

McCalla, A. F. (2007). FAO in the Changing Global Landscape. California, Department of Agricultural and Resource Economics: University of California.

McCalla, A. F. and C. L. Revoredo (2001). Prospects for Global Food Security: a Critical Appraisal of Past Projections and Predictions. Washington, DC, International Food Policy Research Institute.

McEvedy, C. and R. Jones (1974). Atlas of world population history. New York, Facts on File.

McHarry, J., F. Scott, *et al.* (2002). Towards Global Food Security: Fighting against hunger. Earth Summit. Towards Earth Summit 2002, Earth Summit 2002.

McLachlan, M. and J. Garrett (2008). "Nutrition change strategies: the new frontier." Public Health Nutrition 11(10): 1063-1075.

McLaughlin, A., G. J. W. Hiba, *et al.* (2000). "Comparison of energy inputs for inorganic fertilizer and manure based corn production." Canadian Agricultural Engineering 42(1).

MDG (2000). "Proportion of population below minimum level of dietary energy consumption. ." Retrieved 10 July 2008, 2008, from http://mdgs.un.org/unsd/mdg/Metadata.aspx?IndicatorId=5

Mehta, V. N. (1929). "Famines and Standards of Living." The ANNALS of the American Academy of Political and Social Science 145: 82 - 89.

Merritt-Hawkes, O. A. (1928). "The Population Conference at Geneva." Journal of Heredity 19: 313-315.

Meyer, J. (2000). "Qualitative research in health care Using qualitative methods in health related action research This is the last in a series of three articles." BMJ 320: 178-181.

Misselhorn, A. A. (2005). "What drives food insecurity in southern Africa? a meta-analysis of household economy studies." Global Environmental Change Part A 15(1): 33-43.

Mokyr, J. and C. Ó. Grada (2002). "What do people die of during famines: the Great Irish Famine in comparative perspective." European Review of Economic History 6(1): 339-363.

Moore, S., J. N. Hall, *et al.* (2010). "Global and National Socioeconomic Disparities in Obesity, Overweight, and Underweight Status." Journal of Obesity 2010 11.

Morgan, D. L. (1998). The focus group guidebook. London, Sage.

Mud Valley (2010) Designing a questionnaire - focus groups. Mud Valley Brand marketing

Muir, P. (2009) Land.

Muller, O. and A. Jahn (2009). "Malnutrition and Maternal and Child Care." Maternal and Child Health(Part 3): 287-310.

Müller, R. (2000). The Concept of Model and its Triple History. 13th International Conference on History and Philosophy of Science (organized by the IUHPS/DHS-DLMPS Joint Commission), University of Zurich, 19-22 October 2000; topic: “Scientific Models: Their Historical and Philosophical Relevance", Zurich, IUHPS/DHS/DLMPS.

Nandy, S., M. Irving, *et al.* (2005). "Poverty, child undernutrition and morbidity: new evidence from India." Bulletin of the World Health Organization 83(3): 161-240.

Neill, J. (2008) Why use Effect Sizes instead of Significance Testing in Program Evaluation?

Nellemann, C. (2009). The Environmental Food Crisis: The Environment's Role in Averting Future Food Crises. Geneva, United Nations Environment Programme (UNEP) GRID-Arendal.

Nierenberg, D. (2003). Meat production and consumption grow. Vital Signs 2003. L. Starke. New York, W.W. Norton.

Noor, K. B. M. (2008). "Case Study: A Strategic Research Methodology." American Journal of Applied Sciences 5(11): 1602-1604.

Novak, J. D. and A. J. Cañas (2008). The Theory Underlying Concept Maps and How to Construct and Use Them. Technical Report. Pensacola, Florida, Cornell University: 36.

Ó Grada, C. (2008). "The ripple that drowns? Twentieth-century famines in China and India as economic history." The Economic History Review 61(Supplement 1): 5-37.

Ó Gráda, C. (2009). Famine: A Short History. Princeton, University Presses of California, Columbia and Princeton.

ODI (2009). "Research and Policy in Development: Theoretical Models." Retrieved 23rd Jan 2011, 2011, from http://www.odi.org.uk/rapid/tools/Theory/.

OFDA/CRED (2010). The Centre for Research on the Epidemiology of Disasters: History. International Disaster Database. Brussels, Belgium, Universite catholique de Louvain. 2010.

Oltmer, J. (2006). "The unspoilt nature of German ethnicity": Immigration and integration of "ethnic Germans" in the German Empire and the Weimar Republic." Nationalities Papers 1465-3923 34(4): 429 - 446.

ONS (2008). The Office for National Statistics: Purposive sampling. U. S. Authority. London, ONS.

Osmani, S. R. (2002). Measurement and Assessment of Food Deprivation and Undernutrition: Part VII: Conclusions - Keynote speaker panel. International Scientific Symposium, Rome, FAO.

PAP (2008) Population and human development - the key connections. . People and the Planet Online

Patenaude, B. M. (2002). The big show in Bololand: the American relief expedition to Soviet Russia in the famine of 1921. Stanford, California, Stanford University Press.

Pelletier, D. (1994). "The Potentiating Effects of Malnutrition on Child Mortality: Epidemiologic Evidence and Policy Implications." Nutrition Reviews 52(12): 409-415.

Perner, L. (2003) What do we know about consumer confidence? Consumer Psychogist Newsletter 1,

Peters, P. (1993). Biotechnology: A Guide To Genetic Engineering. Dubuque, Iowa, Wm. C. Brown Publishers, Inc.

Peterson, M. D. (2004). Starving Armenians: America And The Armenian Genocide, 1915-1930 And After. Charlottesville, London, University of Virginia Press.

Pimentel, D. and M. Giampietro (1994). "Food, Land, Population and the U.S. Economy." Retrieved 6 May, 2008, from http://dieoff.org/page40.htm

Pingali, P. (2006). "Westernization of Asian diets and the transformation of food systems: Implications for research and policy." Food Policy 32: 2881-2980.

Radimer, K. L. (2002). "Measurement of household food security in the USA and other industrialised countries." Public Health Nutrition 5(6A): 859-864.

Rainville, B. and S. Brink (2001). Food Insecurity in Canada, 1998-1999. Hull, Québec, Human Resources and Skills Development Canada

Ralte, A. (1996). The Hunger Report 1995: Progress in Overcoming Micronutrient Deficiencies 1989-1994. E. Messer and P. Uvin. Amsterdam, Gordon and Breach: 141-156.

Rasler, K. A. and W. R. Thompson (1983). "Global Wars, Public Debts, and the Long Cycle." World Politics 35(4): 489-516.

Reason, P. and K. L. McArdle (2006). BRIEF NOTES ON THE THEORY AND PRACTICE OF ACTION RESEARCH. Understanding Research Methods for Social Policy and Practice. S. Becker and A. Bryman, Sage Publications.

Reinhardt, E. (2004). "itamin and Mineral Deficiency, A Global Progress Report." UN Chronicle Sept-Nov.

Richards, H. M. and L. J. Schwartz (2002). " Ethics of qualitative research: are there special issues for health services research?" Family Practice 19: 135-139.

Richardson, A. (2003). "The geometry of knowledge: Lewis, Becker, Carnap and the formalization of philosophy in the 1920s." Studies In History and Philosophy of Science Part A Volume 34(1): 165-182.

Riely, F. and N. Mock (1995). Inventory of food security impact indicators: food security indicators and framework. A Handbook for Monitoring and Evaluation of Food Aid Programs Arlington, VA, IMPACT.

Riely, F., N. Mock, *et al.* (1999). Food Security Indicators and Framework for Use in the Monitoring and Evaluation of Food Aid Programs. Washington, DC, Food and Nutrition Technical Assistance Project (FANTA): 50.

Rivera, W. M. and M. K. Qamar (2003). Agricultural Extension, Rural Development and the Food Security Challenge. Rome, Food and Agriculture Organisation.

Romney, A., S. Weller, *et al.* (1986). "Culture as consensus: A theory of culture and informant accuracy." American Anthropologis 88: 313-38.

Rosegrant, M. W., C. Ringler, *et al.* (2008). International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT): Model Description. Washington, International Food Policy Research Institute (IFPRI): 42 pp.

Rosen, S. (2010). Global Food Security Assesment. M. Gibson. Washington, USDA?ERS: 1.

Roughgarden, J. (1979). Theory of Population Genetics and Evolutionary Ecology: An Introduction. New York, Macmillan.

RTFN (2010). Land grabbing and nutrition: Challenges for global governance. Right to Food and Nutrition Watch. Germany, Brot für die Welt (Bread for the world). 2010: 90.

Ruxin, J. N. (1996). Hunger, Science, and Politics: FAO, WHO, and Unicef Nutrition Policies, 1945 - 1978, Chapter II The Backdrop of UN Nutrition Agencies, by Joshua Nalibow Ruxin. London, University College London. PhD.

Sachs, J. (2008) The Power Of One: How to End the Global Food Shortage. Time Magazine Online

Sandstead, H. H. and L. M. Klevay (2000). "History of Nutrition Symposium: Trace Element Nutrition and Human Health." The Journal of Nutrition 130(2): 2.

Saunders, M., P. Lewis, *et al.* (2007). A Research Methods for Business Students. Harlow, Pearson Publishing.

SCAR (2008). New challenges for agricultural research: climate change, food security, rural development, agricultural knowledge systems. The 2nd SCAR Foresight Exercise. G. Brunori, J. Jiggins, R. Gallardo and O. Schmidt. Brussels, EU Commission - Standing Committee on Agricultural Research (SCAR).

Scaramozzino, P. (2006). Measuring Vulnerability to Food Insecurity. Rome, FAO Agricultural and Development Economics Division (ESA): 26.

Schmidhuber, J. (2003). The outlook for long-term changes in food consumption patterns: Concerns and policy options. FAO Scientific Workshop on Globalization of the Food System, Rome, FAO.

Schneider, K. R. and R. G. Schneider (2010). Genetically Modified Food: What are GM Foods? Florida, University of Florida: The Institute of Food and Agricultural Sciences (IFAS).

SCN (2004). The Fifth Report on the World Nutrition Situation: Nutrition for Improved Development Outcomes. New York, UN: Standing Committee on Nutrition.

Scrimshaw, N. S. (1987). "The Phenomenon of Famine." Annual Review of Nutrition 7(7): 1-22.

SD (2001). Gender and Nutrition: Gender and development fact sheets. Rome, FAO/Sustainable Development Department.

Selwyn, N. and K. Robson (1998). "Using e-mail as a research tool." Social Research Update(21).

Shaohua, C. and M. Ravallion (2001). "How Did the World's Poorest Fare in the 1990s?" Review of Income and Wealth 47: 283-300.

Schmidt, H. and Jacobsen E.W. (2004) "Linear systems approach to analysis of complex dynamic behaviours in biochemical networks" Systems Biology 1(1): 149-158.

Shoemaker, P. J., Tankard, Jr., J. W., & Lasorsa, D. L. (2004). How to build social science theories. Thousand Oaks, CA, Sage.

Shoham, J. and C. Lopriore (2007). Livelihoods Assessment and Analysis: Introduction to Livelihoods. online learning course, EC FAO.

Sillers, D. (2008). National and International Poverty Lines: An Overview. US, USAID/EGAT/PR.

Smith, L. C., A. E. E. Obeid, *et al.* (2000). "The geography and causes of food insecurity in developing countries." Agricultural Economics 22(2): 199-215.

SOFI (2001). The State of Food Insecurity in the World 2001. Rome, Food and Agriculture Organisation.

SOFI (2005). State of Food Insecurity. Rome, Food and Agricultural Organisation.

SOFI (2006). State of Food Insecurity: Eradicating world hunger – taking stock ten years after the World Food Summit. Rome, Food and Agricultural Organisation.

SOFI (2008). The State of Food Insecurity in the World 2008. Rome, Food and Agriculture Organisation: 59.

SOFI (2009). The State of Food Insecurity in the World 2009. Rome, Food and Agriculture Organisation: 59.

Spratt, C., R. Walker, *et al.* (2004). Module A5: Mixed research methods, Commonwealth of Learning: Practitioner Research and Evaluation Skills Training in Open and Distance Learning (PREST).

Steck, T. L. (2008). "Human Population Explosion." Retrieved 25th March, 2008, from http://www.eoEarth.org/article/Human_population_explosion

Strauss, A. and J. Corbin (1994). Grounded theory methodology. Handbook of qualitative research. N. K. Denzin and Y. S. Lincoln. Thousand Oaks, CA, Sage: 273-285.

Strauss, A. and J. Corbin (1998). Basics of Qualitative Research Techniques and Procedures for Developing Grounded Theory (2nd edition). Handbook of qualitative research. Thousand Oaks, CA, Sage: 312.

Sulistyowati, C. (2002) Can Gmo Ensure Food Security Amid The Population Growth. Institute of Development Studies and Technological Assistance. BIC News

Svedberg, P. (1987). Undernutrition in Sub-Saharan Africa: A Critical assessment of the Evidence. Working Papers, UN World Institute for Development and Economics Research (WIDER).

Svedberg, P. (2000). Poverty and Undernutrition: Theory, Measurement, and Policy. Oxford, Oxfor University Press.

Svedberg, P. (2002). Measurement and Assessment of Food Deprivation and Undernutrition: Part III: Parallel contributed papers sessions - Fallacies in - and ways of improving - the FAO methodology for estimating prevalence of undernutrition. International Scientific Symposium: FIVIMS - An Inter-Agency Initiative to Promote Information and Mapping Systems on Food Insecurity and Vulnerability, Rome, FAO.

Swaminathan, M. S. (1990). Sir John Crawford Memorial Lecture: Changing Nature of the Food Security Challenge: Implications for Agricultural Research and Policy. Washington, Consultative Group on International Agricultural Research.

Tashakkori, A. and C. Teddlie (1998). Mixed methodology: Combining qualitative and quantitative approaches. Thousand Oaks CA, Sage.

Teorey, T. J., D. Yang, *et al.* (1986). "A Logical Design Methodology for Relational Databases using the Extended Entity-Relationship Model." ACM Computing Surveys 18(2): 197-222.

Thomlinson, R. (1975). Demographic Problems: Controversy over population control. Ecino, CA, Dickenson Publishing Company.

Tomkins, A. and F. Watson (1989). Malnutrition and Infection - A Review - Nutrition Policy Discussion Paper No. 5. Geneva, UN Administrative Committee on Coordination - Subcommittee on Nutrition.

Towers, N. and R. Chen (2008). "Employing the participative paradigm as a valid empirical approach to gaining a greater understanding of contemporary supply chain and distribution management issues." International Journal of Retail & Distribution Management 36(8): 627 - 637.

Trochim, W. and R. Linton (1986). "Conceptualization for Evaluation and planning." Evaluation and Program Planning 9(289-308).

Trochim, W. M. K. (2006). Research Methods Knowledge Base, Cornell University/Atomic Dog Publishing.

Troyer, A. F. (2004). "Breeding widely adapted, popular maize hybrids." Euphytica 92(1-2): 163-174.

Turner, B. L. and S. B. Brush (1987). Comparative farming systems. New York, Guilford Publishers Inc.

UCS (1992). "1992 World Scientists' Warning to Humanity." Retrieved 21st July 2009, 2009, from http://www.ucsusa.org/about/1992-world-scientists.html.

UN (1973). The Determinants and Consequences of Population Trends: New Summary of Findings on Interaction of Demographic, Economic and Social Factors, vol. I, Population Studies, No. 50. Sales No. E.71.XIII.5. New York, United Nations.

UN (2010). United Nations Statistical Database, United Nations.

UN/DPI (2004) What are the Least Developed Countries (LDCs)? fact-sheet number 20

UNCTAD (2011). "UN list of LDCs after the 2006 triennial review." Retrieved 23rd Feb 2010, 23rd Feb 2010, from http://www.unctad.org/Templates/Page.asp?intItemID=3641&lang=1.

UNESCO (2009). "About UNESCO: What is it? What does it do? ." Retrieved 30 Feb 2010, 2010, from http://portal.unesco.org/en/ev.php-URL_ID=3328&URL_DO=DO_TOPIC&URL_SECTION=201.html.

UNHCR (2009). Global Trends: Refugees, Asylum-seekers, Returnees, Internally Displaced and Stateless Persons. Geneva, Office of the United Nations High Commissioner for Refugees. 2010.

UNICEF (1990). Policy Review: Strategy for improved nutrition of children and women in developing countries. Refugee Studies Centre. New York, United Nations Children's Fund (UNICEF): 34 pp.

UNICEF (1998). The State of the World's Children 1998. New York City, United Nations Children's Fund.

UNICEF (2007). The State of the World's Children 2007: Women and Children - The double dividend of gender equality New York City, United Nations Children's Fund.

UNICEF (2009). Tracking Progress on Child and Maternal Nutrition: Survival and development priority. New York, United Nations Children's Fund.

UNPP (2009). World Population Prospects: The 2008 Revision Population Database, United Nations Population Fund.

UNSD (2006). Note on definition of regions for statistical analysis. Montreal, UNSD: Committee for the Coordination of Statistical Activities.

UOR (2009). "University of Reading: Agriculture, Policy and Development, History of Agriculture." Retrieved 4 June 2008, 2008, from http://www.ecifm.rdg.ac.uk/history.htm

USAID (1992). POLICY DETERMINATION: Definition of Food Security. USAID, US Agency for International Development.

USAID (1995). POLICY DETERMINATION: Food Aid and Food Security. USAID, US Agency for International Development.

USAID (2007). Food for Peace: FY 2008 P.L. 480 Title II Program Policies and Proposal Guidelines Washington, D.C, United States Agency for International Development.

USAID (2010). "Our Work: A Better Future For All. US Agency for International Development." Retrieved 12th Jan 2010, 2010, from http://www.usaid.gov/our_work/

USCB (2008). Historical Estimates of World Population. Washington, D.C., U.S. Census Bureau.

USDA (1999). US Action Plan on Food Security: Solutions to Hunger, U.S. Department of Agriculture (USDA).

USDA (2009). "Food Security in the United States: Measuring Household Food Security." Retrieved 15th October 2009, 2009, from http://www.ers.usda.gov/Briefing/FoodSecurity/measurement.htm.

von Braun, J., Ed. (1995). Employment for Poverty Reduction and Food Security. Washington D.C, International Food Policy Research Institute.

von Braun, J. (1995). A New World Food Situation: New Driving Forces and Required Actions. International Food Policy Research Institute. Washington, D.C, The International Food Policy Research Institute.

Vos, F., J. Rodriguez, *et al.* (2009). Annual Disaster Statistical Review 2009: The numbers and trends. Brussels, Belgium, CRED: Centre for Research on the Epidemiology of Disasters 46.

Waal, A. D. (1989). Famine that Kills: Darfur, Sudan, 1984-1985. Oxford, Clarendon Press.

Walford, C. (1879). The famines of the world: Past and Present. London, Edward Stanford.

Walonick, D. S. (1993). StatPac Gold IV: Survey & Marketing Research Edition. Minneapolis, StatPac Inc.

Wand, Y., V. C. Storey, *et al.* (1999). "An Ontological Analysis of the Relationship Construct in Conceptual Modeling." ACM Transactions on Database Systems 24(4): 494-528.

Watkins, S. C. and J. Menken (1985). "Famines in Historical Perspective." Population and Development Review 11(4): 647-675.

Watson, F. (1999). "One hundred years of famine - a pause for reflection." Field Exchange(8): 20-23.

Weber, R. (2004). "The rhetoric of positivism versus interpretivism." MIS Quarterly 28(1): iii-xii.

WEF (2009) Nutrition. Summit on the Global Agenda 2009 Council Reports 2009,

Weingärtner, L. (2004). Food and Nutrition Security, Assessment Instruments and Intervention Strategies: Background Paper No. I. Food Security Information for Decision Making. I. T. Course. Rome, EC-FAO Food Security Information for Action Programme.

Wells, J. (2005). Human Ecology Review Special Issue No. 13: 17-22.

Wengraf, T. (2001). Qualitative research interviewing: biographic narrative and semi-structured methods. London, Sage.

Wesenbeeck, C. F. v., M. A. Keyzer, *et al.* (2009). "Estimation of undernutrition and mean calorie intake in Africa: methodology, findings and implications." International Journal of Health Geographics 8(37).

WFP (2008). "What Is Hunger? ." Retrieved 25 April 2008, from http://www.wfp.org/hunger/what-is.

WFP (2009). Emergency Food Security Assessment Handbook. Rome, World Food Program.

WFP (2009). World Food Program Annual Report. Rome, UN/WFP.

WFP (2009). "The World Food Programme: Food Quality Control." Retrieved 2 April 2010, 2010, from http://foodquality.wfp.org/Home/tabid/36/Default.aspx.

WFP (2010). "Website of the World Food program." Retrieved 25 April 2008, from http://www.wfp.org/.

WHO (2004). Food and Nutrition Needs in Emergencies. Geneva, World Health Organisation: 57 pp.

WHO (2006). WHO Child Growth Standards: Length/Height-for-age, Weight-for-age, Weight-for-length, Weight-for-height and Body Mass Index-for age: Methods and Development. Geneva, World Health Organisation.

WHO (2009). WHO Global Database on Vitamin A Deficiency Report: Global prevalence of vitamin A deficiency in populations at risk 1995–2005. Geneva, World Health Organisation.

WHO (2010). Global Database on Child Growth and Malnutrition. Geneva, Switzerland, World Health Organisation.

WHO (2010). The WHO Global Database on Body Mass Index (BMI). Geneva, Switzerland, World Health Organisation. 2010.

WHO (2010). "World Health Organisation: Children's environmental health indicators." Retrieved 2nd April 2010, 2010, from http://www.who.int/ceh/indicators/malnourishedwomen.pdf.

WHO (2010). World Health Statistics. Geneva, World Health Organisation: 149.

WHO (2011). "WHO Trade, foreign policy, diplomacy and health: Food Security." Retrieved 1st Jan 2011, 2011, from http://www.who.int/trade/glossary/story028/en/

WHO/EMRO (2010). You Are What You Eat, World Health Organisation: Eastern Mediterranean Regional Office.

Wiesmann, D. (2006). A Global Hunger Index: Measurement Concept, Ranking of Countries, and Trends. Washington, DC, International Food Policy Institute.

Williams, B. (2005). Soft Systems methodology. Michigan, The Kellogg Foundation.

Wissemann, V. (2007). "Plant evolution by means of hybridization." Systematics and Biodiversity 5(3): 243-253.

WIT (2008). World Ecology Report. New York, World Information Transfer.

World Bank (1986). Poverty and Hunger: Issues and Options for Food Security in Developing Countries. . Washington DC, World Bank Group.

