

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

The complexity of rural livelihoods and poverty in the developing world has led to a shift in the agricultural research paradigm from the strengthening of top-down national agricultural research systems towards non-linear dynamic systems that are geared to enabling greater individual and community innovation, greater capacity by end users to obtain and to properly utilise knowledge and research outputs, as well as overall transformation (Spielman, 2005; World Bank, 2007a; CTA, 2010). The shift in the agricultural research paradigm has been a gradual process since the early 1980s, when it was recognised that the participation of the intended end users of agricultural technologies in the research process would lead to greater adoption and improved research output. These participatory agricultural research systems paved the way for research processes that went beyond the mere participation of end users in field research to the incorporation of indigenous technical knowledge. This allowed better adaptation of technologies and the identification of farmers' priorities for new knowledge; thus changing the nature of research agenda setting. The focus of these participatory agricultural research approaches was to increase the supply of new knowledge and to strengthen national research systems.

In more recent years, the agricultural research paradigm has undergone another major shift towards an Agricultural Innovation Systems (AIS) perspective. This perspective views the agricultural research process as a complex and dynamic system, in which the participation of end users is only one part of a complex set of other processes and interactions between different actors that are working together (directly or indirectly) to bring about innovation or improvements at different levels in the agricultural system/value chain. The shift towards AIS orientation was precipitated by the realisation that despite stronger national research systems, agricultural productivity remained low in many parts of the developing world. This was as a result not only of the lack of appropriate technologies and the lack of access to those technologies, infrastructure, inputs and credit; but also due to the lack of access to markets

because of gaps in information and skills that prevented rural end users from effectively utilising, adopting and adapting technologies.

One case in point is Malawi, where the government has created an enabling environment for the work of agricultural research and development agencies that, through the use of agricultural innovation systems concepts, recognise the potential for improving rural livelihoods by enabling rural innovation amongst smallholder producers, hence reducing rural poverty. The reduction of rural poverty is critical for Malawi, as nearly 40% of the total population live below the poverty line. This is mainly due to the prevalence of smallholder agriculture; which is characterised by complete reliance on rain-fed farming, making it susceptible to shocks arising from unfavourable weather conditions and low landholding sizes with a typical household of about six people cultivating on average less than 0.5 hectares of land (World Bank, 2007b). Despite the difficulties of the agricultural sector in Malawi, it remains the backbone of the economy with contributions of nearly 35 % to total GDP. In addition, the agricultural sector accounts for approximately 80 % of all export earnings and employs over 85 % of the country's total population (World Bank, 2007a). The agricultural sector is dualist in nature, with smallholder and estate sub-sectors. The majority of the population (85 %) engaged in subsistence farming within the smallholder sub-sector and nearly 67 % of all rural incomes come from subsistence farming (Chinsinga, 2007). Smallholder agriculture is predominantly maize based. An increasing population, low land holdings, erratic rainfall, poor soil fertility management and natural resource degradation all contribute to intensify the fragmentation of land and low soil fertility, resulting into general poor agricultural productivity.

As such, investments in agricultural research to develop improved technologies and improved delivery mechanisms for better utilisation of natural resources for enhancing livelihoods have been a key concern within scientific and policy forums in Malawi. This is also the case in many other developing countries (Hall, *et al.* 2006). In Malawi, innovation systems concepts in agricultural research have been promoted, as evidence exists that any small improvements in the incomes of rural individuals, which can be brought about by the adoption and utilisation of improved agricultural technologies, have the potential to bring significant improvements in rural livelihoods (Delgado, *et al.* 1998; Mwabu & Thorbecke, 2001).

The AIS research paradigm has manifested itself in practice and also in policy, with agricultural research innovation systems approaches featuring highly in policy documents of many African countries¹ (Sanginga, *et al.* 2009). In practice, AIS driven research has manifested itself as a research paradigm in which there is emphasis on two key aspects. The first is developing technologies to enhance production and productivity; and the second is linking farmers to produce markets. These two interlinked activities are carried out whilst ensuring sustainability of the engagement of the end users by strengthening farmers' capacity for research and on-farm experimentation and their capacity to identify and access markets. This is done with the aim of demystifying the scientific research process and effectively shifting farmers from being recipients of knowledge and research outputs to becoming part of the knowledge generation process.