World Bank (2008). World Development Report 2008 Agriculture for Development. Washington, DC, World Bank.

World Bank (2009). "Understanding Poverty." Retrieved 5th June 2009, 2009, from http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/0,,contentMDK:20153855~menuPK:373757~pagePK:148956~piPK:216618~theSitePK:336992,00.html.

World Resources (1999). Disappearing Food: How Big are Postharvest Losses? US, EarthTrends.

WRI (2010). "Disappearing food; How big are postharvest losses?". Retrieved 12th Jan 2011, 2011, from http://www.wri.org/publication/content/8386.

Wu, F. and W. P. Butz (2004). The future of genetically modified crops: lessons from the Green Revolution. US, Rand Corporation.

Yaffee, R. A. (2003) Common Correlation and Reliability Analysis with SPSS for Windows. Information Technology Services (ITS)

Yin, R. K. (1994). Case Study Research. Design and Methods. Thousand Oaks, CA, Sage.

Zhang, W. (2008). "A forecast analysis on world population and urbanization process." Environment Development and Sustainability 10(6): 717-730.

Zhang, X., M. Rockmore, *et al.* (2007). A typology for vulnerability and agriculture in Sub-Saharan Africa. IFPRI discussion papers. Washington, International Food Policy Research Institute (IFPRI).

Zhi Ping Song, Bao Rong Lu, *et al.* (2004). "Fitness Estimation through Performance Comparison of F1 Hybrids with their Parental Species Oryza rufipogon and O. sativa." Annals of Botany 93(3): 311-316.

Zirkle, C. (1969). "Plant Hybridization and Plant Breeding in Eighteenth-Century American Agriculture." Agricultural History 43(1): 25-38.

Appendices

11 Appendix A: Famines of the 20th Century

Table 11.1 Worst Famines of the 20th Century

Date	Location	No. of Deaths	Additional Information	Causes
1913-14	W. Africa (Sahel)	125,000		Drought
1914-18	Armenia Belgium Mount-Lebanon Germany	Millions	Famine and death from persecution and disease during World War I. Reports of cannibalisation	Famine exacerbated by WW1
1917- 19	Persia	¼ pop	Famine. As much as 1/4 of the population living in Iran died in the famine worsened by Russian revolution	Famine and Conflict
1921-22	Soviet Union	5-9 million	Massive crop failures were intensified by failures of Soviet central planning and Stalin's withholding of food	Drought
1927	N.W. China	3-6 million	Initially triggered by drought it was exacerbated by local warlords and excessive tax	Drought
1928-29	China (Hunan)	2 million		Drought and conflict
1932-34	Soviet Union (Ukraine)	7-8 million	Stalin's collectivisation programme where the government seized grain for export earnings caused revolts by peasants led to collective land, agricultural produce and implements being declared state property	Government Policy
1936-38	Sichuan, China,	5 million		Famine
1940-44	Warsaw Leningrad Greece Netherlands	70,000	Famine worsened by freezing temperatures and disease made worse by blockades	Famine, disease and conflict
1943	China (Henan)	5 million	Japanese invasion and Chinese government grain seizures to finance the war caused massive famine	Conflict and Policy
1942-44	India (Bengal)	2.1-3 million	Combined crop failure and exported foods by India's British administration to Allied soldiers coincided with the end of rice imports and a lack of food price control.	Conflict and Policy
1943	Rwanda-Burundi	300,000	Famine in Rwanda caused migration to the Congo	Conflict and Drought
1946-47	Soviet Union (Ukraine and Belorussia)	2 million	Famine induced by the reinforcement of agricultural collectivisation policies during WW2	Drought and Government Policy
1957-58	Ethiopia Tigray	100,000-397,000	Famine in Tigray, Ethiopia	Drought and Locusts
1958-62	China	30-33 million	Mao Zedong's 'Great Leap Forward' plan to modernise agriculture. Collectivisation the practice of giving the state a large percentage of their crops	Political action
1967-70	Nigeria (Biafra)	1 million	Biafran famine caused by Nigerian blockade	Conflict
1969	West Africa (Sahel)	101,000	Sahel drought created famine	Drought
1972-74	Wollo, north-eastern Ethiopia	40,000 to 80,000	Recurrent crop failures and continuous food shortages	Crop Failure
1974	Bangladesh	1.5 million	Famine in Bangladesh	Flood and Market Failure
1979	Cambodia	1.5-2 million	After a decade of conflict - the civil war from 1970 to 1975 then the Khmer Rouge	Conflict
1980	Uganda (Karamoja)	30,000		Conflict and Drought
1982-85	Mozambique	100,000		Conflict and Drought
1983-85	Ethiopia	590,000,000-1 million	Caused in part by the 1982–83 El Nino Southern Oscillation	Conflict and Drought
1983-85	Sudan (Darfur, Kordofan) +Sudan South	250,000	Drought and economic crisis as well as government denials of the crisis were exacerbated by conflict	Drought, policy and conflict
1991-93	Somalia	3-500,000	Famine	Conflict and Drought
1995-99	North Korea	2.8-3.5 million	Famine exacerbated by a combination of flooding and government policy	Flood and Government Policy
1998	Sudan (Bahr El Ghazal)	70,000	Drought and war	Conflict and Drought

References: (Fisher 1927; Chamberlin 1934; Gantt 1936; Bennett 1949; Scrimshaw 1987; Waal 1989; Kalayjian, Shahinian *et al.* 1996; Watson 1999; Devereux 2000; Ellman 2000; Dyson and Ó Gráda 2002; Hionidou 2002; Patenaude 2002; Peterson 2004; Leo Lucassen 2006; Oltmer 2006; Ó Grada 2008; WIT 2008; Ó Gráda 2009).

12 Appendix B: Pilot Group Studies

12.1 1st Pilot Focus Group

Agenda: welcome, review of agenda, review of goal of the meeting, review of ground rules, introductions, questions and answers, wrap up.

Aim: to explore the proposed question structure as well as content and procedural aspects of the focus groups. The pilot is divided into 3 separate sections looking at aspects of both focus group sets as well as the interview questions.

Moderator's initial remarks:

What I am hoping to do is to carry out two rounds of three focus groups each containing 10 participants. In the first group we are aiming to determine a single framework of food security out of a possible three. The second group looks to tackle this process from a different perspective and create a new framework from the ground up. Lastly the final expert interviews aim to compare the two and add any further insights. I would like you to go through the process as if we were in the study completing the study then I'd like to discuss any ambiguities that might have arisen as well as any thoughts on improving the content and procedure.

Moderator: The FAO and others suggest that this concept is built on four pillars that together support the notion of food security: availability, access, stability, utilisation.

Availability

Question	Question Type	Aim
• What do you understand by the concept of availability of food?	Open	To establish a group level of understanding
• Please tell me more	Probing	To draw out further insight

Write group answers on a flipchart and encourage the extraction of new ideas through body language and encouraging comments as well as further probing or follow up questions such as:

• You mention (Availability – production, supply, market location/ density, transport costs, yield, land degradation, climate change, trade laws, food aid, natural disasters) can you think of any other associated ideas that might help with availability of food?	Probing/ Follow up	To expand understanding of food availability

Access

• What do you understand by the concept of access to food?	Open	To establish a group level of understanding
• Can you expand on that?	Probing	drawing out further insight

Write group answers on a flipchart and encourage the extraction of new ideas through body language and encouraging comments as well as further probing or follow up questions such as:

• You mention (poverty, physical health, subsidies, food aid), from the cards placed in front of you can you pick out any associated ideas that might help with access to food?	Probing/ Follow up	To expand understanding of food access

Utilisation

• What do you understand by the concept of the biological utilisation of food?		To establish a group level of understanding
• What does that mean for food security?	Probing	To draw out further insight

Write group answers on a flipchart and encourage the extraction of new ideas through body language and encouraging comments as well as further probing or follow up questions such as:

• You mention (health of individuals, morbidity, health care, nutrition education, water, sanitation), from the cards placed in front of you can you pick out any associated ideas that might help with utilisation?	Probing/ Follow up	To expand understanding of food utilisation

Stability

• What do you understand by the concept of stability of the food supply?		To establish a group level of understanding
• Please tell me more	Probing	To draw out further insight

Write group answers on a flipchart and encourage the extraction of new ideas through body language and encouraging comments as well as further probing or follow up questions such as:

• You mention (risks, shocks, hazards, natural disasters, price of food, conflict), from the cards placed in front of you can you pick out any associated ideas that might help with stability?	Probing/ Follow up	To expand understanding of food stability

Moderator: Thank you. Now please take a look at the conceptual models and answer the following questions in respect of each model.

The pre-pilot questionnaire was then handed out.

Moderator: Please circle the number that represents your choice.

Thank you. Once you have answered the questions then I'd like you to place the three frameworks in order of preference 1, 2, 3. Then I have a final group question:

• Now of the three conceptual models can you tell me how these models identify with the concepts we've talked about?	Open	To draw on the above understanding and apply this to the models

Moderator: Thank you and this concludes the first round focus groups.

I'd like now to spend a few moments discussing your views on the questions and process.

From the initial definition and opening remarks can you tell me how easy it was for you to understand the concept of food	Open	To draw on the above understanding and decide on the efficacy of the initial opening remarks

security?		
Did the follow up questions adequately draw out further insight into the concepts	Follow up	To draw attention to the questionnaire and elicit conversation
How can these be improved?	Follow up	Drawing out further insight
Regarding the criteria for the evaluation of the frameworks do these help in determining a good selection	Open	To determine a single framework from the three
How can these be improved?	Follow up	Drawing out further insight

Moderator: Thank you for your help.

Expected time 30 minutes followed by a 5 minute break.

Interviews

Moderator: Based on the previous exercises can you answer the following questions

Question	Question Type	Aim
• Are the existing FAO, EU and USAID definitions of food security (FS) acceptable?	Closed	Thoughts about definitions
• Can you expand on this?	Probing	Thoughts about definitions
• Would you like to see the definition revised?	Follow up	Are the definitions adequate
• Are the existing fundamental pillars: availability, access, *etcetera*. adequate to properly portray the concept in today's environment	Closed	Is there sufficient underpinning of the FS concept
• How would you improve on this if at all?	Open	Idea generation
• What are your thoughts on current conceptual frameworks in general – do they work?	Open	Thoughts about Frameworks
• Can you expand on this?	Follow up	Drawing out further insight

Moderator: Thank you. Adding another dimension of newness to evaluation criteria for the expert interviewee's can you comment on the different criteria of novelty or newness.

Criteria	Descriptor	Question	Model A	Model B
New or Novel	Is this model new or a Novel in any way?	Is this model introducing new insights into the food security definitions?	No 1 2 3 4 5 Yes	No 1 2 3 4 5 Yes
		If yes - are these for the better ?	No 1 2 3 4 5 Yes	No 1 2 3 4 5 Yes
		Is the model redefining relationships?	No 1 2 3 4 5 Yes	No 1 2 3 4 5 Yes

Moderator: Now with the pens and paper in front of you can you write down two questions or statements that best describes the different domains of comprehensiveness, selectivity *etcetera*. As a group can you determine the 6 appropriate questions/statements. Can you rate these.

Thank you for your kind attendance this concludes the days pilot study.

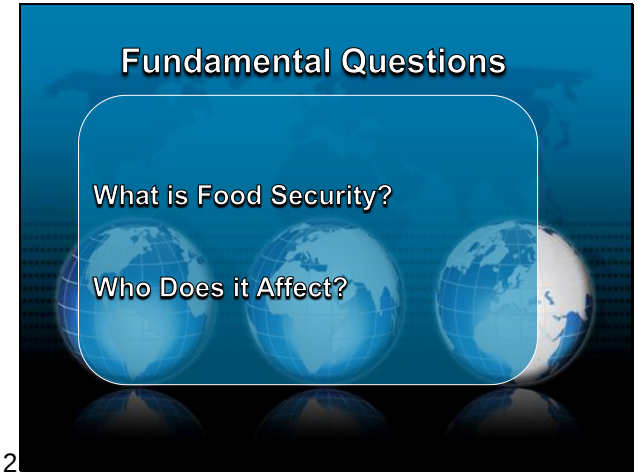
The second round of focus groups questions were not piloted as this system is based on Trochim's methodology which itself uses established criteria and procedural methods requiring little external validation.

Transcripts can be found in the electronic supplement to this publication

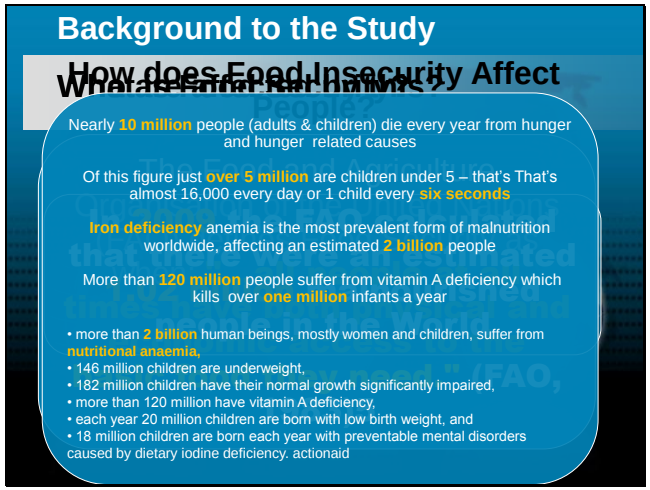
12.1.1 Annex 1: Focus Group Slides

Slide 1

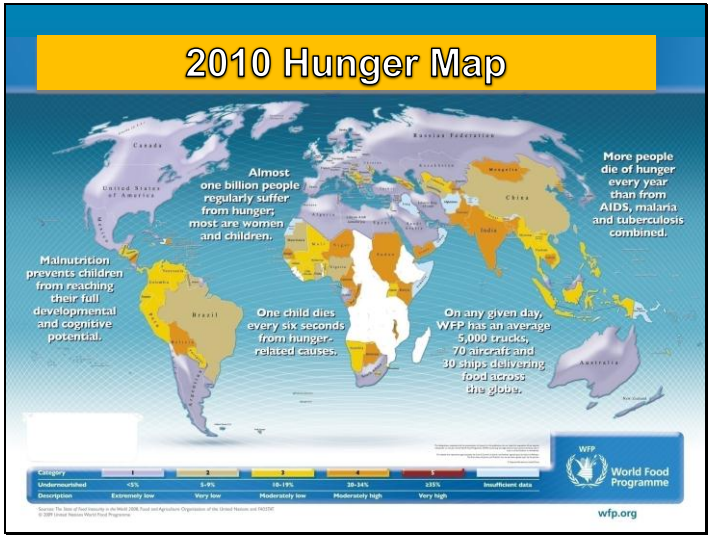
Slide 2



Slide 3

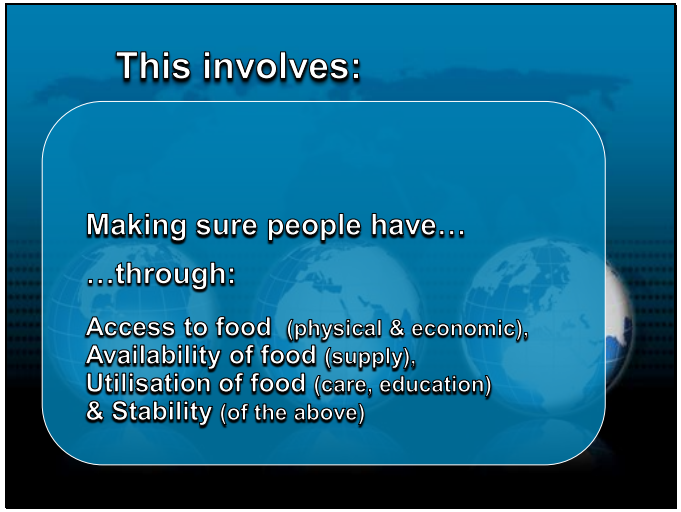


Slide 4



Slide 5

Slide 6



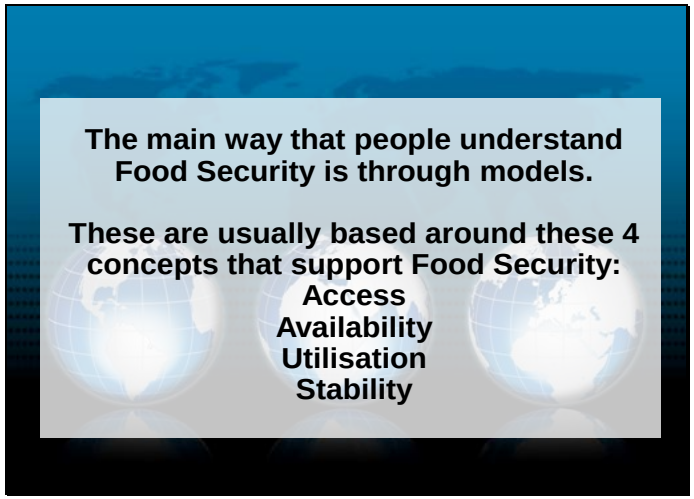
Slide 7

Slide 8

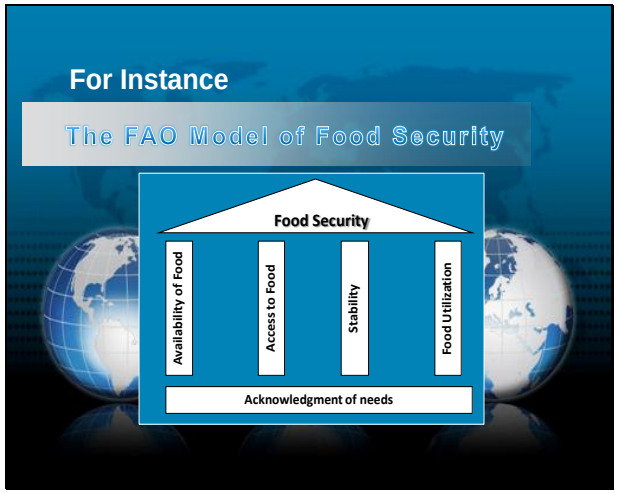
Slide 9

Slide 10

Slide 11



Slide 12



12.1.2 Annex 2: Food Security Definitions

A) Food and Agriculture Organisation (FAO)

"Food security [is] a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO 1996; SOFI 2001)

B) United States Department of Agriculture (USDA)

The most recent USDA definition is based on Anderson's 1990 Life Sciences Research Office which offered:

"Access by all people at all times to enough food for an active, healthy life. Food security includes at a minimum: (1) the ready availability of nutritionally adequate and safe foods, and (2) an assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies)" (Andersen 1990; USDA 2009).

C) The United Sates Agency for International Aid (USAID)

the current USAID's definition is based on the USAID Policy Determination #19 from 1992:

"When all people at all times have both physical and economic access to sufficient food to meet their dietary needs in order to lead a healthy and productive life." (USAID 1992; USAID 2010).

D) The US PL 480 – Food For Peace

Known officially as the Agricultural Trade Development and Assistance Act of 1990, Public Law 480 (PL 480) defines food security more flexibly. As in the USAID's definition, PL 480's is also based on Policy Determination #19 yet is necessarily flexible in their view to allow a range of policy responses.

"Access by all people at all times to sufficient food and nutrition for a healthy and productive life." (USAID 1995).

12.2 2nd Pilot Focus Group

The second pilot group was adapted based on the first groups findings.

Agenda: welcome, review of agenda, review of goal of the meeting, review of ground rules, introductions, questions and answers, wrap up.

Aim: to pilot the first round focus groups.

Moderator's initial remarks:

What we are going to do today is explore the notion of food security then look at some of the models that aim to help us in this understanding. We will look at three models and ultimately grade them according to several criteria of quality.

The participants are told of the different definitions as outlined above

They are then given a PowerPoint presentation

A discussion follows ensuring everyone comprehends the subject reasonably

The questionnaires are administered

The group is thanked

12.2.1 Annex 3: Framework Questionnaires and Evaluation Criteria

Quality Domains; Top 6 Statements in each Domain – Pre Pilot Test

The negative questions are highlighted in Yellow

Comprehensiveness:

1 The model does not fully describe the concept of food security

2 The model fully reflects the pillars of availability, access, utilisation and stability

3 Most of the pillars of food security are clearly present (not ambiguous)

4 The model does not adequately portray the aspects of access, availability, utilisation & stability

5 The framework is fully comprehensive of the food security definition.

6 This model includes access, availability, utilisation and stability in a comprehensive fashion

New or Novel

7 The definition and the model are in equilibrium

8 The framework does not bring anything new to the concept

9 The model introduces new insights into the food security definition

10 The new insights are for the better

11 The framework explains the model and no more

12 The model redefines traditional relationships

Selectivity:

13 The relationships between the entities are clear and precise

14 There are some entities that seem non-relevant

15 There are entities noticeably left out

16 There needs to be more entities in the framework

17 There are superfluous variables in the model

18 The model's variables are not clear

Specificity:

19 The overall concept is properly elucidated/ clear

20 There sufficient of the right variables

21 The boundaries of the concept are properly defined

22 There is a clear concise concept outlined in the framework

23 The boundaries are blurred and need defining

24 There are noticeable omissions

Comparability:

25 There are things that could be added to make the model clearer

26 The model compares well to the food security definitions

27 The definition is not reflected in the model

28 The model needs to be redefined

29 The model nearly fills the remit of the definition

30 The definition and the framework do not tally

Simplicity:

31 The model is simple and easy to follow

32 The framework is complex and unwieldy

33 The overall concept is easily understood

34 There are quite a few variables but they work really well in a simple way

35 The framework is unnecessarily complex

36 There too many variables or concepts involved

Table 12.1 Quality Domains; Top 3 Statements in each Domain – Post Pilot Test (after ANOVA analysis)

Criteria	Descriptor	Original Question Number	Question	Scale
Comprehensiv-eness	Comprehensive to support any claims - adequately achieve its stated aims	2 3 4	A. The model fully reflects the pillars of availability, access, utilisation and stability B. Most of the pillars of food security are clearly present (not ambiguous) C. The model does not adequately portray the aspects of access, availability, utilisation & stability	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
New or Novel	Is this model new or a Novel in any way?	8 9 12	D. The framework does not bring anything new to the concept E. The model introduces new insights into the food security definition F. The model redefines traditional relationships	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
Selectivity	Logical variable choices	13 14 15	G. The relationships between the entities are clear and precise H. There are some entities that seem non-relevant I. There are entities noticeably left out	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
Specificity	Clear and precise - delineating the extent of the models coverage and assumptions	19 21 23	J. The overall concept is properly elucidated/ clear K. The boundaries of the concept are properly defined L. The boundaries are blurred and need defining	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	25 26 27	M. There are things that could be added to make the model clearer N. The model compares well to the food security definitions O. The definition is not reflected in the model	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	33 34 35	P. The overall concept is easily understood Q. There are quite a few variables but they work really well in a simple way R. The framework is unnecessarily complex	Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree Disagree 1 2 3 4 5 Agree

12.2.2 Annex 4: ANOVA Test

The following SPSS ANOVA analysis output of the 36 question set showing the mean, standard deviation and standard error.

Table 12.2 SPSS ANOVA analysis

Descriptives

Question Number	Number Responses	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	6	3.17	1.329	.543	1.77	4.56	1	5
2	6	5.00	1.673	.683	3.24	6.76	2	6
3	6	4.33	1.366	.558	2.90	5.77	2	6
4	6	4.67	1.506	.615	3.09	6.25	2	6
5	6	3.00	1.414	.577	1.52	4.48	1	5
6	6	3.33	2.251	.919	.97	5.70	1	6
7	6	2.67	1.506	.615	1.09	4.25	1	5
8	6	5.17	1.329	.543	3.77	6.56	3	6
9	6	5.17	1.169	.477	3.94	6.39	3	6
10	6	3.50	1.871	.764	1.54	5.46	1	6
11	6	3.17	1.169	.477	1.94	4.39	2	5
12	6	4.67	1.211	.494	3.40	5.94	3	6
13	6	4.83	1.169	.477	3.61	6.06	3	6
14	6	5.00	.894	.365	4.06	5.94	4	6
15	6	5.17	.753	.307	4.38	5.96	4	6
16	6	3.50	2.074	.847	1.32	5.68	1	6
17	6	4.50	1.643	.671	2.78	6.22	2	6
18	6	3.17	.753	.307	2.38	3.96	2	4
19	6	4.83	1.835	.749	2.91	6.76	2	6
20	6	3.33	1.211	.494	2.06	4.60	2	5
21	6	5.67	.516	.211	5.12	6.21	5	6
22	6	2.50	1.378	.563	1.05	3.95	1	4
23	6	3.83	1.169	.477	2.61	5.06	2	5
24	6	3.67	1.966	.803	1.60	5.73	2	6
25	6	5.00	.894	.365	4.06	5.94	4	6
26	6	5.00	1.549	.632	3.37	6.63	2	6
27	6	5.00	1.265	.516	3.67	6.33	3	6
28	6	2.83	1.329	.543	1.44	4.23	1	5
29	6	3.50	1.049	.428	2.40	4.60	2	5
30	6	2.83	1.835	.749	.91	4.76	1	6
31	6	3.83	2.137	.872	1.59	6.08	1	6
32	6	4.00	1.673	.683	2.24	5.76	2	6
33	6	4.33	1.211	.494	3.06	5.60	3	6
34	6	3.83	.983	.401	2.80	4.87	2	5
35	6	5.00	1.095	.447	3.85	6.15	3	6
36	6	3.67	2.251	.919	1.30	6.03	1	6
Total	216	4.07	1.598	.109	3.86	4.29	1	6

12.2.3 Annex 5: Reliability

Reliability measures of Cronbach's Alpha using SPSS of the second pilot group questionnaires.

Comprehensibility

Case Processing Summary

		N	%
Cases	Valid	18	100.0
	Excluded[a]	0	.0
	Total	18	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.767	3

Selectivity

Case Processing Summary

		N	%
Cases	Valid	18	100.0
	Excluded[a]	0	.0
	Total	18	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.752	3

Specificity

Case Processing Summary

		N	%
Cases	Valid	18	100.0
	Excluded[a]	0	.0
	Total	18	100.0

a. Listwise deletion based on all variables in the procedure.

Cronbach's Alpha	N of Items

Case Processing Summary

		N	%
Cases	Valid	18	100.0
	Excluded[a]	0	.0
	Total	18	100.0

.776	3

Comparability

Case Processing Summary

		N	%
Cases	Valid	18	100.0
	Excluded[a]	0	.0
	Total	18	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.723	3

Simplicity

Case Processing Summary

		N	%
Cases	Valid	18	100.0
	Excluded[a]	0	.0
	Total	18	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.797	4

13 Appendix C: Primary Research; Branch One

13.1 Case Studies

Table 13.1 Measure of Fit of Normal Distribution of the Case Study Model Scores

Question	Mean	Std. Deviation	Skewness	Kurtosis
	Statistic	Statistic	Statistic (Std. Error .845)	Statistic (Std. Error 1.741)
A	2.0000	1.26491	.889	-.781
B	3.6667	1.03280	-.666	.586
C	4.0000	1.54919	-1.936	3.958
D	3.8333	.75277	.313	-.104
E	3.6667	1.03280	-.666	.586
F	3.6667	1.03280	-.666	.586
G	3.1667	.98319	-.456	-2.390
H	4.3333	.81650	-.857	-.300
I	3.3333	.81650	-.857	-.300
J	3.6667	.51640	-.968	-1.875
K	3.6667	.81650	.857	-.300
L	3.8333	.75277	.313	-.104
M	3.8333	.75277	.313	-.104
N	4.3333	.81650	-.857	-.300
O	4.5000	.54772	.000	-3.333
P	3.8333	.40825	-2.449	6.000
Q	3.0000	1.26491	-.889	-.781
R	3.3333	1.86190	-.723	-1.875

13.2 Focus Group: Model Reduction - Measure of Fit of Normal Distribution of Focus Groups

Table 13.2 Measure of Fit of Normal Distribution` of the 2nd round focus Group scores (Number 18)

	Mean	Std. Deviation	Skewness	Kurtosis
	Statistic	Statistic	Statistic (Std Error .536)	Statistic (Std Error 1.038)
A	3.17	1.295	.203	-1.233
B	2.72	1.742	.330	-1.772
C	2.72	1.602	.124	-1.660
D	2.72	1.526	.193	-1.418
E	3.17	1.618	-.115	-1.625
F	2.50	1.505	.641	-1.028
G	2.89	1.530	.209	-1.499
H	3.11	1.491	-.212	-1.305
I	3.11	1.491	.028	-1.396
J	2.94	1.626	.100	-1.626
K	2.78	1.166	.234	-.978
L	3.61	1.461	-.629	-1.043
M	3.00	1.372	.154	-.868
N	3.00	1.609	-.095	-1.711
O	2.83	1.383	.033	-1.308
P	2.94	1.434	.513	-1.164
Q	3.17	1.339	-.340	-.849
R	3.44	1.580	-.640	-1.154

14 Appendix D: Primary Research; Branch Two

14.1 Focus Group: Map Generation

Aim:
Agenda: welcome, review of agenda, review of goal of the meeting, review of ground rules, introductions, questions and answers, wrap up.

Aim: to establish a new food security framework from the ground up.

Moderator's initial remarks: (after ground rules)

What we are going to do today is we are going to try to analyse those factors that affect food security (either positively or negatively) and through discussion identify any further considerations then rate these and organise them into groups.

According to the Food and Agriculture Organisation (FAO) of the United Nations, Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

The FAO suggest that this concept is built on four pillars that together support the notion of food security: Availability, access, stability, utilisation.

Before we begin I'd just like to explore the above concepts as a group.

Table 14.1 Second Round Focus Group Questions

Question	Question Type	Aim
• What do you understand by the concept of availability of food?	Open	To establish a group level of understanding
• Please tell me more	Probing	To draw out further insight
• What do you understand by the concept of access to food?	Open	To establish a group level of understanding
• Can you expand on that?	Probing	drawing out further insight
• What do you understand by the concept of the biological utilisation of food?		To establish a group level of understanding
• What does that mean for food security?	Probing	To draw out further insight
• What do you understand by the concept of stability of the food supply?		To establish a group level of understanding
• Please tell me more	Probing	To draw out further insight

Thank you. Now, as individuals can you look at the cards provided and bearing the previous discussion in mind can you look at the cards and with pen and paper and write down any

other ideas that are generated when you think of food access, availability, utilisation and stability. The final keywords are detailed in the following section.

After this can you now place these in any groupings that make sense to you: you cannot have a single group with only 1 item in it, nor can you have a single group with all items in it. Other than that you can place as many or as few in as many groups as you feel comfortable.

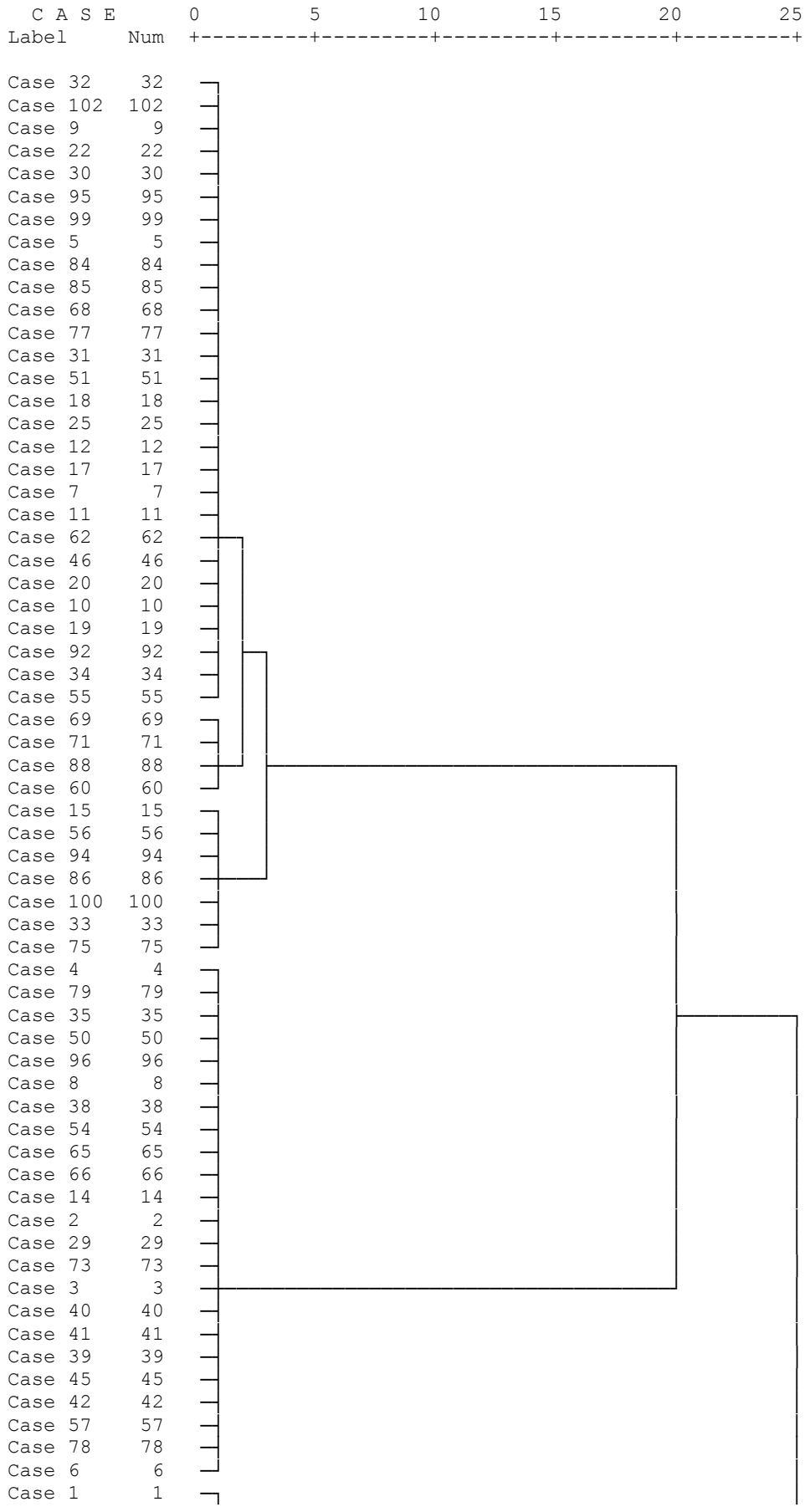
14.2 Annex 1: Focus Group Final Keywords

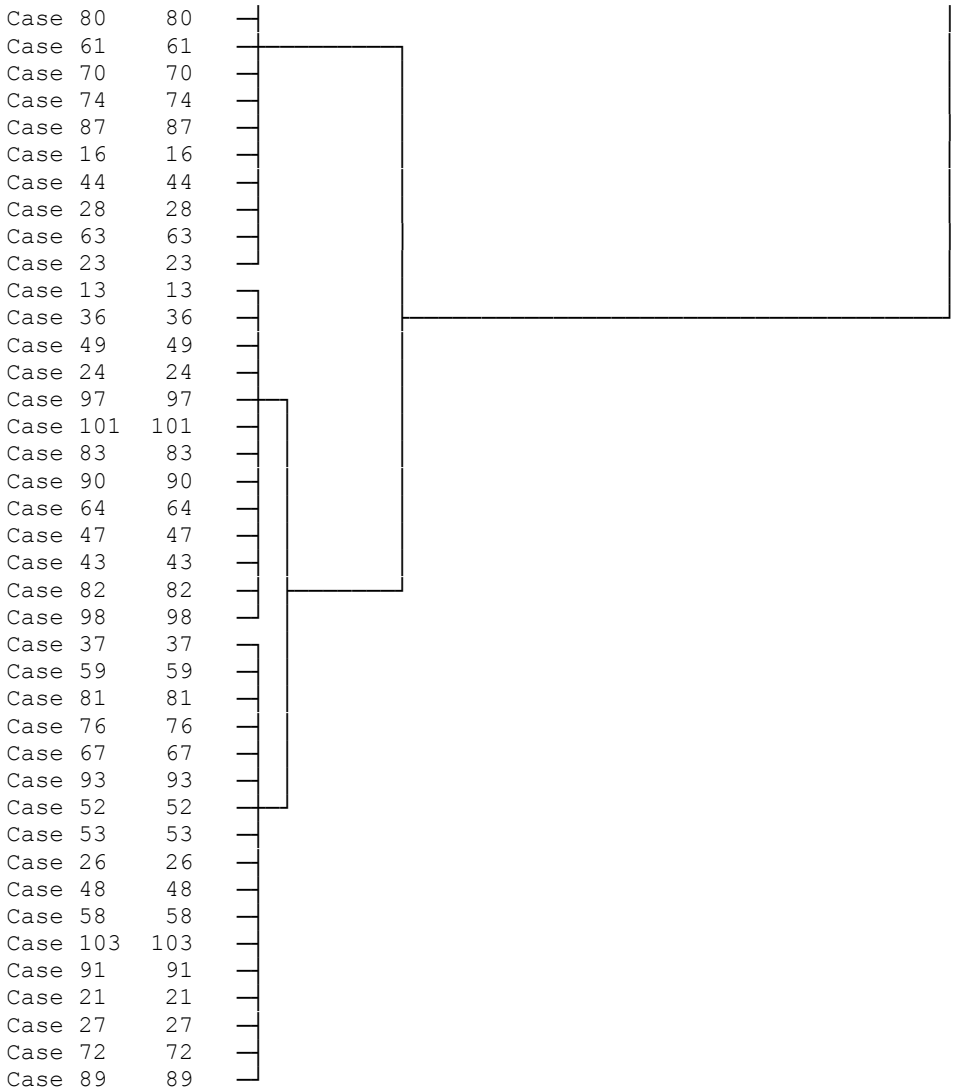
Table 14.2 Keywords Finalised by the Second Round Focus Groups

Agricultural Investment	Energy in Agriculture	Land Rights
Agricultural Practices	Energy/ Fossil Fuels	Land Use Changes
Agricultural Yield /Productivity	Environment and Natural Resources	Macronutrients Lipids Proteins Carbohydrates
Agrochemicals	Environmental/ Ecological Accounting	Market Integration
Atmosphere	Environmentalism	Micronutrients Vitamins Minerals
Balanced Food Intake	Existing Health Status	Monitoring Measuring Food Security
Biodiversity	Fertiliser Manufacture Use	Monoculture Practice
Biotechnology	Financial Stability	National Economy
Carbon footprint	Food Aid	Natural Resource Allocation
Care Practices	Food Available For Human Consumption	NGOs CSO's Charities, Other Stakeholders
Changing Cropping Seasons	Food for Biofuels	Overgrazing
Climate change	Food for Industrial Usage	People's Changing Diets
Commodity Speculation	Food for Livestock feed	Pesticides Manufacture
Crop rotation Practices	Food for Seed	Physical Infrastructure
Cultural Traditions	Food Price Rises	Policy Oversight
Debt and Structural Adjustment	Food Prices	Political Stability
Deforestation	Food Wastage	Political Will
Desertification	Fossil Fuels	Pollution/ Greenhouse gases
Dietary Guidelines	Freedom and Democracy	Poor Land Management
Diseases Affecting Nutrition Utilisation	Gender Equality	Population Sustainability
Early Warning Systems	General Political Enabling Environment	Poverty/ Wealth
Ecological footprint	Genetically Modified Organisms	Productivity
Economic Development/ Wealth	Global Water Resource	Refugees
Economical Sustainability	Governance	Rights and Human Capital Development
Ecosystems	Government/ Politics	Rural/ Urbanisation
Education	Green Revolution	Safe Water
Emergencies & Crises	Health Services	Safety Nets
Employment	Healthcare	Sanitation
Inflation	Human Food Consumption	Scarcity of Fresh Water
Institutional Infrastructure	Human Rights	Science and Technology
Intensive/Extensive agriculture	Humanitarian Intervention	Shocks/ Natural Disasters
Irrigation	Individual/ Household Objectives	Social Stability
War/Conflict and Social displacement	Individuals Livelihoods/ Entitlements	Soil erosion
Water footprint	Inefficiency/Wastage of water	Sustainability
Welfare Politics		

14.3 Annex 2: Hierarchical Cluster Analysis

Dendrogram using Ward Method - Rescaled Distance Cluster Combined




Case 80 80
Case 61 61
Case 70 70
Case 74 74
Case 87 87
Case 16 16
Case 44 44
Case 28 28
Case 63 63
Case 23 23
Case 13 13
Case 36 36
Case 49 49
Case 24 24
Case 97 97
Case 101 101
Case 83 83
Case 90 90
Case 64 64
Case 47 47
Case 43 43
Case 82 82
Case 98 98
Case 37 37
Case 59 59
Case 81 81
Case 76 76
Case 67 67
Case 93 93
Case 52 52
Case 53 53
Case 26 26
Case 48 48
Case 58 58
Case 103 103
Case 91 91
Case 21 21
Case 27 27
Case 72 72
Case 89 89

15 Appendix E: Author's Models Keywords

1. Table: 15.1 Food Security Keywords From the Literature ReviewFood Security
2. Individual/ Household Objectives
3. Other Individual/ Household Goals and Priorities
4. Secure Shelter
5. Family Security
6. Child Education
7. Healthcare
8. Capital Expenditure
9. Food Available For Human Consumption
10. Food Production
11. Agriculture Production
12. Forestry Production
13. Fisheries Production
14. Aquaculture Production
15. Agricultural Practices
16. Irrigation
17. Energy in Agriculture
18. Intensive/Extensive agriculture
19. Agrochemicals
20. Fertiliser Manufacture/Use
21. Pesticides Manufacture/ Use
22. Agricultural Yield /Productivity
23. Monoculture Practice
24. Crop rotation Practice
25. Science and Technology
26. Green Revolution
27. Biotechnology
28. Genetically Modified Organisms
29. Demand for food
30. People's Changing Diets
31. Human Food Consumption
32. Food for Livestock feed
33. Food for Seed
34. Food for Biofuels
35. Food for Industrial Usage
36. Food Wastage
37. Food Access
38. Poverty/ Wealth
39. General Enabling Environment
40. Economic Development/ Wealth
41. Globalisation
42. Development Economics
43. Balance of Payments
44. Debt and Structural Adjustment
45. Commodity Prices
46. National Economy
47. Foreign Direct Investment
48. Agricultural Investment
49. Physical Infrastructure
50. Market Integration
51. Employment
52. Industry Structure
53. Inflation
54. Balance of Trade
55. Individuals Livelihoods/ Entitlements
56. Natural Capital
57. Physical Capital
58. Financial Capital
59. Social Capital
60. Human Capital
61. Stability
62. War/Conflict and Social displacement
63. Rights and Human Capital Development
64. Freedom and Democracy
65. Political Will
66. Commodity Speculation
67. Political Stability
68. Financial Stability
69. Institutional Infrastructure
70. Shocks/ Natural Disasters
71. Social Stability
72. Biological Utilisation
73. Balanced Dietary Intake
74. Macronutrients Lipids Proteins Carbohydrates
75. Micronutrients Vitamins Minerals
76. Cultural Traditions
77. Sanitation
78. Dietary Guidelines
79. Safe Water
80. Care Practices
81. Health Services
82. Education
83. Famine/ Hunger/ Malnutrition
84. Diseases Affecting Nutrition Utilisation
85. HIV/ AIDS Affecting Nutrition Utilisation
86. Other Disease
87. Existing Health Status
88. Measles
89. Acute respiratory infections
90. Diarrhoea
91. Malaria
92. Governance
93. Socio-Cultural/ Demographic
94. Rural/ Urbanisation
95. Education
96. Gender Equality
97. Development Paradigms
98. Land Rights
99. Welfare Politics Safety Nets
100. Government/ Politics
101. Human Rights
102. Healthcare
103. Humanitarian Intervention
104. Food Aid
105. NGOs CSO's Charities, Other Stakeholders
106. Policy Oversight
107. Development Programs
108. Poverty Alleviation Analysis
109. Sustainability
110. Environmentalism
111. Economical Sustainability
112. Population Sustainability
113. Socially Sustainability
114. Natural Resource Allocation
115. Monitoring Measuring Food Security
116. Emergencies & Crises
117. Food Price Rises
118. Early Warning Systems
119. Rainfall Index
120. Vegetation Index
121. Environment and Natural Resources
122. Lithosphere/ Land
123. Soil erosion
124. Poor Land Management
125. Overgrazing
126. Salinisation
127. Waterlogging
128. Land Use Changes
129. Deforestation
130. Desertification
131. Energy/ Fossil Fuels
132. Atmosphere
133. Climate change
134. Pollution/ GHGs
135. Global Warming
136. El Nino/ Nina shift
137. Cropping Seasons
138. Crop Varieties
139. Yields
140. Biosphere
141. Biodiversity
142. Ecosystems
143. Variety of Species
144. Poor Management
145. Hydrosphere
146. Eutrophication
147. Global Water Resource
148. Scarcity of Fresh Water
149. Inefficiency/Wastage of water
150. Environmental/ Ecological Accounting
151. Ecological footprint
152. Carbon footprint
153. Water footprint

16 Appendix F: Food Security Framework Evaluation

Twenty-five models were found in the literature review to represent food security. This appendix details the individual evaluations of those models.