Apart from engaging end users, AIS driven research also engages the wider community and involves other actors who are important in the agricultural value chain, but who are traditionally not involved in research. This involves the engagement of non-traditional research actors such as agribusiness owners, input and output dealers and policy makers as part of the innovation platform (Van Rooyen & Tui, 2010). In the past, the focus of research was only on the first aspect, with the assumption that markets and institutions were in place. However, it was found that in many cases, farmers frequently rejected technologies because markets essentially failed them due to various reasons; including the thinness of markets in remote rural areas, high transactions costs associated with accessing lucrative markets and/or the prevalence of other pre-existing socio-economic barriers to entry (Kherallah & Kirsten, 2002; Johnson, 2005 cited by Kaaria, *et al.* 2008).

1.2 RESEARCH PROBLEM AND JUSTIFICATION

Despite the importance accorded to the AIS research paradigm in transforming rural livelihoods from a subsistence orientation to an agri-business perspective, the paradigm is not a panacea for the problems plaguing the agricultural sector in Africa. This is mainly because

¹ In recognition of the presence of innovation systems perspectives in national policies, there is emerging work by the World Bank and the International Food Policy Research Institute to provide innovation benchmarking for improving public policies for strengthening national agricultural research systems.

some of its main features² have been part of the debates in the agricultural research arena for the last 20 years (Hall, 2007) but have been reworked to suit the contemporary social, economic and political conditions as well as advancements in analytical tools and research capacities. Although adaptation of the agricultural research process to suit prevailing contexts is not erroneous, the danger is that the prevailing agricultural research paradigm may lose focus of its core aims with the centre being on what Hall (2007a) terms "debates ... by agricultural scientists ... about how agricultural knowledge should be used for development ... with the aim of directing policy towards one specific approach at the expense of others". This may in fact be the reason that there are currently very few empirical studies that analyse the impacts of AIS in an African context on rural people's ability to better utilise available natural resources – thereby enhancing their production, increasing their food security or diversifying their livelihoods. Hence, in order to steer agricultural research policy debate towards actual discussion of the effects on end users' livelihoods of the use of AIS in the research process, it is essential that empirical evidence be generated. This will ensure that the focus is not solely on the organisation of the agricultural research process but rather mainly on the impacts of the paradigm shift.

Given these concerns and the increasing prevalence of the innovation systems concept in agricultural research rhetoric, policy and practice in Africa, and in Malawi in particular, it is essential that robust quantitative studies be conducted that analyse empirically the impact of the use of innovation systems concepts in agricultural research on the livelihood outcomes of rural households. Studies, such as those conducted by Kaarai *et al.* (2008; 2009) are mainly case study analysis of the impacts of the use of AIS concepts in the research process. These studies lack the analytical rigour of methods employed in the study of AIS as employed in the developed world (Spielman, *et al.* 2009). It is for this reason that the World Bank (2007b) has called for "empirical validation" of the use of AIS concepts in research in Africa.

Furthermore, since AIS research and development goes beyond technology development to the fostering of market participation of rural end users, any contemporary relevant studies must go beyond micro-economic level analysis to examine the impacts of macro-economic policy shocks that transmit through the market economy on rural livelihoods. Studies that go

² Main features of innovation systems agricultural research, such as farmer participatory research, farmer empowerment, inclusion of indigenous technical knowledge and the interaction of multiple interdisciplinary stakeholders, have in one way or another also featured in past agricultural research paradigms and analytical tools, such as the Agricultural Knowledge and Information Systems and Participatory Rural Appraisal.

beyond the micro-economic level to assess the impacts of macro-economic policy shocks can be found in literature (Robilliard *et al.*, 2001; Bourguignon *et al.*, 2008; Ravallion & Loxsin, 2008; Bussolo *et al.*, 2008). However the majority of such studies provide an assessment of the aggregate impacts of macro-economic policy shocks such as impacts on aggregate reduction in poverty. They do not provide insight into specific household level effects. Secondly, the few studies which can be found in literature which assess household level effects in Malawi such as studies by Dorward (2003; 2006) and Dorward *et al.* (2004) have used modelling techniques in which the household model is integrated with a rural economy model to simulate the effects of different policy shocks; but in which the macro-economy is exogenous to the rural economy model. Although the modelling techniques are robust, they do not reflect reality of the linkages between the rural households, the rural economy and the macro-economy in Malawi. As such there has been a call for the development of simple, unambiguous techniques that are capable of providing an analysis of household level effects of macro-economic policy changes which take into account existing relationships and linkages between the different levels of the economy in Malawi (Dorward *et al.*, 2004).