16.1 Overarching Models of Food Security

Overarching models are those whose central focus puts food security or insecurity at the heart of the construct; whether from an individual, household, national or global level. The following 6 frameworks are discussed and evaluated in detail in chapter 5; the case studies:

FAO Four Pillar Construct;

US Agency for International Development (USAID) (2 models);

Human Resources and Skills Development, Canada ;

Ericksen;

FIVIMS;

Other frameworks of a holistic nature include those of the International Food Policy Research Institute (IFPRI) and long time reviewers of food security Frankenberger and Maxwell.

16.1.1 Gross and Colleagues Model of Food and Nutrition Security 1999

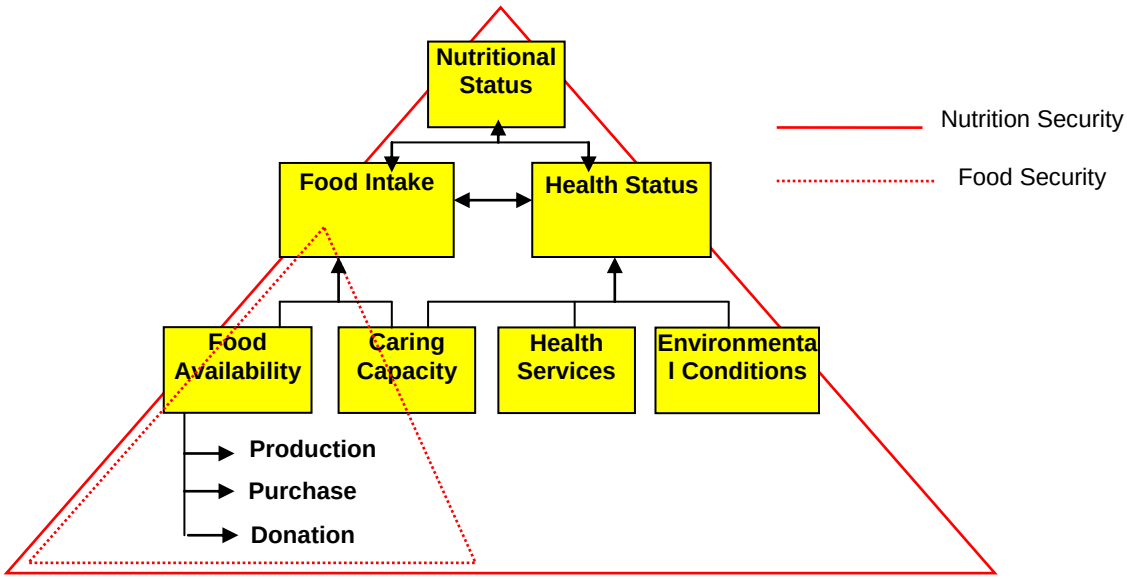


Figure 16.1 Gross, Schultink and Kielmann Model of Food and Nutrition Security 1999

Source: from Community Nutrition: Definition and Approaches (Gross *et al.* 1999).

In Gross and colleagues model (figure 16.1) what is immediately obvious is the clear separation of food and nutrition security. This is despite the FAO's insistence that the two are implicitly one and the same thing (FAO 1996; SOFI 2001). However by explicitly redefining food security as a component of availability and to some extent the caring capacity it renders the pillar of utilisation obsolete. Furthermore while this model is

particularly good in that it highlights the two way relationship between nutritional status and both health and food intake alike, by separating the elements of the wider concept the author has not completed the picture. Instead we are left with a vague notion of the individual components of which nutrition security is paramount yet no clear influence of the wider influences in its achievement. Ultimately the model has suggestively portrayed a more complex notion of food security yet in its simplification fails to properly convey the bigger picture to the reader. The Evaluation of this model against the criteria outlined in the literature review is summarised in table 16.1.

Table 16.1 Model A1: Gross and Colleagues Model of Food and Nutrition Security 1999

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	1
		B. Most of the pillars of food security are clearly present (not ambiguous)	2
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	3
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	5
		E. The model introduces new insights into the food security definition	4
		F. The model redefines traditional relationships	1
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	3
		H. There are some entities that seem non-relevant	4
		I. There are entities noticeably left out	3
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	1
		K. The boundaries of the concept are properly defined	3
		L. The boundaries are blurred and need defining	5
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	3
		N. The model compares well to the food security definitions	3
		O. The definition is not reflected in the model	3
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	1
		Q. There are quite a few variables but they work really well in a simple way	2
		R. The framework is unnecessarily complex	4
		Total Score	**51**

16.1.2 FAO Four Pillar Construct

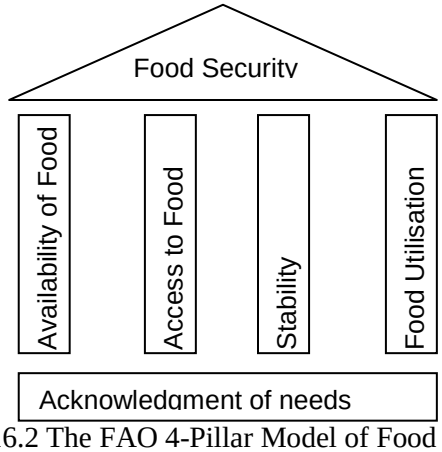


Figure 16.2 The FAO 4-Pillar Model of Food Security

After years of analysis the 1974 the World Food Conference properly formalised the modern notion of food security (FAO 1996). As a result today the FAO's definition of food security implies the concept as being supported by four pillars: food availability, access, stability and utilisation . It is viewed as a needs-based technical concept and is the foundation upon which further associated constructs are elaborated (FAO 2008). This model is evaluated further in the case study review. The initial author evaluation of this model against the criteria outlined in the literature review is summarised in table 16.2.

Table 16.2 Model A2: FAO Four Pillar Construct

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	4
		B. Most of the pillars of food security are clearly present (not ambiguous)	3
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	5
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	5
		E. The model introduces new insights into the food security definition	4
		F. The model redefines traditional relationships	4
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	2
		H. There are some entities that seem non-relevant	4
		I. There are entities noticeably left out	5
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	2
		K. The boundaries of the concept are properly defined	4
		L. The boundaries are blurred and need defining	4
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	3
		N. The model compares well to the food security definitions	2
		O. The definition is not reflected in the model	3
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	3
		Q. There are quite a few variables but they work really well in a simple way	4
		R. The framework is unnecessarily complex	4
		Total Score	**65**

16.1.3 Smith and Colleagues Hierarchical Framework of Food Security 2002

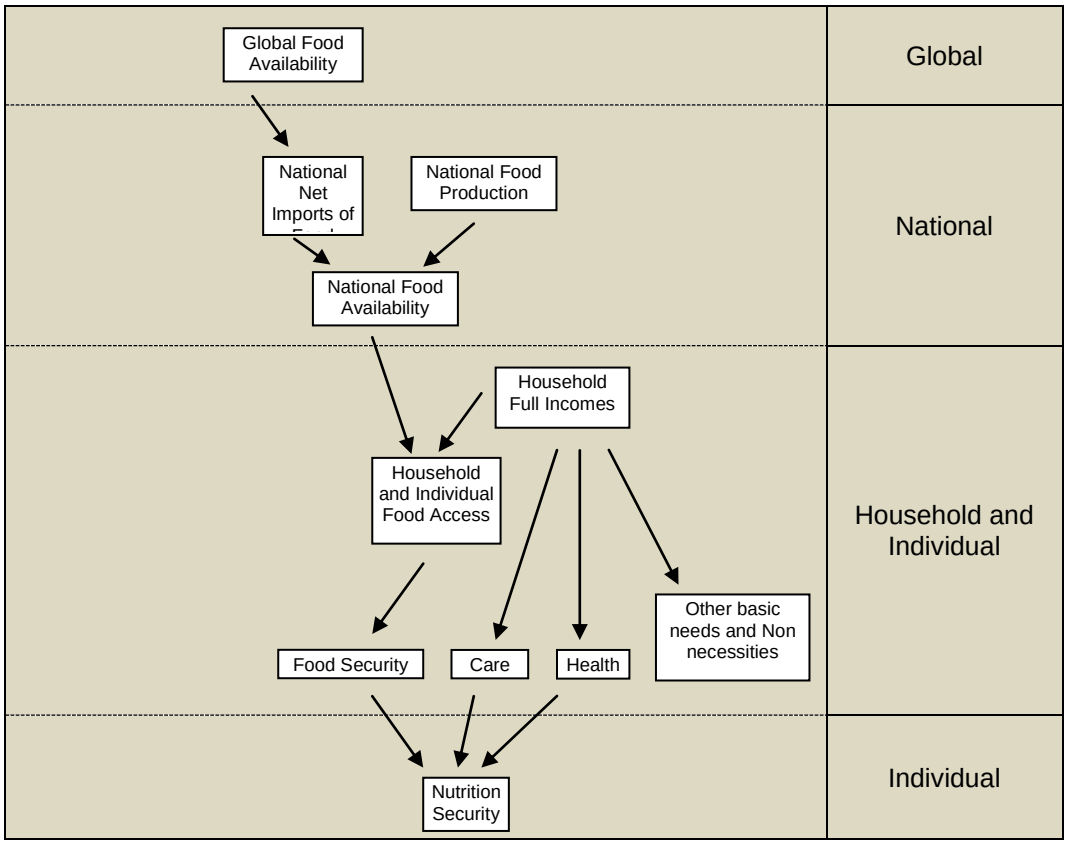


Figure 16.3 Lisa Smith Framework 2002 adapted from UNICEF and Frankenberger

SOURCE: Adapted from UNICEF (1998), Frankenberger *et al.*, 1997a and Frankenberger *et al.*, 1997b. (Smith, Obeid *et al.* 2000).

The above framework (figure 16.3) is adapted by Lisa Smith from similar earlier models by UNICEF and Frankenberger. Overall Smith sees the notion of food security as being wrapped up in global and national food availability as well as access. As in Gross *et al.* (1999) Smith also sees the notion of nutrition security as separate from the UN's implicit food security catchall (FAO 1996; SOFI 2001). Explicit too in this model are the notions of care and health practices. In this framework Smith sees food security of households and individuals as a function of national and global food availability and access. This model is very narrow in its interpretation of the concept with few relationships of influential causality beyond care and health. There is also no reference to stability of the food security concept, in fact this model predominantly focuses on the dimensions of access and availability. That said what relationships there are clear and unambiguous. The Evaluation of this model against the criteria outlined in the literature review is summarised in table 16.3.

Table 16.3 Model A3: Smith and Colleagues Hierarchical Framework of Food Security 2002

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	1
		B. Most of the pillars of food security are clearly present (not ambiguous)	4
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	5
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	3
		E. The model introduces new insights into the food security definition	3
		F. The model redefines traditional relationships	3
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	1
		H. There are some entities that seem non-relevant	3
		I. There are entities noticeably left out	3
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	4
		K. The boundaries of the concept are properly defined	4
		L. The boundaries are blurred and need defining	5
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	4
		N. The model compares well to the food security definitions	2
		O. The definition is not reflected in the model	4
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	3
		Q. There are quite a few variables but they work really well in a simple way	1
		R. The framework is unnecessarily complex	4
		Total Score	**57**

16.1.4 US Agency for International Development (USAID) Model 1

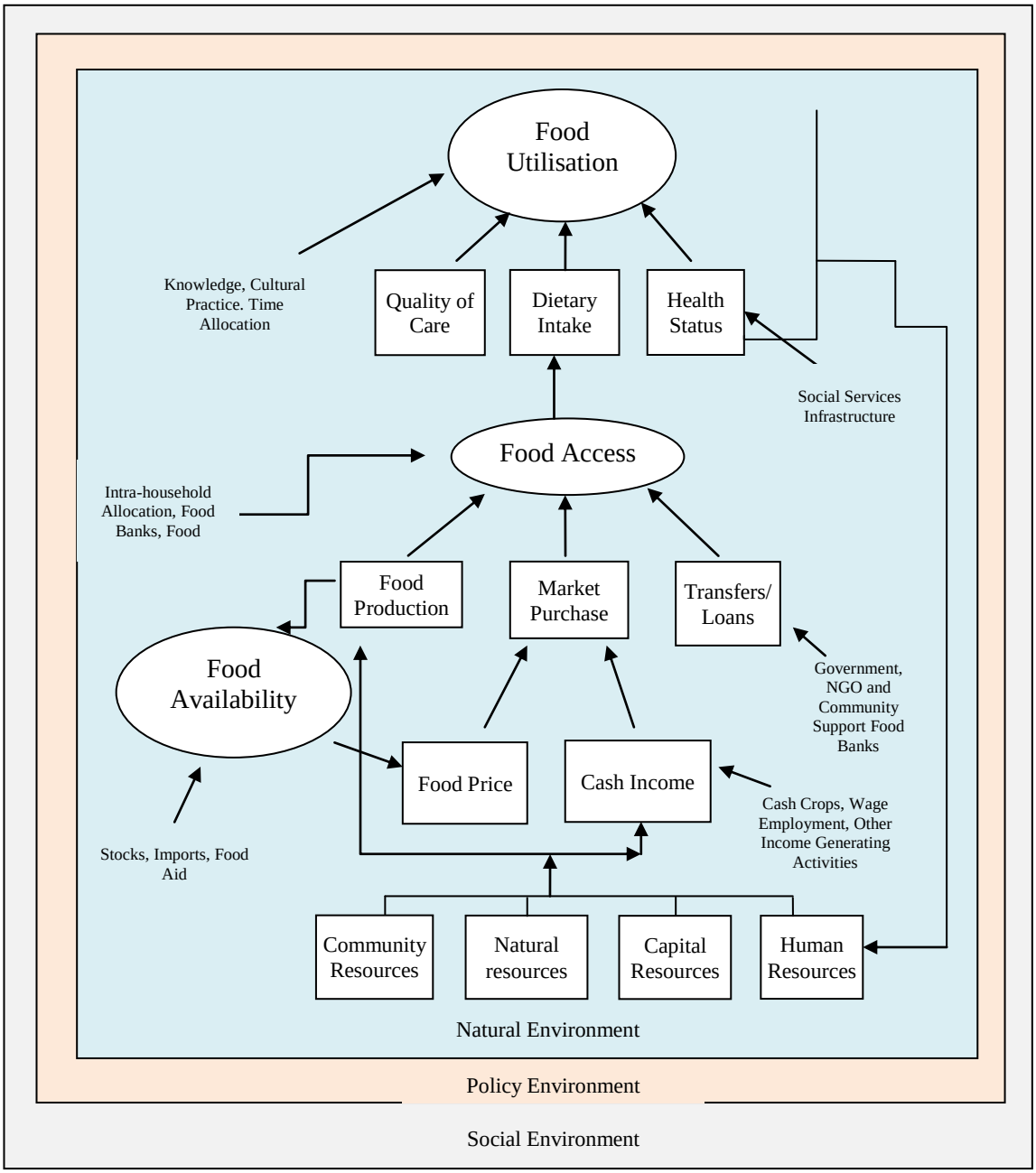


Figure 16.4 USAID's Expanded Conceptual Framework of Food Insecurity: model 1

Source: from Inventory of Food Security Impact Indicators (Riely and Mock 1995).

Riely, Mock, Cogill, Bailey and Kenefick detail the analytical framework used by USAID in figure 16.4. This model is based on an explanatory framework that aims to elucidate relationships among several factors and in the process hope to clarify the mechanisms or pathways by which food security itself is undermined. Riely *et al.,* also suggest that a well-defined framework is crucial for interpreting food security and other indicators that might indirectly promote the analysis of insecurity. In this way the model is based on the interaction of the three pillars of food, availability and utilisation and certain of the determinants that affect these outcomes (Riely and Mock 1995; USAID 1995). This model is

evaluated further in the case study review. The initial author evaluation of this model against the criteria outlined in the literature review is summarised in table 16.4.

Table 16.4 Model A4: US Agency for International Development (USAID) Model 1

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	4
		B. Most of the pillars of food security are clearly present (not ambiguous)	3
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	5
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	5
		E. The model introduces new insights into the food security definition	2
		F. The model redefines traditional relationships	3
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	3
		H. There are some entities that seem non-relevant	3
		I. There are entities noticeably left out	3
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	2
		K. The boundaries of the concept are properly defined	3
		L. The boundaries are blurred and need defining	5
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	5
		N. The model compares well to the food security definitions	3
		O. The definition is not reflected in the model	4
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	2
		Q. There are quite a few variables but they work really well in a simple way	4
		R. The framework is unnecessarily complex	5
		Total Score	**64**

16.1.5 US Agency for International Development (USAID) Model 2

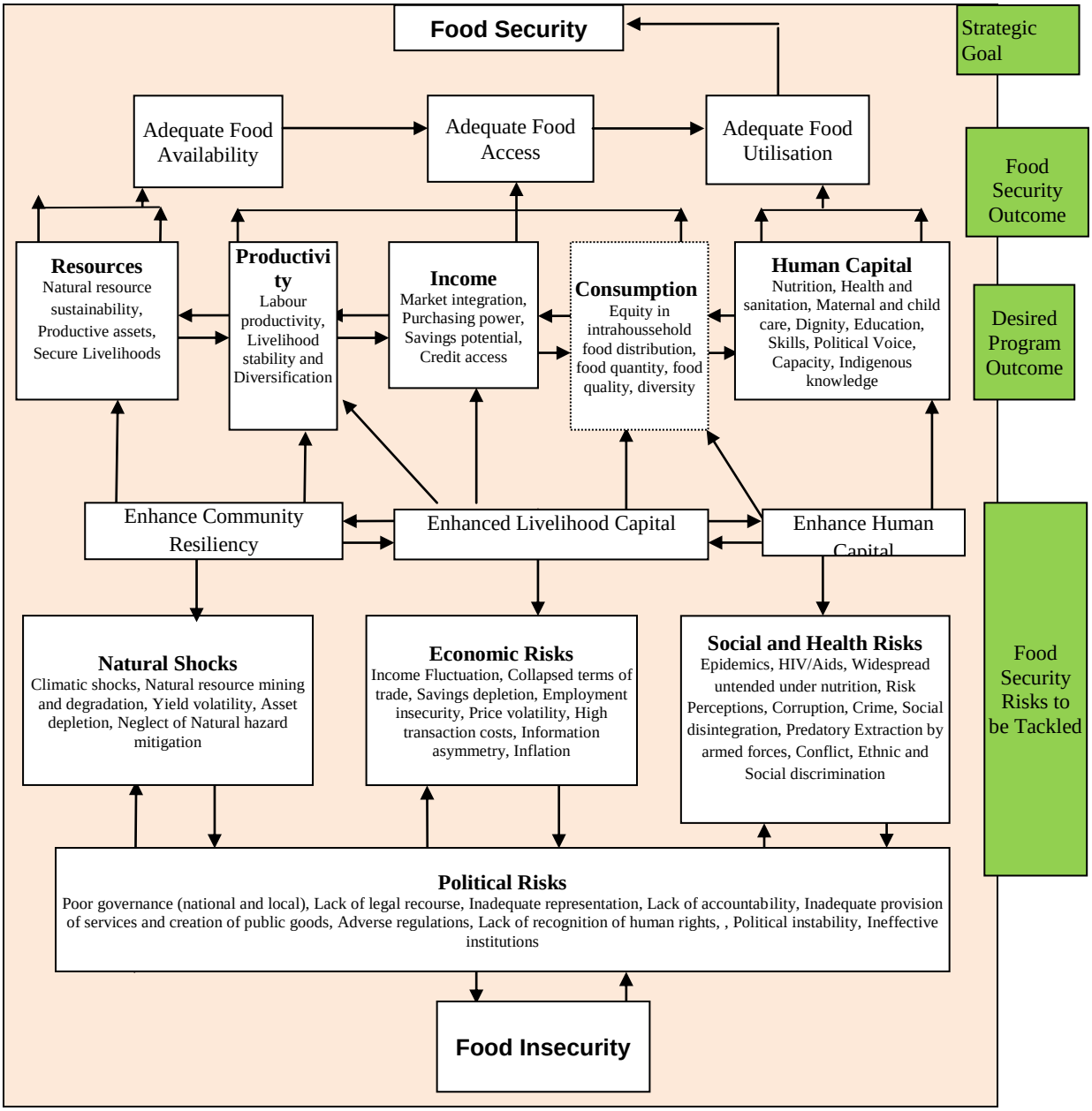


Figure 16.5 USAID's Expanded Conceptual Framework of Food Insecurity: model 2

Source: from Inventory of Food Security Impact Indicators (USAID 2007).

The USAID, Food for Peace (FFP) partnership expanded on their 1995 framework by adding a dimension of vulnerability to the concept. This is shown in the above figure 16.5 which filled a recognised shortcoming of the original concept (USAID 2007). With this newer, fuller version, the USAID accept that food security can be: "lost as well as gained" (USAID 2007). In this way the ability to reduce the exposure to risk becomes integral to any proposed solutions. This model is evaluated further in the case study review. The initial author evaluation of this model against the criteria outlined in the literature review is summarised in table 16.5.

Table 16.5 Model A5: US Agency for International Development (USAID) Model 2

Appendix F: Food Security Framework Evaluation

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	3
		B. Most of the pillars of food security are clearly present (not ambiguous)	1
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	5
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	5
		E. The model introduces new insights into the food security definition	4
		F. The model redefines traditional relationships	4
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	4
		H. There are some entities that seem non-relevant	5
		I. There are entities noticeably left out	5
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	1
		K. The boundaries of the concept are properly defined	3
		L. The boundaries are blurred and need defining	5
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	3
		N. The model compares well to the food security definitions	1
		O. The definition is not reflected in the model	3
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	4
		Q. There are quite a few variables but they work really well in a simple way	3
		R. The framework is unnecessarily complex	5
		Total Score	**64**

16.1.6 The International Fund for Agricultural development (IFAD)

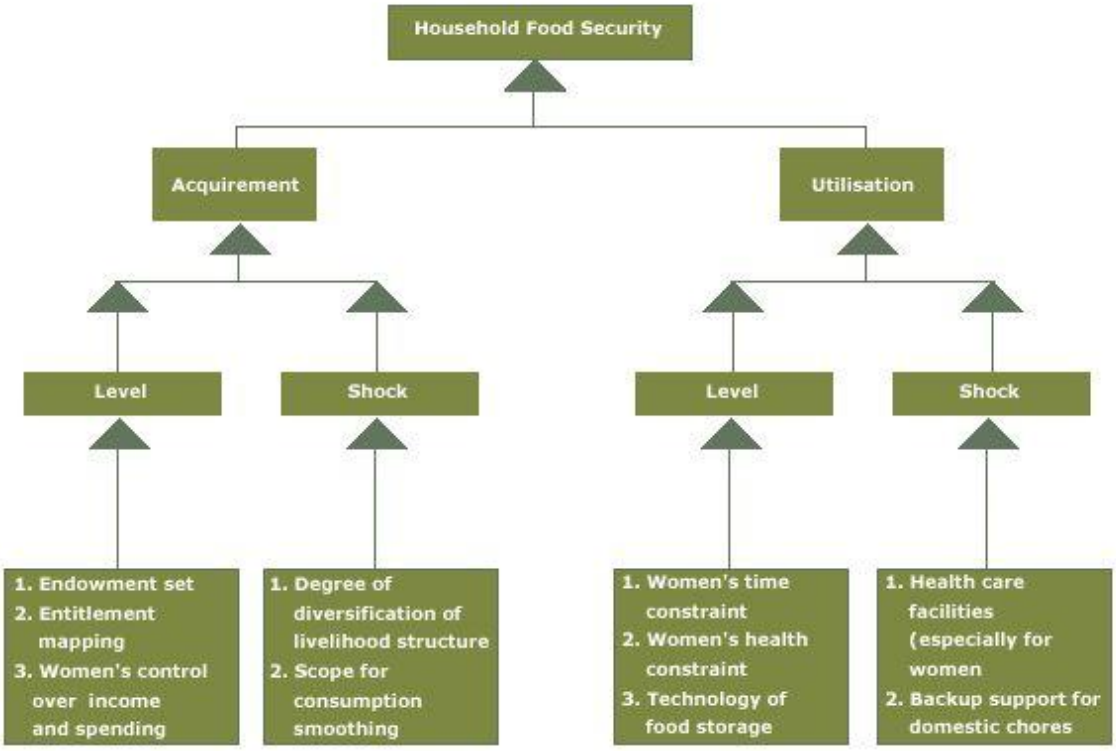


Figure 16.6 IFAD's Flow Chart of the Determinants of Household Food Security

Source: IFPRI Food Security: A Conceptual Framework (IFAD 2009).

The IFAD framework identified determinants of household food security as comprising four different levels (IFAD 2009). The first two determinants of acquirement can be described, using Sen's notions of endowment and entitlement mapping. Such resources include tangibles such as land, animals, machinery, water, trees, forests, and common property, while the intangible resources include labour, power and social rights. In this way, using combinations of these resources, household's can acquire food. Being strictly focused at the household level IFPRI's model does not fully reflect the overarching food security concept. Instead it concentrates on two aspects alone, those of access and utilisation. In the dimension of utilisation too there is a dominance of variables associated with women, this tends to ignore the focus of the individual and their existing health status. Furthermore this focus does not take into account other exogenous variables such as water and sanitation. All in all its narrow focus and use of specific variables that are neither complete nor representative renders this model of limited use. The Evaluation of this model against the criteria outlined in the literature review is summarised in table 16.6.

Table 16.6 Model A6: The International Fund for Agricultural development (IFAD)

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	4
		B. Most of the pillars of food security are clearly present (not ambiguous)	1
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	3
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	3
		E. The model introduces new insights into the food security definition	3
		F. The model redefines traditional relationships	2
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	2
		H. There are some entities that seem non-relevant	4
		I. There are entities noticeably left out	4
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	3
		K. The boundaries of the concept are properly defined	2
		L. The boundaries are blurred and need defining	5
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	3
		N. The model compares well to the food security definitions	3
		O. The definition is not reflected in the model	4
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	4
		Q. There are quite a few variables but they work really well in a simple way	3
		R. The framework is unnecessarily complex	4
		Total Score	**57**

16.1.7 Conceptual Understanding of Food Security in Cambodia

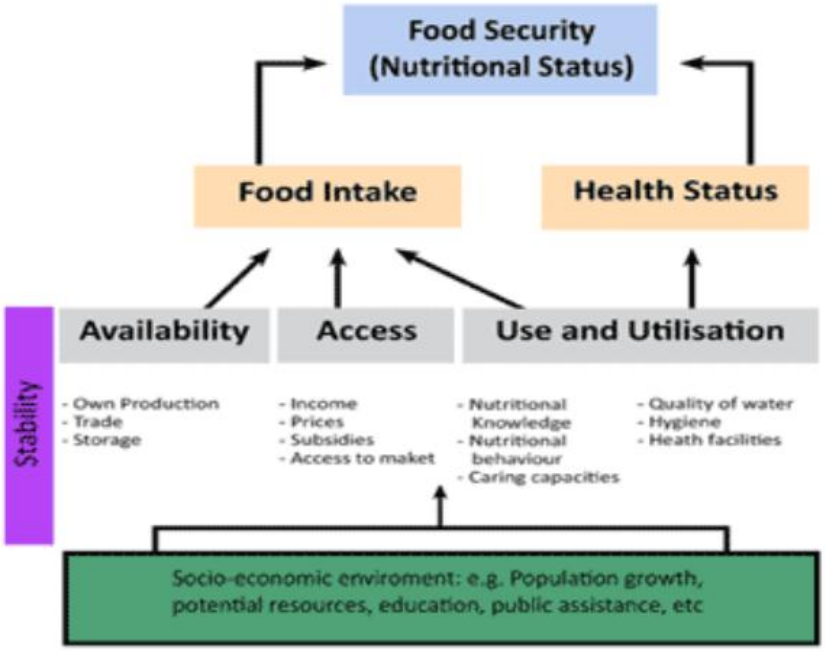


Figure 16.7 Conceptual Understanding of Food Security in Cambodia

Source: The Council for Agricultural and Rural Development (CARD) (CARD 2001).

The model in figure 16.7 is at first glance quite comprehensive; it combines nutrition and food security into one overarching goal and clearly delineates the responsibilities of the 4-pillars dimensions. It also cleverly associates the surrounding variables of environment and stability of these dimensions. There is an element missing in the access component, that of the non-financially based entitlements to food such as community, family and government support. Although there is some allusion to this in the term ‘public assistance’ its role is perhaps unclear. Where perhaps this model is lacking is that it stops there; of use would have been the inclusion of the interaction of many of these variables into for instance a livelihoods component. The Evaluation of this model against the criteria outlined in the literature review is summarised in table 16.7.

Table 16.7 Model A7: Conceptual Understanding of Food Security in Cambodia

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	2
		B. Most of the pillars of food security are clearly present (not ambiguous)	3
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	4
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	4
		E. The model introduces new insights into the food security definition	4
		F. The model redefines traditional relationships	1
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	3
		H. There are some entities that seem non-relevant	5
		I. There are entities noticeably left out	5
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	2
		K. The boundaries of the concept are properly defined	2
		L. The boundaries are blurred and need defining	4
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	5
		N. The model compares well to the food security definitions	1
		O. The definition is not reflected in the model	4
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	2
		Q. There are quite a few variables but they work really well in a simple way	1
		R. The framework is unnecessarily complex	3
		Total Score	**55**

16.1.8 UNU Theoretical Framework of Food Security 1998

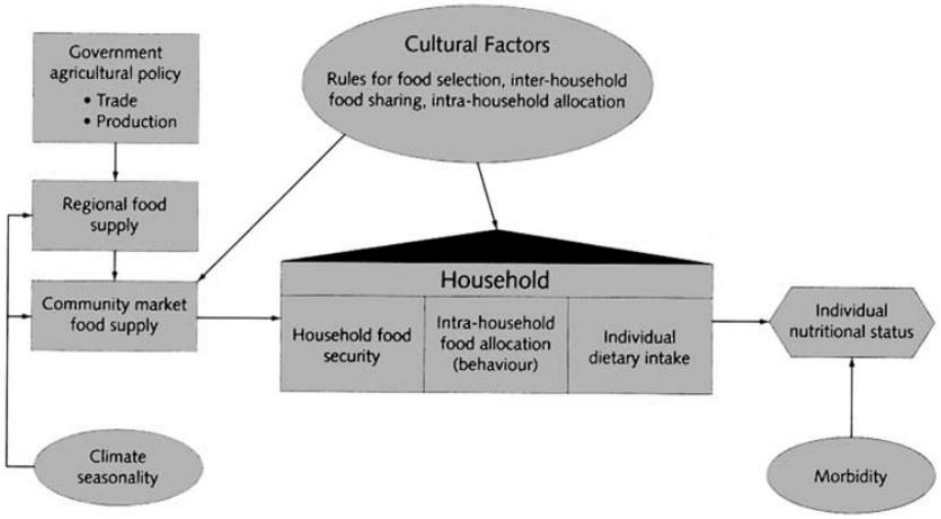


Figure 16.8 UNU Theoretical Framework of Food Security 1998

Source: From Operationalising household food security in rural Nepal (UNU 1998)

The UNU' framework pictured in figure 16.8 is a broad conceptual framework for examining household food security. While household is explicitly the objective here the individual is still the focal point of the output of food security. At once what is clear from this model is the vagueness of the chosen variables; for instance there is some mention of production and availability but no mention of access or utilisation. Also while some element of stability here is presumed to belong to the cultural component, just why climate and seasonality was singled out at the expense of other variables is not clear. What is good here though is the inclusion of morbidity as being associated with individual nutritional status. Unfortunately morbidity is not the sole component of this aspect and there is no mention of other influences like health care, water and sanitation. The Evaluation of this model against the criteria outlined in the literature review is summarised in table 16.8.

Table 16.8 Model A8: UNU Theoretical Framework of Food Security 1998

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	3
		B. Most of the pillars of food security are clearly present (not ambiguous)	4
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	4
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	3
		E. The model introduces new insights into the food security definition	1
		F. The model redefines traditional relationships	2
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	4
		H. There are some entities that seem non-relevant	3
		I. There are entities noticeably left out	4
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	4
		K. The boundaries of the concept are properly defined	2
		L. The boundaries are blurred and need defining	3
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	3
		N. The model compares well to the food security definitions	4
		O. The definition is not reflected in the model	5
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	4
		Q. There are quite a few variables but they work really well in a simple way	3
		R. The framework is unnecessarily complex	4
		Total Score	**60**

16.1.9 Human Resources and Skills Development, Canada

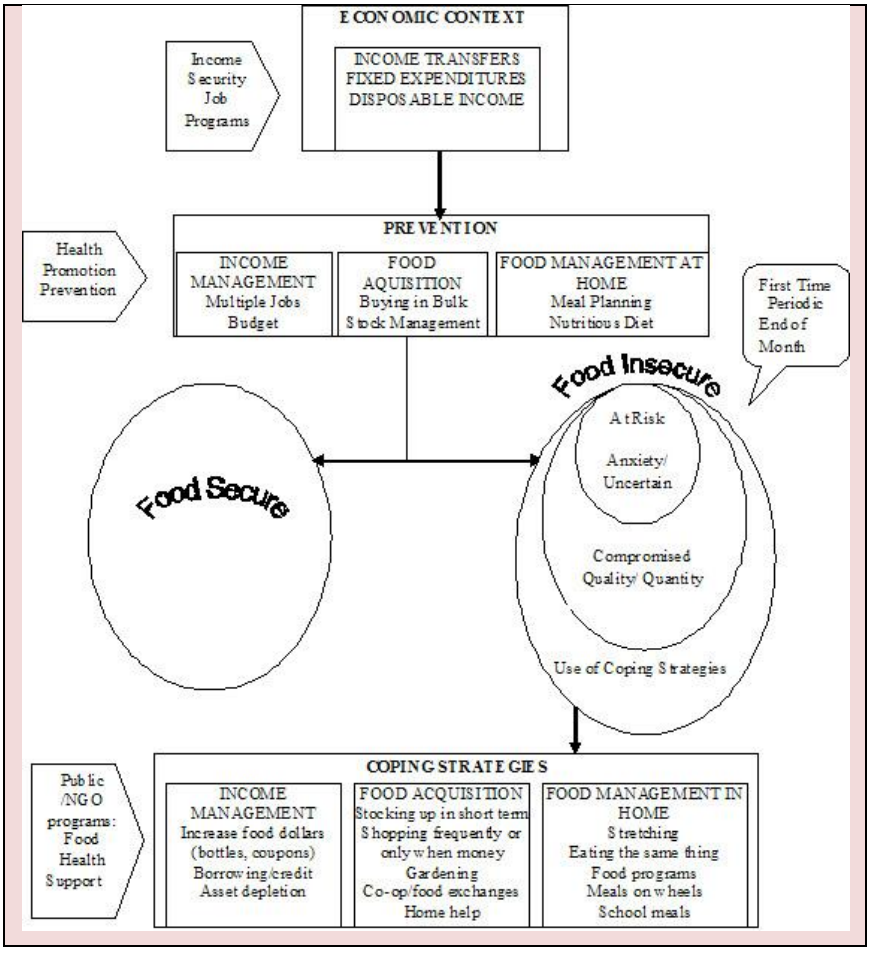


Figure 16.9 Human Resources and Skills Development Framework of Food Security

Source: from Food Insecurity in Canada (Rainville and Brink 2001).

This model figure 16.9 clearly separates the two extremes of food security and insecurity. Its use of coping strategies is novel and demarcates boundaries for economic, health and environmental contexts. This model is evaluated further in the case study review. The initial author evaluation of this model against the criteria outlined in the literature review is summarised in table 16.9.

Table 16.9 Model A9: Human Resources and Skills Development, Canada

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	1
		B. Most of the pillars of food security are clearly present (not ambiguous)	4
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	4
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	5
		E. The model introduces new insights into the food security definition	1
		F. The model redefines traditional relationships	3
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	1
		H. There are some entities that seem non-relevant	3
		I. There are entities noticeably left out	5
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	4
		K. The boundaries of the concept are properly defined	2
		L. The boundaries are blurred and need defining	4
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	4
		N. The model compares well to the food security definitions	4
		O. The definition is not reflected in the model	5
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P**. The overall concept is easily understood	4
		Q. There are quite a few variables but they work really well in a simple way	4
		R. The framework is unnecessarily complex	5
		Total Score	**63**

16.1.10 Polly Ericksen Model of Food Security 2008

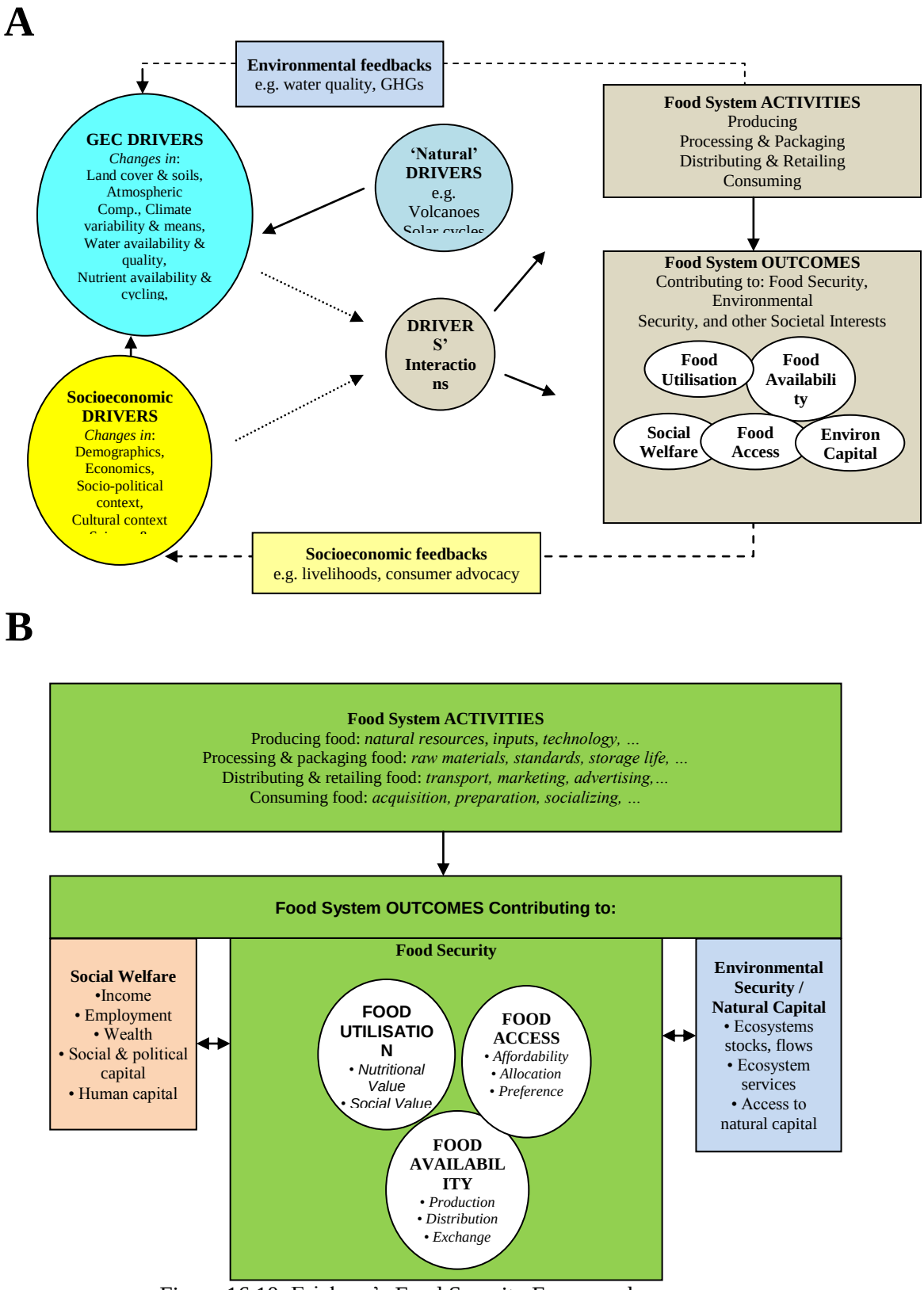


Figure 16.10: Ericksen's Food Security Framework

Source: What Is the Vulnerability of a Food System to Global Environmental Change? (Ericksen 2008)

Ericksen relies on a two part model to provide an overview of food security and the environment. An interesting idea is the notion of feedbacks. This is a sophisticated view of the macro environment highlighting the risks inherent in a the vulnerability of the environment. Importantly too, Ericksen notes the expanding concept of the food system and links it to the wider societal interests. This ‘‘systems’’ approach, according to Ericksen lends itself well to the analysis of:

“...a ‘problem-determined system’ rather than a ‘system-determined problem’...” (Ericksen 2008). The Evaluation of this model against the criteria outlined in the literature review is summarised in Table 16.10.

Table 16.10 Model A10: Polly Ericksen Model of Food Security 2008

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	4
		B. Most of the pillars of food security are clearly present (not ambiguous)	4
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	5
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	3
		E. The model introduces new insights into the food security definition	3
		F. The model redefines traditional relationships	4
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	2
		H. There are some entities that seem non-relevant	4
		I. There are entities noticeably left out	4
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	2
		K. The boundaries of the concept are properly defined	4
		L. The boundaries are blurred and need defining	3
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	5
		N. The model compares well to the food security definitions	4
		O. The definition is not reflected in the model	3
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	4
		Q. There are quite a few variables but they work really well in a simple way	3
		R. The framework is unnecessarily complex	4
		Total Score	**65**

16.1.11 Achieving Food Security in China 2010

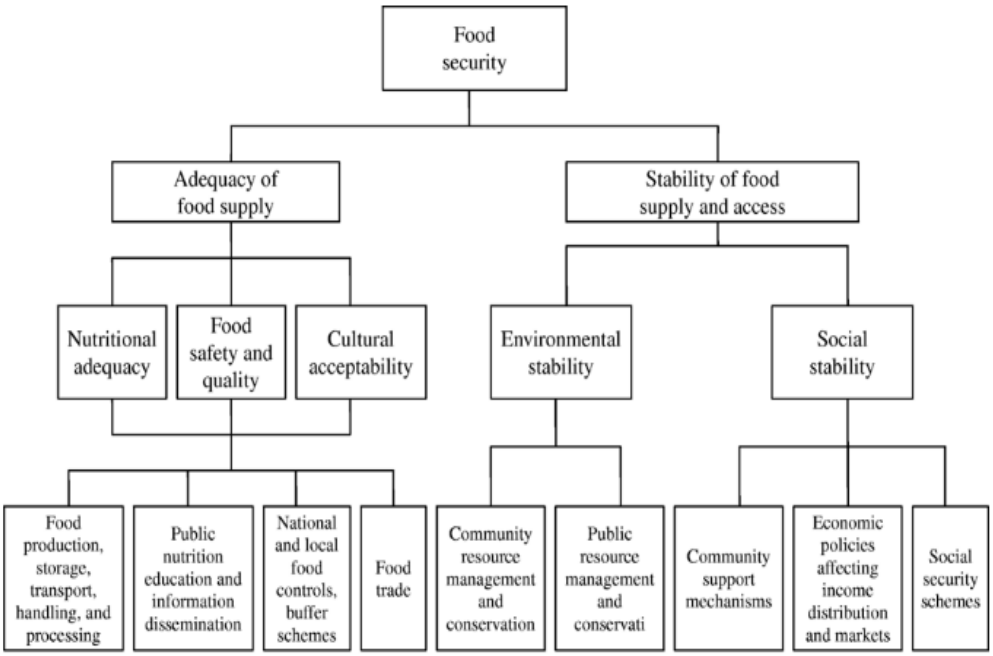


Figure 16.11 Model of Food Security in China

Source: Achieving Food Security in China: Past Three Decades and Beyond (Zhou 2010)

In adapting a model from Arne Oshaug and colleagues (Oshaug *et al.* 1994) Zhou (2010) utilise the pillars of supply and stability of the food security concept. These are covered well in both terms of macro and micro variables although interestingly there is no mention of the political supporting environment. Of particular note however in this model is the omission of the pillars of access and utilisation. That said not every model is built in this image although these pillars usually take into account the variables contained within its concept. Zhou's model on the other hand incorporates food safety and quality under the banner of availability ' of food. Further the use of nutritional adequacy as well as cultural acceptability under the same heading tends to confuse rather than clarify the relationships. The Evaluation of this model against the criteria outlined in the literature review is summarised in table 16.11.

Table 16.11 Model A11: Achieving Food Security in China 2010

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	2
		B. Most of the pillars of food security are clearly present (not ambiguous)	1
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	5
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	3
		E. The model introduces new insights into the food security definition	3
		F. The model redefines traditional relationships	4
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	3
		H. There are some entities that seem non-relevant	4
		I. There are entities noticeably left out	5
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	3
		K. The boundaries of the concept are properly defined	1
		L. The boundaries are blurred and need defining	3
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	4
		N. The model compares well to the food security definitions	4
		O. The definition is not reflected in the model	5
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	1
		Q. There are quite a few variables but they work really well in a simple way	4
		R. The framework is unnecessarily complex	5
		Total Score	**60**

16.1.12 Committee on World Food Security Model 2000

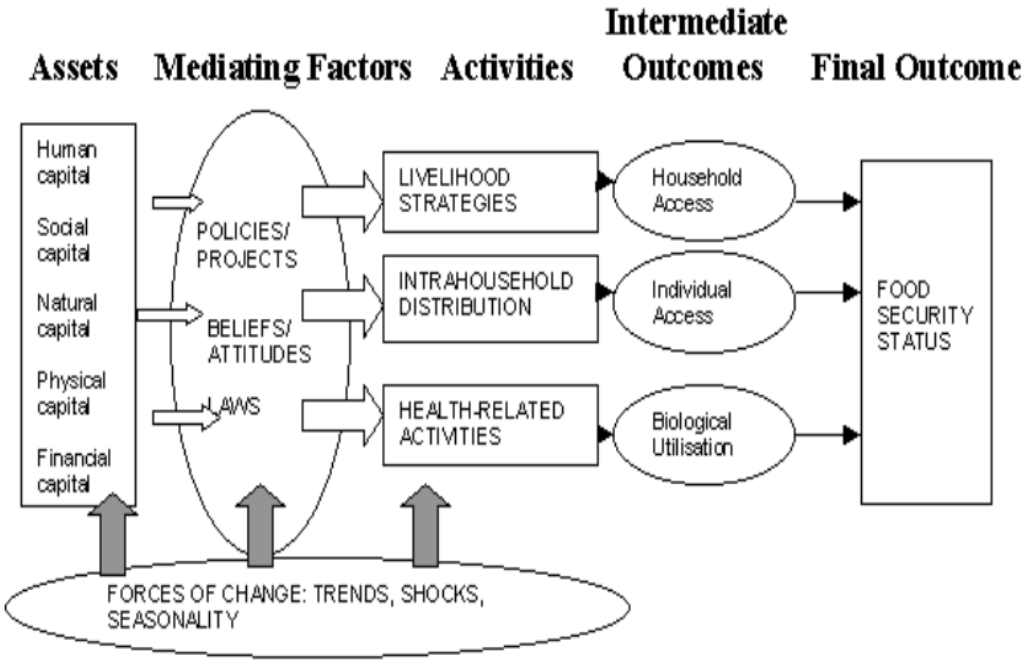


Figure 16.12 Committee on World Food Security Food Security Model 2000

Source: CFS Report Who Are the Food Insecure? (CFS 2000)

Figure 16.12 shows the Committee on World Food Security (CFS) model from the report 'Who Are the Food Insecure?' from 2000. It features heavily the livelihoods approach which it combines with the three pillars of FAO's 4 pillar model. Presumably the 4th pillar is represented by the forces of change. In the report the CFS describe the mediating factors of the model as influencing the way that people combine their assets to achieve particular livelihood strategies. What is not immediately obvious from this is the extent to which people have command over these choices although in their defence this is explicit in accompanying text to the model. What is also common in the UN institutional models is the notion that nutrition security is implied in food security through the connection of utilisation. Overall the model is fairly reflective of the food security concept although it does leave the reader relying on considerable textual references to clarify certain relationships, particularly the outside influences of environment, policy and trends. The Evaluation of this model against the criteria outlined in the literature review is summarised in table 16.12.

Table 16.12 Model A12: Committee on World Food Security Model 2000

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	1
		B. Most of the pillars of food security are clearly present (not ambiguous)	1
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	4
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	4
		E. The model introduces new insights into the food security definition	3
		F. The model redefines traditional relationships	2
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	2
		H. There are some entities that seem non-relevant	3
		I. There are entities noticeably left out	5
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	1
		K. The boundaries of the concept are properly defined	3
		L. The boundaries are blurred and need defining	3
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	4
		N. The model compares well to the food security definitions	2
		O. The definition is not reflected in the model	5
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	4
		Q. There are quite a few variables but they work really well in a simple way	4
		R. The framework is unnecessarily complex	4
		Total Score	**55**

16.1.13 Work Stream 5: Food Security 2009

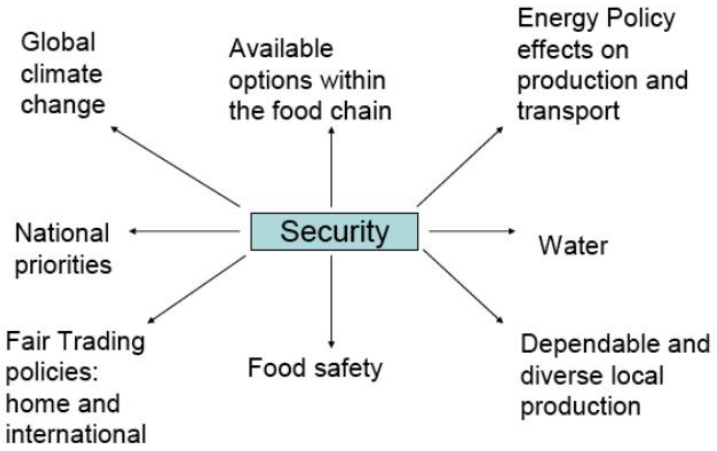


Figure 16.13 Work Stream 5: Food Security Model 2009

Source: Work Stream 5: Scottish Government's Food Forum (Workstream 5 2009).

What is immediately obvious in the Scottish Government's Food Forum model of food security shown in figure 16.13 is that all roads lead independently to security. Whether this 'security' is representative of food security or security of each of the individual elements is unclear. If as the author suspects it is representative of the former then there appears to be very little structure beyond the immediate represented relationships. Of note here is that such relationships are not always linear or direct and the model seems to discount such relationships in favour of simplicity. Furthermore the model cherry picks certain variables from the macro environment of influence at the expense of many of the immediate micro environment variables such as utilisation, household or livelihood components. Importantly too the model ignores completely one of the more fundamental of the pillars; that of access to food. The Evaluation of this model against the criteria outlined in the literature review is summarised in table 16.13.

Table 16.13 Model A13: Work Stream 5: Food Security 2009

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	1
		B. Most of the pillars of food security are clearly present (not ambiguous)	1
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	4
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	3
		E. The model introduces new insights into the food security definition	3
		F. The model redefines traditional relationships	1
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	4
		H. There are some entities that seem non-relevant	4
		I. There are entities noticeably left out	3
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	4
		K. The boundaries of the concept are properly defined	1
		L. The boundaries are blurred and need defining	4
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	4
		N. The model compares well to the food security definitions	2
		O. The definition is not reflected in the model	4
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	1
		Q. There are quite a few variables but they work really well in a simple way	4
		R. The framework is unnecessarily complex	4
		Total Score	**52**

16.1.14 Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS) – Food Security

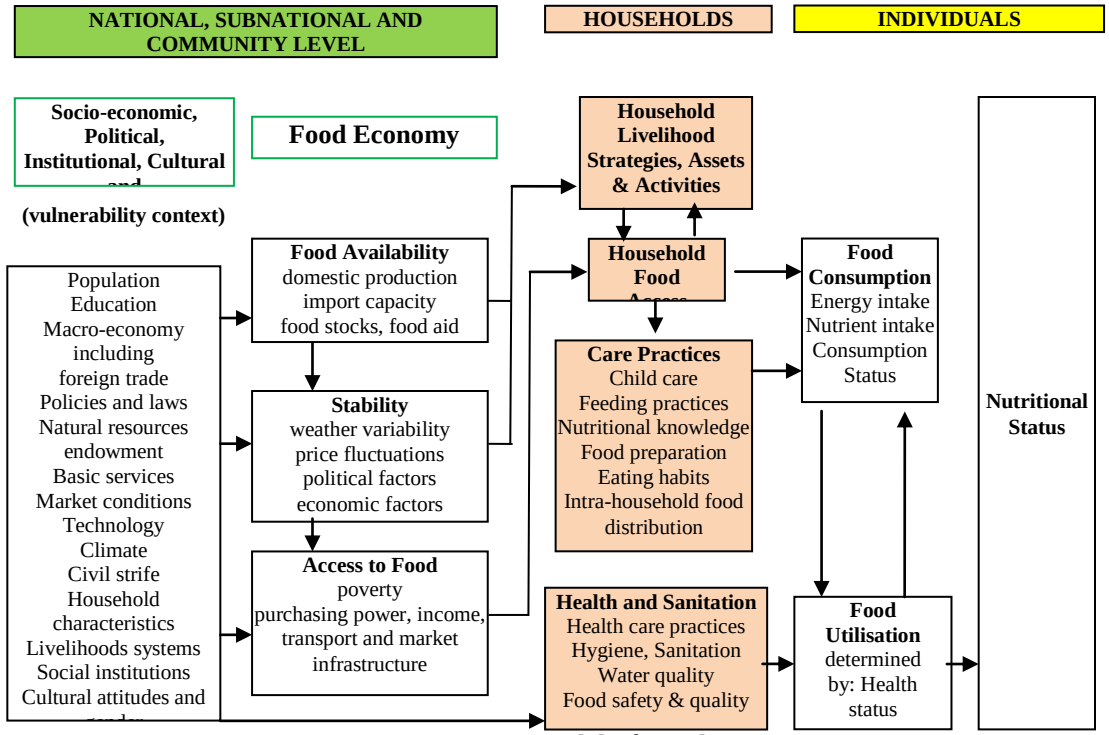


Figure 16.14: FIVIMS Model of Food Security

Source: from The FIVIMS Initiative: Food Insecurity and Vulnerability Information and Mapping Systems. (FIVMS 2008).

The FIVIMS model figure 16.14 is perhaps one of the well known models of food security. This model clearly illustrates causality between the macro environment and the constructs of access, availability and stability. It is a well balanced model that clearly elucidates entities and relationships. This model is evaluated further in the case study review. The initial author evaluation of this model against the criteria outlined in the literature review is summarised in table 16.14.

Table 16.14 Model A14: Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS) Food Security

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	2
		B. Most of the pillars of food security are clearly present (not ambiguous)	3
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	5
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	4
		E. The model introduces new insights into the food security definition	4
		F. The model redefines traditional relationships	3
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	4
		H. There are some entities that seem non-relevant	5
		I. There are entities noticeably left out	5
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	2
		K. The boundaries of the concept are properly defined	4
		L. The boundaries are blurred and need defining	4
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	5
		N. The model compares well to the food security definitions	4
		O. The definition is not reflected in the model	3
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	2
		Q. There are quite a few variables but they work really well in a simple way	2
		R. The framework is unnecessarily complex	3
		Total Score	**64**

16.2 Vulnerability

Another perspective of food security views the phenomenon from the standpoint of vulnerability. The biggest advantage according to some is that while traditional food security analysis concentrates on retrospective measures, vulnerability analysis ensures a forward looking, proactive approach more likely to identify causality (Løvendal and Knowles 2005). However, it is also suggested that despite these obvious advantages, vulnerability is not consistently applied or rarely adequately operationalised. It is suggested as a result that vulnerability might at one time or another refer to hunger, food insecurity, famine or other associated concepts within the food security catchall (Løvendal and Knowles 2005).

16.2.1 **Food Insecurity and Vulnerability Information** and **Mapping Systems (FIVIMS) – Vulnerability 1**

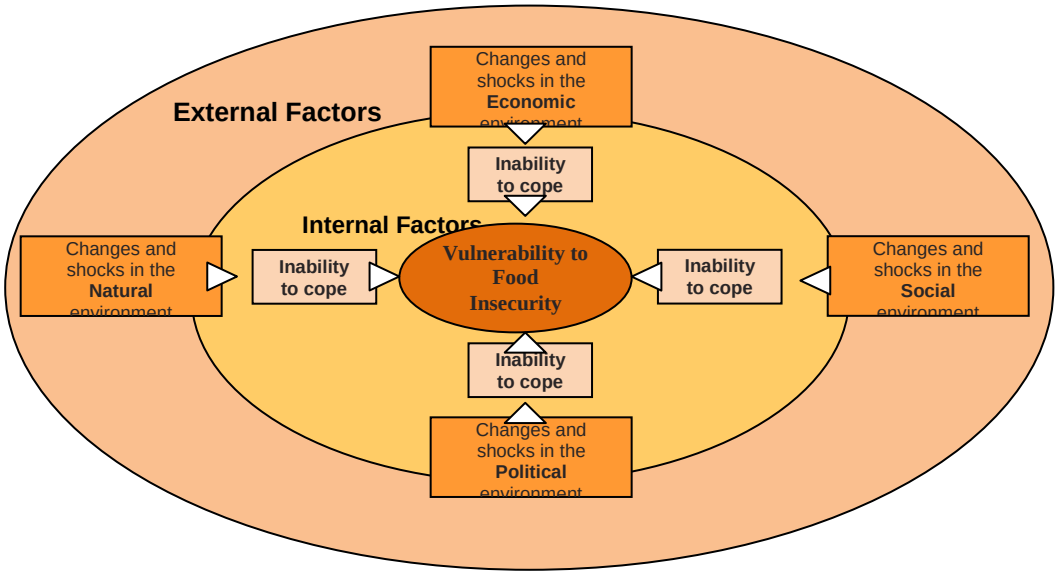


Figure 16.15 FIVIMS Model of Food Security Vulnerability (part 1)
Source: from the FIVIMS Initiative: Food Insecurity and Vulnerability Information and Mapping Systems: Tools and Tips (FIVMS 2008).

This model (figure 16.15) is a very simple version of the vulnerability of the food security concept and includes both internal and external factors. In this model a person's vulnerability is his or hers inability to cope with these factors. While a useful addition as an adjunct to other models in and of itself it does little to elucidate the bigger picture of food security. In this way with its narrow focus it is of limited value beyond highlighting the influential factors of vulnerability. The Evaluation of this model against the criteria outlined in the literature review is summarised in table 16.15.

Table 16.15 Model A15: Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS)– Vulnerability 1

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	2
		B. Most of the pillars of food security are clearly present (not ambiguous)	1
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	3
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	3
		E. The model introduces new insights into the food security definition	2
		F. The model redefines traditional relationships	2
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	3
		H. There are some entities that seem non-relevant	5
		I. There are entities noticeably left out	4
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	4
		K. The boundaries of the concept are properly defined	3
		L. The boundaries are blurred and need defining	5
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	4
		N. The model compares well to the food security definitions	4
		O. The definition is not reflected in the model	3
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	1
		Q. There are quite a few variables but they work really well in a simple way	3
		R. The framework is unnecessarily complex	4
		Total Score	**56**

16.2.2 **Food Insecurity and Vulnerability Information** and **Mapping Systems (FIVIMS) – Vulnerability 2**

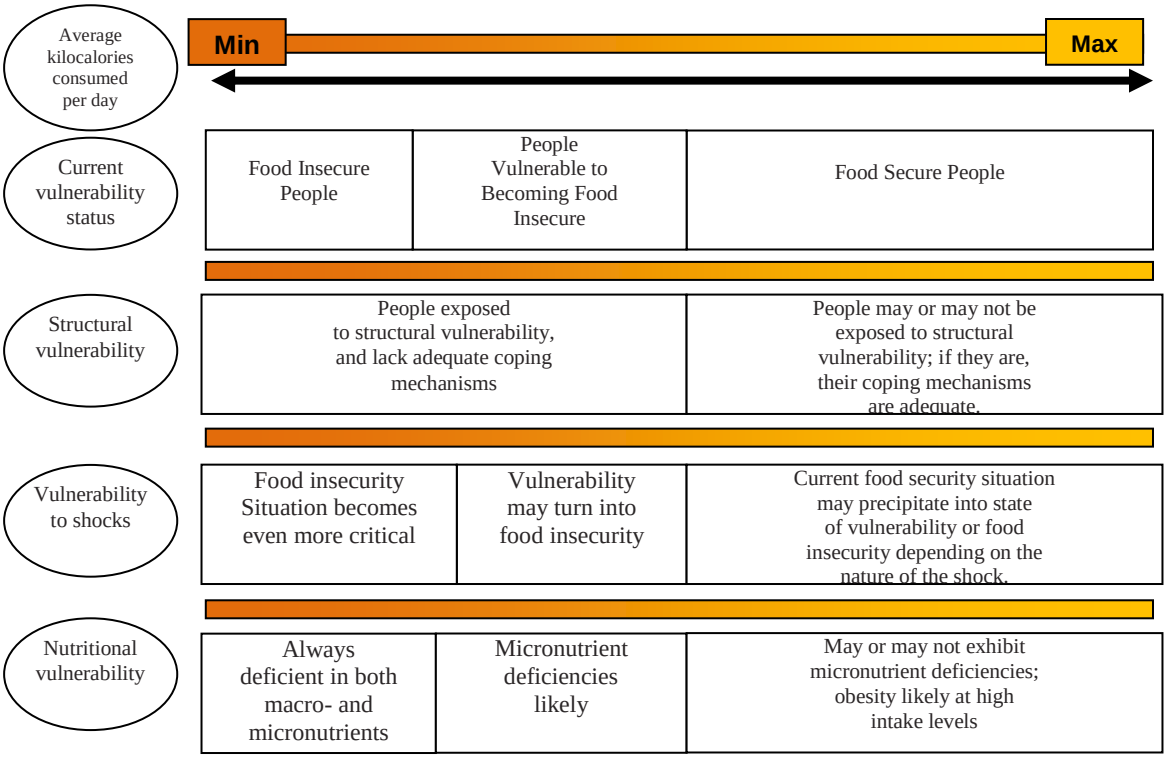


Figure 16.16 FIVIMS Alternative Model of Food Security (part 2)

Source: from the FIVIMS Initiative: Food Insecurity and Vulnerability Information and Mapping Systems: Tools and Tips (FIVMS 2008).

As well as the previous part 1 FIVIMS framework the above part 2 (figure 16.16) also concentrates on the vulnerability aspect of the concept. However, while part 1 is a simple diagrammatic approach aiming to distil the concept into its simplest component parts, part 2 relies on a textual narrative to highlight the various dimensions. In this case as in the previous one the model successfully highlights the various dimensions of vulnerability although in this model the depth of vulnerability is highlighted as falling between minimum and maximum effects. Once again though this acts as a good supplemental model to other models of food security yet by itself it is insufficient as a standalone framework. The Evaluation of this model against the criteria outlined in the literature review is summarised in table 16.16.

Table 16.16 Model A16: Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS)– Vulnerability 2

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	3
		B. Most of the pillars of food security are clearly present (not ambiguous)	4
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	4
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	5
		E. The model introduces new insights into the food security definition	1
		F. The model redefines traditional relationships	4
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	3
		H. There are some entities that seem non-relevant	5
		I. There are entities noticeably left out	3
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	3
		K. The boundaries of the concept are properly defined	2
		L. The boundaries are blurred and need defining	3
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	5
		N. The model compares well to the food security definitions	1
		O. The definition is not reflected in the model	5
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	2
		Q. There are quite a few variables but they work really well in a simple way	1
		R. The framework is unnecessarily complex	3
		Total Score	**57**

16.2.3 FAO Løvendal and Knowles, 2005

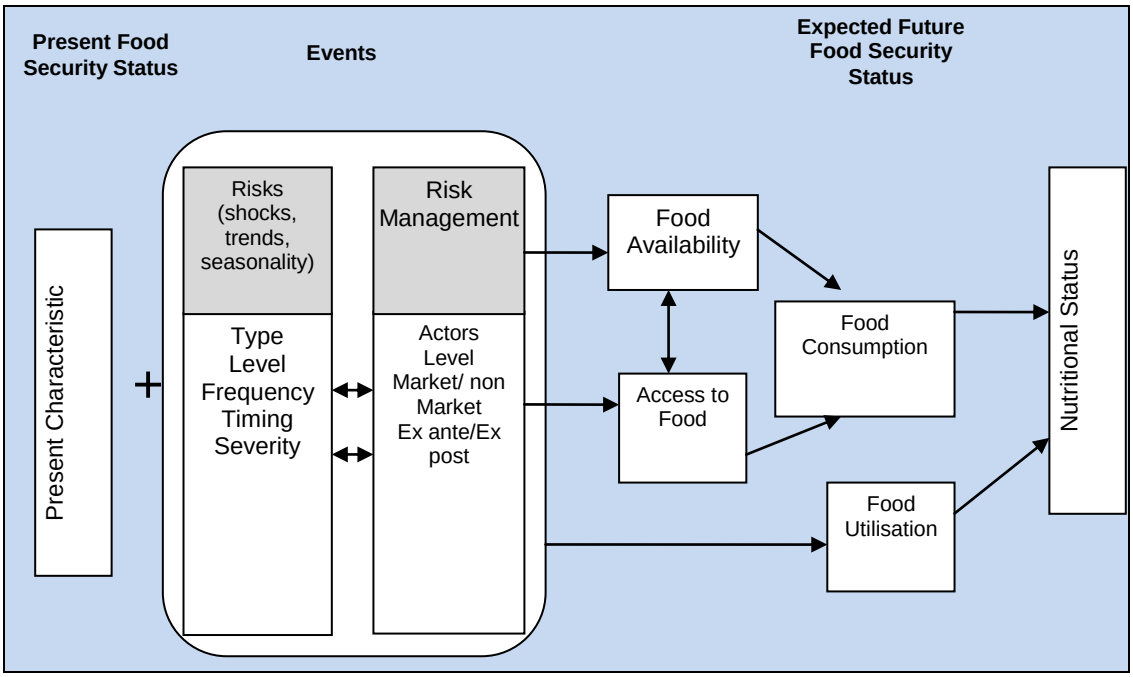


Figure 16.17 FAO Framework for Analysing Vulnerability to Food Insecurity

Source: from Tomorrow's Hunger: A Framework for Analysing Vulnerability to Food Insecurity (Løvendal and Knowles 2005) .

The above framework by Løvendal and Knowles (figure 16.17) on behalf of the FAO presents a framework that aims to identify the probability of becoming food insecure in the future. This is determined by present day conditions and potential risks that will impact in the future. As a model it is inclusive of all four dimensions of access, availability, stability and utilisation. Although in this model the stability, or risk component is further divided into the events themselves and the risk management processes. This is an interesting addition in that few other models directly tackle vulnerability in this way; other models might define this in terms of coping strategies by the individual or the state. As in the previous two vulnerability models this framework too becomes a useful add-on to existing fuller models but by itself there is insufficient breadth of coverage to give any real big picture of food security. The Evaluation of this model against the criteria outlined in the literature review is summarised in table 16.17.

Table 16.17 Model A17: FAO Løvendal and Knowles, 2005

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	1
		B. Most of the pillars of food security are clearly present (not ambiguous)	1
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	4
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	5
		E. The model introduces new insights into the food security definition	3
		F. The model redefines traditional relationships	3
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	4
		H. There are some entities that seem non-relevant	4
		I. There are entities noticeably left out	4
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	3
		K. The boundaries of the concept are properly defined	2
		L. The boundaries are blurred and need defining	4
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	4
		N. The model compares well to the food security definitions	4
		O. The definition is not reflected in the model	5
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	1
		Q. There are quite a few variables but they work really well in a simple way	2
		R. The framework is unnecessarily complex	5
		Total Score	**59**

16.3 Malnutrition and Nutrition Security

Proximal to the food security notion is that of malnutrition and nutrition security. Some argue that nutrition security is a more rounded concept than solely aiming for security of food. That said the food security concept definition implicitly renders biological utilisation of food as paramount to the concept (FAO 1996; SOFI 2001). Consequently it can be argued that both malnutrition and nutrition security are two aspects of the same continuum. When it comes to malnutrition however the FAO for instance see the situation as one of overlapping domains. In this scenario the FAO view malnourishment and food insecurity as closely linked yet separable. They clearly make the separation that suggests not all malnourished are food insecure and vice versa.

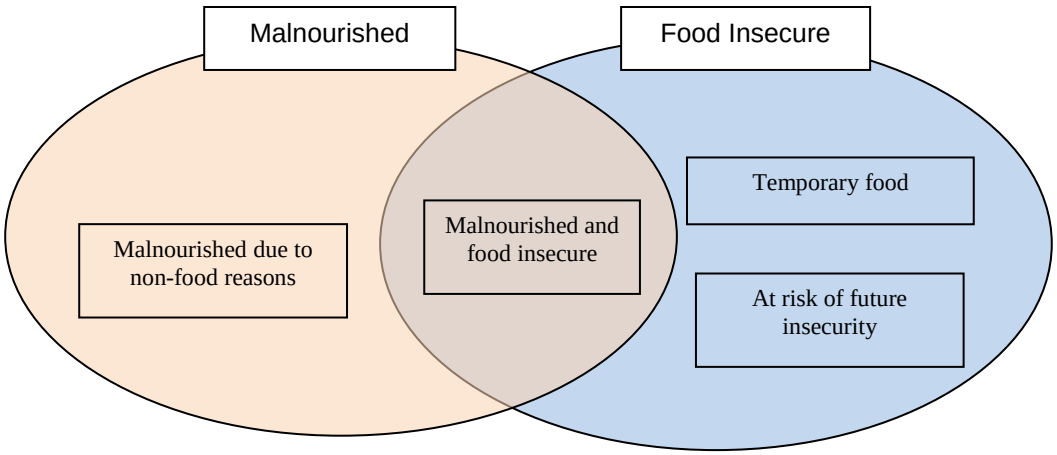


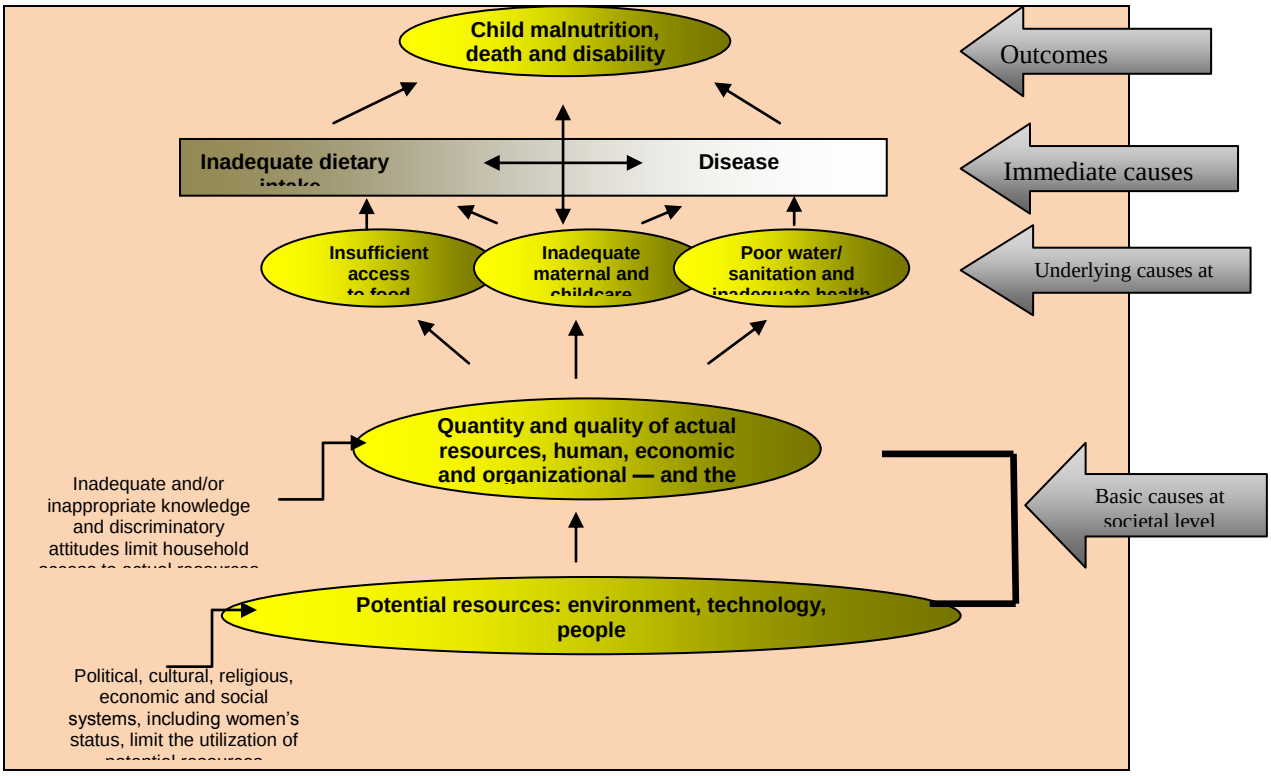
Figure 16.18 FAO Malnutrition Concept

Source: Based on FAO' An Introduction to the Basic Concepts of Food Security (EC/FAO 2008)

16.3.1 The United Nations Children Fund (UNICEF), 1990/98

One of the most widely represented of all the malnutrition models is that of the United Nations Children Fund developed from 1990 (UNICEF 1990). Variously adapted over the years, figure 16.19 A and B shows the multi-sectoral causes of malnutrition whilst also highlighting the factors perceived as immediate, underlying, and basic.

A



B

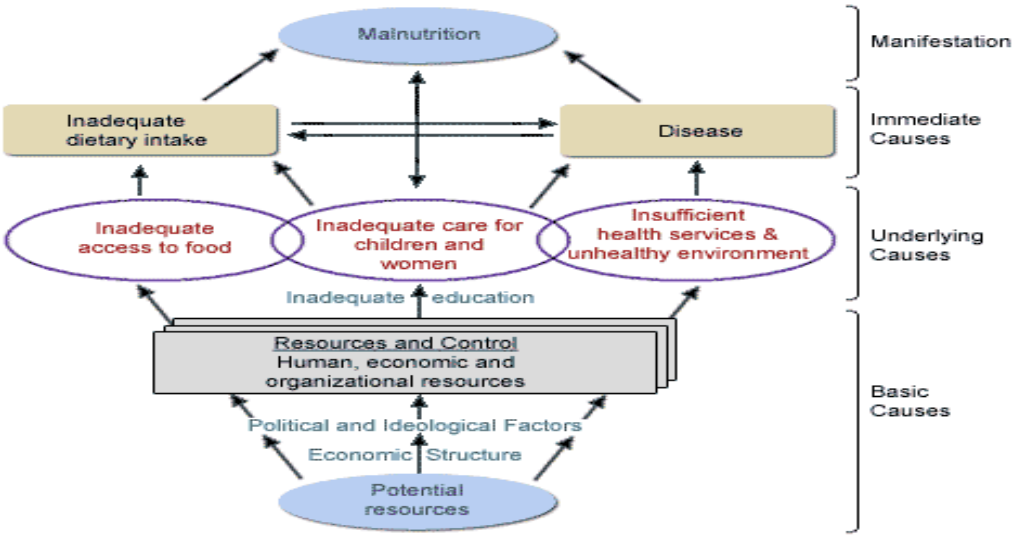


Figure 16.19 A & B UNICEF Framework of Malnutrition, 1990/98

Sources (UNICEF 1990; UNICEF 1998).

At its inception in 1990 it was specifically noted that the model should not be used as a predictive instrument suggesting instead that the model's boundaries were purposefully vague so as to allow further interpretation to be based in context. Essentially the models act

as a focus where questions can be posed and used to determine future models (UNICEF 1990; UNICEF 1998). For this reason these are not considered in terms of evaluation although it is worth looking at them with regards to structure and presentation of the concept. The two models are essentially similar representations of the same construct and are treated as one. In terms of how the model deals with nutrition of note is the division of the concept into 4 parts consisting of basic, underlying and immediate causes as well as manifestation. Although dealing solely with the components of access and utilisation the model does show a clear and intuitive progression of ideas. Alas though as in the vulnerability models of the previous section this model too becomes an acceptable add-on yet does little to portray the concept of food security in its entirety. The Evaluation of this model against the criteria outlined in the literature review is summarised in table 16.18.

Table 16.18 Model A18: The United Nations Children Fund (UNICEF), 1990/98

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	1
		B. Most of the pillars of food security are clearly present (not ambiguous)	2
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	5
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	5
		E. The model introduces new insights into the food security definition	2
		F. The model redefines traditional relationships	2
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	3
		H. There are some entities that seem non-relevant	4
		I. There are entities noticeably left out	5
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	3
		K. The boundaries of the concept are properly defined	1
		L. The boundaries are blurred and need defining	4
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	5
		N. The model compares well to the food security definitions	4
		O. The definition is not reflected in the model	4
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	3
		Q. There are quite a few variables but they work really well in a simple way	3
		R. The framework is unnecessarily complex	5
		Total Score	**61**

16.3.2 Committee on Food Security (CFS) 1998

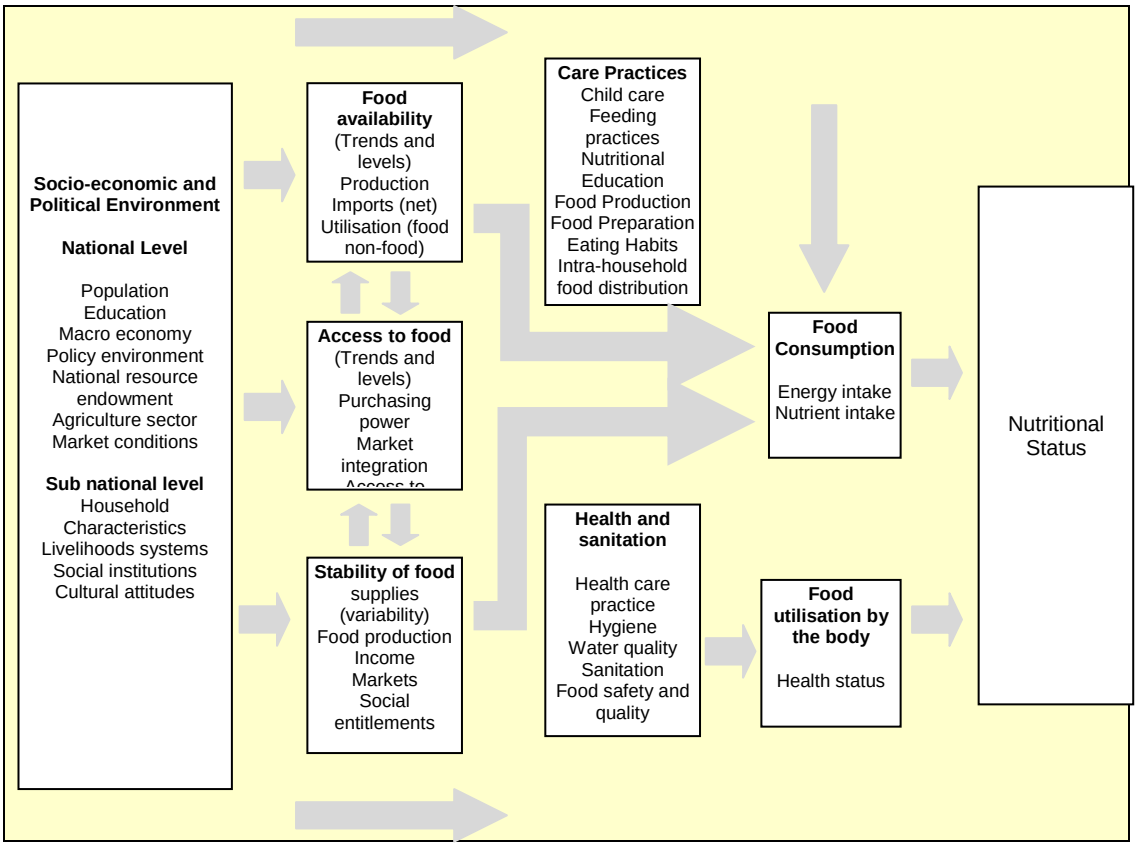


Figure 16.20 Committee on Food Security Nutritional Framework 1998

Source: from the Guidelines for National Food Insecurity and Vulnerability Information and Mapping Systems (CFS 1998).

The above nutrition framework by the CFS (figure 16.20) identifies with all four dimension of food security. This is one of the few models to explicitly draw the livelihoods approach (albeit under external environmental considerations) into such a model. This is useful as it is an important element often assumed in other similar designs. Stability too in this framework is also employed differently and is separated out from other environmental influences to specifically refer to access and availability of food. This is in contrast to those models that treat stability as an aspect of the whole spectrum of risk and vulnerability to include the wider exogenous variables. All this leads to the concept of consumption and utilisation in turn affecting nutrition. Although strictly speaking this framework details the nutritional aspects it is worth noting that it is almost identical to similar models representing the food security concept. Indeed this model was later used in considering the present FIVIMS framework which is one of the six models under consideration in the case studies. As an early example it is quite broad in scope and covers many of the relevant variables associated with the four dimensions although it is quite textually rich and does not elucidate the role of the livelihoods perspective other than mentioning it as an outside influence. The Evaluation

of this model against the criteria outlined in the literature review is summarised in table 16.19.

Table 16.19 Model A19: Committee on Food Security (CFS) 1998

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	4
		B. Most of the pillars of food security are clearly present (not ambiguous)	1
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	5
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	4
		E. The model introduces new insights into the food security definition	4
		F. The model redefines traditional relationships	2
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	2
		H. There are some entities that seem non-relevant	5
		I. There are entities noticeably left out	5
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	1
		K. The boundaries of the concept are properly defined	4
		L. The boundaries are blurred and need defining	4
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	4
		N. The model compares well to the food security definitions	1
		O. The definition is not reflected in the model	5
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	1
		Q. There are quite a few variables but they work really well in a simple way	1
		R. The framework is unnecessarily complex	5
		Total Score	**58**

16.3.3 WHO

The World Health Organisation's (WHO) main focus is addressing the health and nutrition aspects of global food insecurity. They utilise similar constructs as the FAO, with identical concepts of food access and availability yet the third dimension, food use is based on a more detailed concept of food utilisation in which the WHO determine:

> "Food use: appropriate use based on knowledge of basic nutrition and care, as well as adequate water and sanitation" (WHO 2011).

With regards to assessing, estimating and monitoring the food and nutrition needs, particularly in emergencies, the WHO, UNHCR, UNICEF and the WFP jointly developed a set of guidelines that included the 1998 UNICEF model of undernutrition, see UNICEF (WHO 2004).

16.3.4 Beaton and Bengoa Comprehensive Health and malnutrition Model, 1976

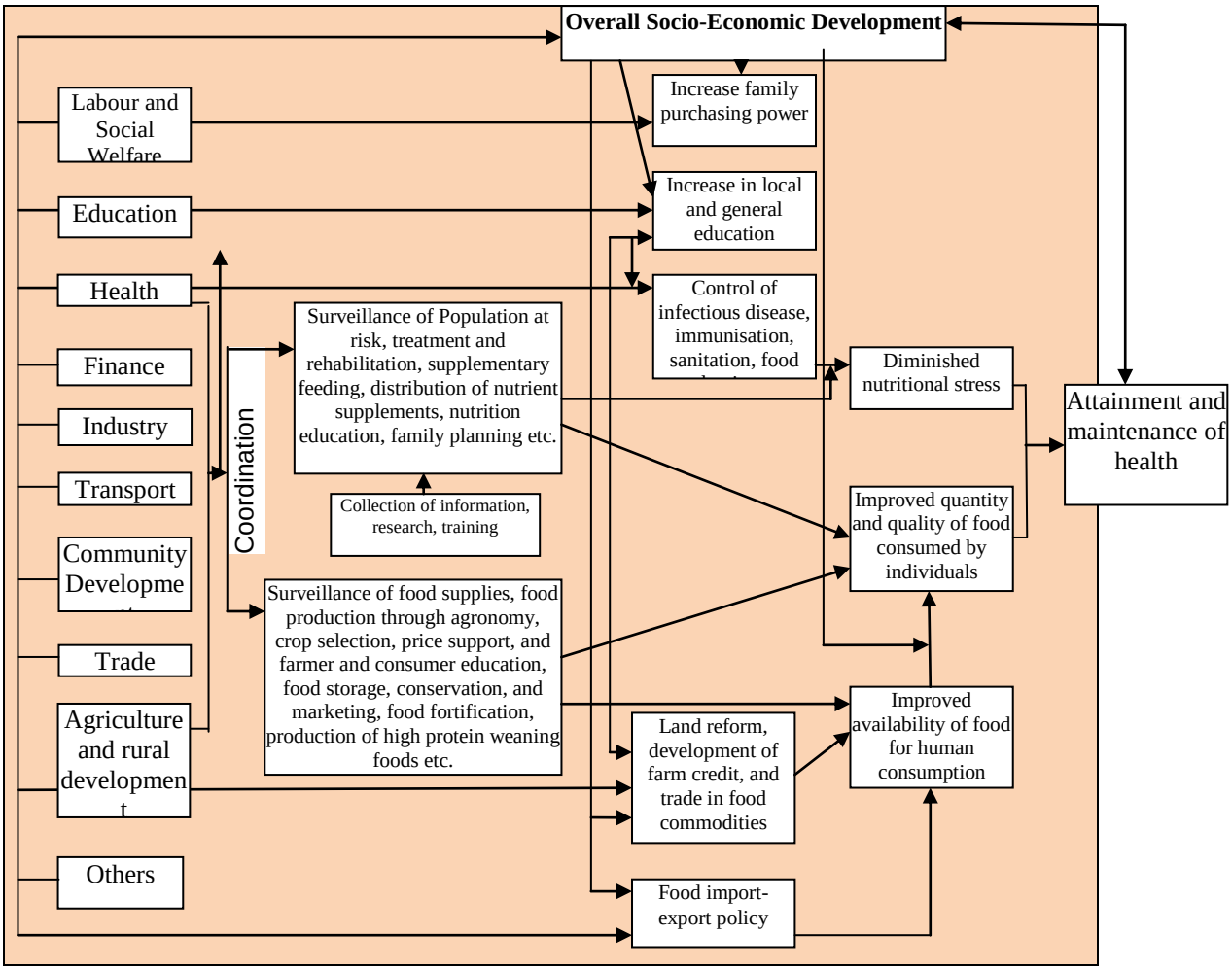


Figure 16.21 Beaton and Bengoa Comprehensive Health and malnutrition Model, 1976

Source: From Nutrition in Preventative Medicine (Beaton and Bengoa 1976).

Beaton and Bengoa take a fully comprehensive approach to food security and aim to combine two broad aims: malnutrition and future health (figure 16.21). These, the authors suggest, can be further divided into three divisions, two food and health oriented programmes of direct intervention and one other incorporating collective indirect intervention. This early (1976) approach aims to partition responsibility among the various ministries including; agriculture, health and lastly those concerned with general socioeconomic conditions (Beaton and Bengoa 1976). As an early concept this model is reflective of many of the elements of the 4-pillars although it is particularly strong in the area of utilisation. This focus on the health and care of the individual is equally matched with a concise understanding of the external environmental influences that include education, trade and agriculture. However while its strength is in its inclusive approach it is achieved at the expense of overall clarity. While the model flows logically from left to right culminating in a clear outcome objective the explicit relationships are numerous and detract from the overall

clarity. The Evaluation of this model against the criteria outlined in the literature review is summarised in table 16.20.

Table 16.20 Model A20: Beaton and Bengoa Comprehensive Health and malnutrition Model, 1976

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	3
		B. Most of the pillars of food security are clearly present (not ambiguous)	1
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	3
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	5
		E. The model introduces new insights into the food security definition	1
		F. The model redefines traditional relationships	1
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	3
		H. There are some entities that seem non-relevant	4
		I. There are entities noticeably left out	3
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	1
		K. The boundaries of the concept are properly defined	1
		L. The boundaries are blurred and need defining	5
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	3
		N. The model compares well to the food security definitions	3
		O. The definition is not reflected in the model	3
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	1
		Q. There are quite a few variables but they work really well in a simple way	1
		R. The framework is unnecessarily complex	5
		Total Score	**47**

16.4 Livelihoods Perspective

Another viewpoint within the food security concept is the livelihoods approach or Sustainable Livelihoods Approach SLA), this view focuses on the means by which people have access to the food they need (DFID 1999; Frankenberger, Luther *et al.* 2002; **Devereux**, **Baulch** *et al.* 2004; Shoham and Lopriore 2007). Since the mid 1970's this approach has gained momentum and has come to increasingly dominate poverty and food security analysis (**Devereux**, **Baulch** *et al.* 2004). Of note too in this approach is the recognition that households have multiple objectives beyond the immediacy of food security which is in stark contrast to the traditional hierarchical .food first. view of policy makers. In conclusion livelihoods approaches can be described as the way people maintain a viable livelihood over time (FAO 2006). This is an important aspect of food security and is reflected in the growing number of models aiming to incorporate this approach.

16.4.1 Department for International Development's (DFID), 1997

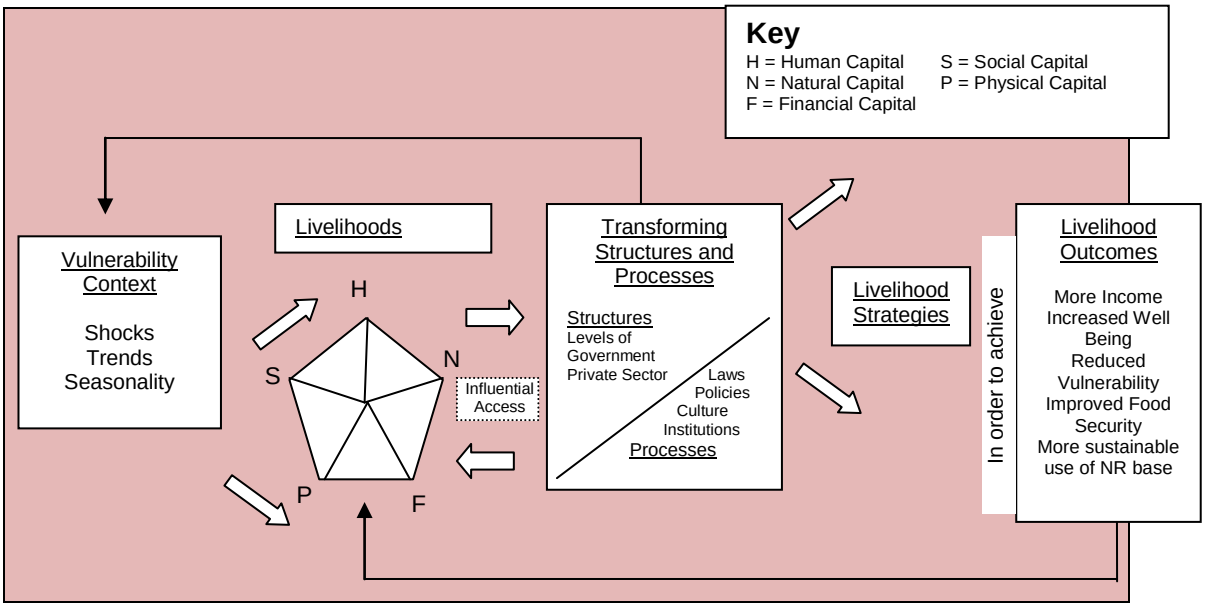


Figure 16.22 the DFID Sustainable Livelihoods Approach

Source: From the Sustainable Livelihoods Guidance Sheets (DFID 1999).

Perhaps the most widely known and used of the Sustainable Livelihoods Approach to food security models is that of the DFID. In 1997 the Department for International Development's (DFID) white paper, while building on Chambers and Conway's ideas, provided the first of many modern concepts of the sustainable livelihood approach (DFID 1997; DFID 1999; Chambers 2005). Building on this the resulting framework (figure 16.22) was developed in 1999 and has been commented on and adapted and adopted by many since. According to the DFID the following representation explicitly offers that households have access to both tangible and intangible assets that aid in meeting livelihoods and thus food security needs. This is represented by the hexagon corresponding to the different capital assets of H – human, S - social, P – physical, F – financial and N – natural. This leads to the idea that these capital can be traded for food security and importantly recognises the feedback system connecting this to shocks and vulnerability. This then determines the livelihoods strategy and ultimately the outcome. As a model of food security it is one element of the bigger picture and as such is not fully reflective. The livelihoods approach concentrates to a large degree on the access component of the 4-pillars and this model reflects that particularly well with its asset capital construct. What is lacking however is the just how this perspective fits in with the overall picture. The Evaluation of this model against the criteria outlined in the literature review is summarised in table 16.21.

Table 16.21 Model A21: Department for International Development's (DFID), 1997

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	1
		B. Most of the pillars of food security are clearly present (not ambiguous)	4
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	3
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	3
		E. The model introduces new insights into the food security definition	2
		F. The model redefines traditional relationships	3
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	1
		H. There are some entities that seem non-relevant	3
		I. There are entities noticeably left out	4
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	2
		K. The boundaries of the concept are properly defined	3
		L. The boundaries are blurred and need defining	5
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	4
		N. The model compares well to the food security definitions	1
		O. The definition is not reflected in the model	5
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	3
		Q. There are quite a few variables but they work really well in a simple way	4
		R. The framework is unnecessarily complex	5
		Total Score	**56**

16.4.2 Timothy Frankenberger -2002, Livelihood's Strategies Model of Food Security

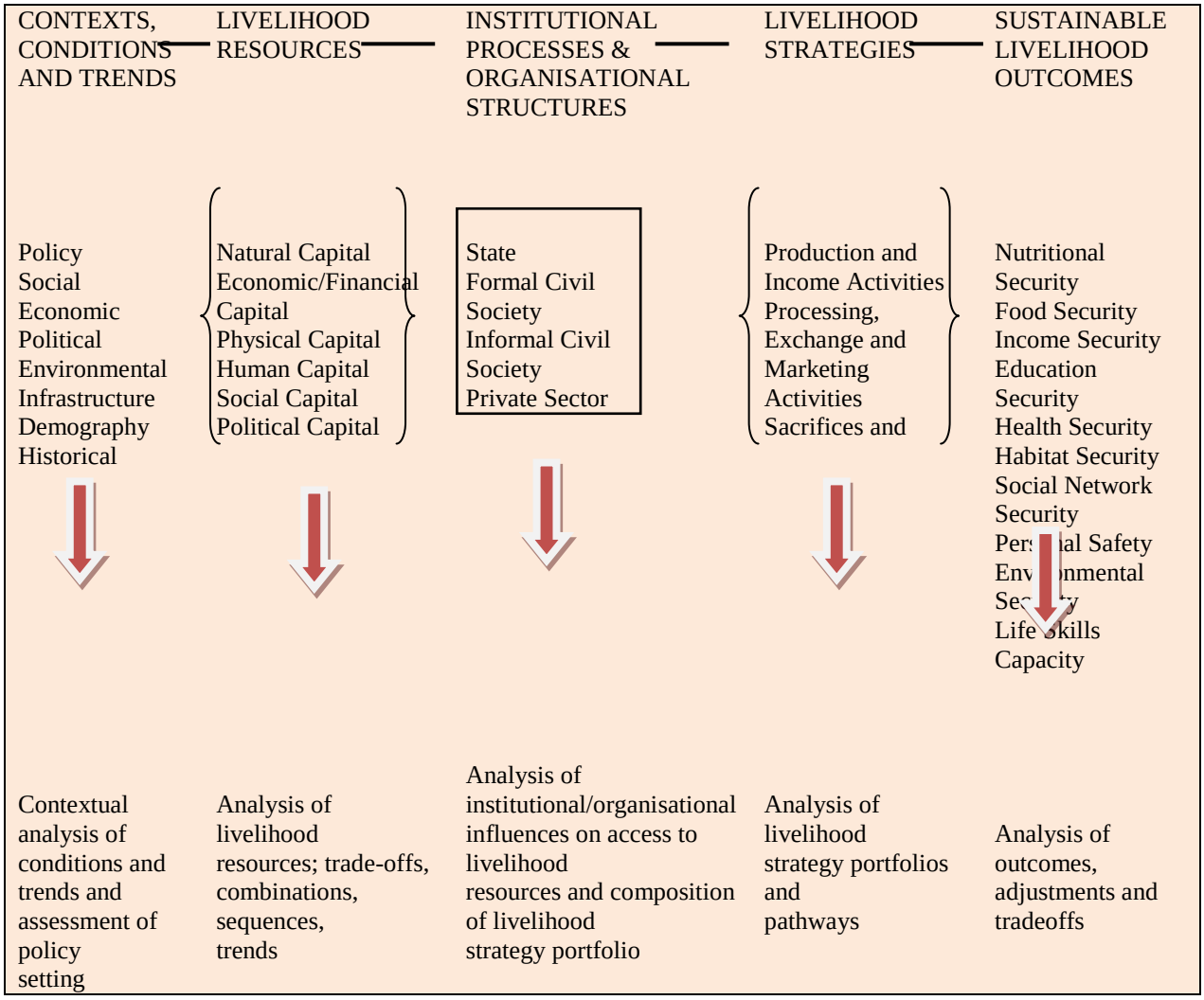


Figure 16.23 Livelihood's Strategies Model of Food Security

Source: from the Household Livelihood Security Assessments: A Toolkit for Practitioners (Frankenberger, Luther *et al.* 2002).

Other notable livelihoods proponents have taken this basic framework and expanded or modified it accordingly. One commentator on food security issues Timothy Frankenberger in league with likeminded colleagues produced the above framework (figure 16.23) in 2002 outlining a similar livelihoods framework to promote further understanding. This adds more detail to the DFID model, particularly in textual information. What is evident is the linear and intuitive progression from Contexts to Outcomes and the associated outcomes for each stage of progression. This is very useful in elucidating the SLA approach. This model by Frankenberger and colleagues also importantly add a further capital asset, that of political capital. This elaboration of the DFID's model also explicitly ties the outcomes of the SLA approach to many household objectives including food and nutrition security as well as health and education security among others. However while it proclaims food and nutrition

security this model once again concentrates on food access and fails to acknowledge other important dimensions of availability and utilisation. In this way the model becomes a useful supplemental model but lacks the overall big picture of food security. The Evaluation of this model against the criteria outlined in the literature review is summarised in table 16.22.

Table 16.22 Model A22: Timothy Frankenberger -2002, Livelihood's Strategies Model of Food Security

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	1
		B. Most of the pillars of food security are clearly present (not ambiguous)	3
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	5
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	5
		E. The model introduces new insights into the food security definition	2
		F. The model redefines traditional relationships	4
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	1
		H. There are some entities that seem non-relevant	4
		I. There are entities noticeably left out	5
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	1
		K. The boundaries of the concept are properly defined	2
		L. The boundaries are blurred and need defining	4
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	5
		N. The model compares well to the food security definitions	3
		O. The definition is not reflected in the model	5
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	2
		Q. There are quite a few variables but they work really well in a simple way	1
		R. The framework is unnecessarily complex	4
		Total Score	**57**

16.4.3 FAO Sustainable Livelihoods Approach

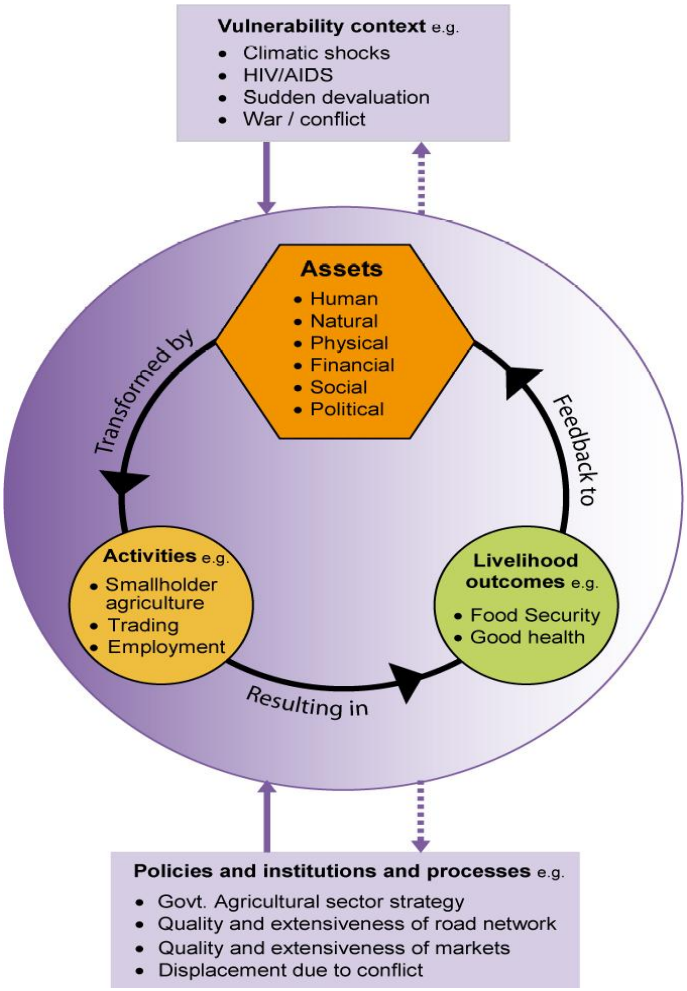


Figure 16.24 FAO's Livelihoods Approach

Source: From FAO's Role & Effectiveness in Emergencies (FAO 2007).

The FAO contend that the severity of a crisis results from the shock of the emergency plus the vulnerability of the affected people. In an effort to circumvent agencies biased 'needs' based assessments, the livelihoods approach according to the FAO, can help better understand the assets base of the family or unit which itself ultimately determines the risk or vulnerability to such emergencies. In this model the FAO explicitly detail the cyclic nature of the asset base and the livelihood outcomes with its many feedback systems. This model too adopts the political asset capital too and closely associates the risks of social, political and economic variables in its effectiveness. As a model of food security this does not adequately consider access or indeed the utilisation of food and nor does it place the concept in context of the overall picture. The Evaluation of this model against the criteria outlined in the literature review is summarised in table 16.23.

Table 16.23 Model A23: FAO Sustainable Livelihoods Approach

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	4
		B. Most of the pillars of food security are clearly present (not ambiguous)	1
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	4
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	4
		E. The model introduces new insights into the food security definition	4
		F. The model redefines traditional relationships	4
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	1
		H. There are some entities that seem non-relevant	3
		I. There are entities noticeably left out	3
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	3
		K. The boundaries of the concept are properly defined	1
		L. The boundaries are blurred and need defining	4
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	5
		N. The model compares well to the food security definitions	3
		O. The definition is not reflected in the model	4
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	1
		Q. There are quite a few variables but they work really well in a simple way	3
		R. The framework is unnecessarily complex	5
		Total Score	**57**

16.4.4 The United Nations Development Programme (UNDP)

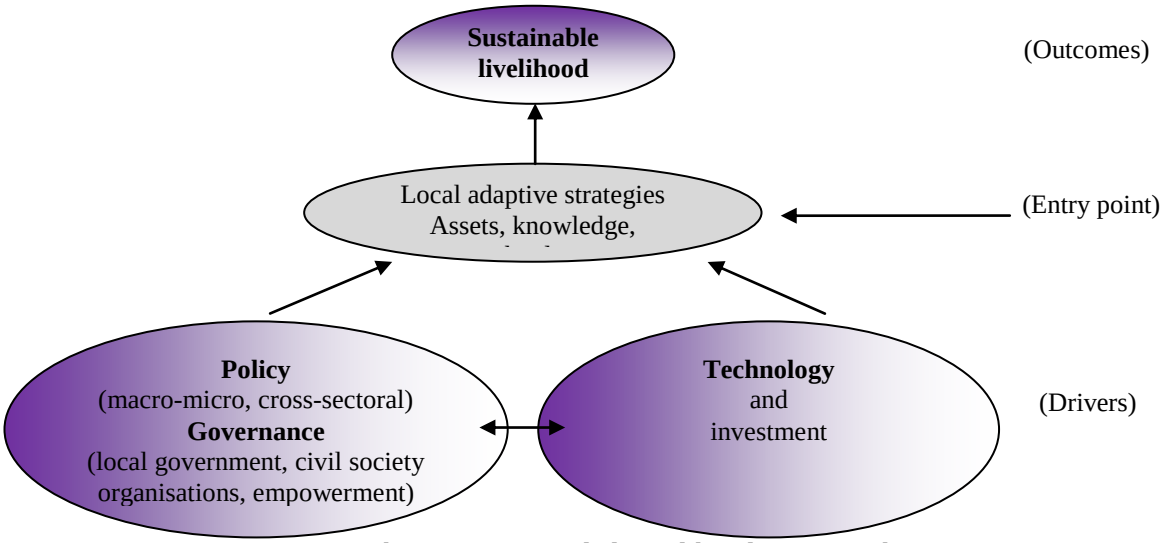


Figure 16.25 The UNDP expanded Livelihood Framework

Source: from thee Sustainable Livelihoods Handbook (Brill, Brown *et al.* 2009).

Like many others before it, the UNDP view livelihoods as the means, entitlements and assets by which people and households make a living the UNDP. This is a rather simplified version and where the adaptive strategies are representative of the capital assets while the external variables are considered the drivers. While all the elements of a SLA are here the reason why technology was made explicit to such a degree is unclear from this model or its accompanying text. Moreover, its simplicity is achieved by reducing the elements of traditional SLA's even further. This tends to create a basic and, this researcher feels, a less than optimum SLA model and by extension a poor overall indicator of the food security concept. The Evaluation of this model against the criteria outlined in the literature review is summarised in table 16.24.

Table 16.24 Model A24: The United Nations Development Programme (UNDP)

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	3
		B. Most of the pillars of food security are clearly present (not ambiguous)	3
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	4
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	5
		E. The model introduces new insights into the food security definition	1
		F. The model redefines traditional relationships	1
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	2
		H. There are some entities that seem non-relevant	4
		I. There are entities noticeably left out	4
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	2
		K. The boundaries of the concept are properly defined	2
		L. The boundaries are blurred and need defining	3
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	4
		N. The model compares well to the food security definitions	1
		O. The definition is not reflected in the model	4
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	4
		Q. There are quite a few variables but they work really well in a simple way	4
		R. The framework is unnecessarily complex	4
		Total Score	**55**

16.4.5 Cooperative for Assistance and Relief Everywhere (CARE International), 1994/99

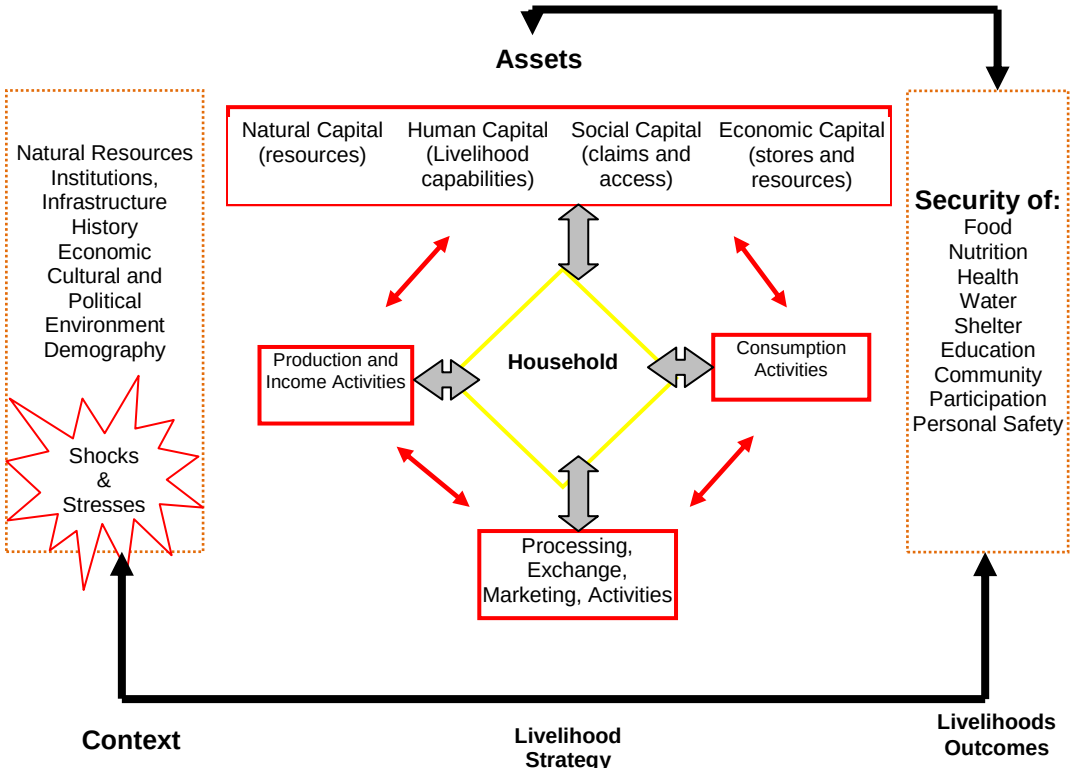


Figure 16.26 CARE International's Household Livelihood Analysis Framework

Source: from Operationalising Household Livelihood Security (Frankenberger, Drinkwater *et al.* 2000).

Building on the SLA frameworks Ashley and Carney suggest that while many SLA's allow more in-depth analysis at the household level, many do not in fact provide a:

> "… similar direction for meso or macro issues." (Ashley and Carney 1999).

This is a common charge of the SLA approach and the reasons for this cite the author's, is mainly the vague and all-encompassing nature of the externalities often used. In attempting to bridge this knowledge gap CARE international, through a paper authored by Frankenberger and Drinkwater expand their analysis into the surrounding vulnerability environment. Accordingly CARE's household livelihoods analysis (HLA) model has become widely acknowledged as enhancing the food security debate with insightful analysis (Ashley and Carney 1999). As with the FAO model this framework also reflects the self-reinforcing or cyclic nature of the SLA approach. On top of this, and as with Frankenberger's earlier efforts this framework also elucidates the various outcomes from food and nutrition security to health and education. However as is common with these types of models they are limiting in their breadth for use as representative of the big picture. The Evaluation of this model against the criteria outlined in the literature review is summarised in table 16.25.

Table 16.25 Model A25: Cooperative for Assistance and Relief Everywhere (CARE International), 1994/99

Quality Criteria	Descriptor	Final Questions	
Comprehensive-ness	Comprehensive to support any claims - adequately achieve its stated aims	**A.** The model fully reflects the pillars of availability, access, utilisation and stability	4
		B. Most of the pillars of food security are clearly present (not ambiguous)	1
		C. The model does not adequately portray the aspects of access, availability, utilisation & stability	4
New or Novel	Is this model new or a Novel in any way?	**D.** The framework does not bring anything new to the concept	4
		E. The model introduces new insights into the food security definition	1
		F. The model redefines traditional relationships	1
Selectivity	Logical variable choices	**G.** The relationships between the entities are clear and precise	3
		H. There are some entities that seem non-relevant	4
		I. There are entities noticeably left out	3
Specificity	Clear and precise -delineating the extent of the models coverage and assumptions	**J.** The overall concept is properly elucidated/ clear	3
		K. The boundaries of the concept are properly defined	1
		L. The boundaries are blurred and need defining	3
Comparability	Is it the best model that fits the hypothesis or explicative criteria?	**M**. There are things that could be added to make the model clearer	5
		N. The model compares well to the food security definitions	1
		O. The definition is not reflected in the model	5
Simplicity	Fewest variables, simplest design that sufficiently explain the construct	**P.** The overall concept is easily understood	2
		Q. There are quite a few variables but they work really well in a simple way	4
		R. The framework is unnecessarily complex	4
		Total Score	**53**