This study will therefore contribute towards not only understanding the paradigm shift in AIS research and development but it will also lead to the generation of credible evidence which can be used as a basis for the formulation of effective agricultural research policies and programmes that are aligned with macro-economic policies.

1.3 HYPOTHESES AND OBJECTIVES

As stated earlier, studies that specifically assess the impacts of AIS driven research on livelihood outcomes have not applied robust quantitative analytical tools. Although these studies provide great insight into the potential of AIS research as a means of improving household incomes, there are two key areas that reduce their efficacy for policy analysis. First, these studies do not provide the extent to which income has been affected by participation in AIS research interventions as they do not quantify the changes in incomes. Thus, there is the need for empirical studies to quantify the impacts of AIS driven research at the household level.

Second, the majority of these studies only assess how livelihoods for participating households have been influenced by research driven by AIS concepts. This is also problematic because the observable changes in the livelihood outcomes for participating households could be the result of other observable and non-observable time variant factors that have the potential to also influence incomes and livelihoods of the participating households, as well as the community at large. Thus, by only assessing the before and after changes in the livelihoods of participating households, it is possible to either over or under estimate the effects of the use of AIS concepts in research. This problem is commonly known as the attribution problem in impact evaluation because the observed outcomes cannot be attributed to the programme intervention that is under analysis (Alston & Pardey, 2001). The most effective approach for overcoming the attribution problem is the use of randomisation, where a programme is assigned randomly to some smaller group from amongst a larger group of eligible households. The results are then compared between the households that were randomly selected and those that did not participate. Although ideal, randomisation is not possible for this study as the analysis is being carried out after the programme intervention has already been completed. In such cases, the attribution problem is overcome by comparing the outcomes of participating and non-participating households. However, to merely compare participants and non-participants also leads to biases, as it is possible that participants had been selected based on a specific criterion which differentiated them from non-participants. In order to overcome this second problem or selectivity bias, the analysis must use non-participants (the counterfactual) who have very similar observable socio-economic characteristics to the participating households prior to the intervention. The detailed establishment of a valid counterfactual for this study is provided in Chapter 4.

Given the lack of quantitative empirical studies and the considerations pertaining to sample selectivity bias and the attribution problem, this study set out to test the following as the first hypothesis:

The livelihood outcomes of rural households in communities with AIS driven research interventions are higher compared to similar outcomes for rural households in communities without such interventions.

Going beyond production and productivity to ensure that farmers' livelihoods are transformed from being subsistence oriented to being market oriented implies that rural

producers; who traditionally have little or no backward and forward linkages; are linked to the greater market economy. This would entail that farmer's livelihoods would be more dependent on the market economy and as such more vulnerable to market forces. This is especially the case in Malawi in which the agricultural sector is composed of three parallel markets which are differentiated by prevailing prices and the price formation process. Figure 1.1 provides an illustration of the Malawi maize market with the inter-linkages existing in the different levels.

The first market is the rural household economy which consists of individual farm households. From Figure 1.1, it can be seen that the household economy is impacted upon by many factors; of which, the basis is that households try to sustainably use all available scarce natural resources to produce livelihood outcomes using different strategies. This is made more complex given that the household is located within a context in which global, macro-level and meso-level changes impact upon them directly and indirectly (Scoones, 1998). The second market is the rural market economy which is the nexus of all household economies in a particular rural locality. And lastly, there is the national market which comprises all rural market economies as well as other sectors such as the estates, semi-commercial and commercial agricultural markets. In the rest of this thesis the 'macro' component refers to the integrated national maize market in Malawi. Any reference to the 'micro' component refers to the household level and the meso-level to the rural economy level.

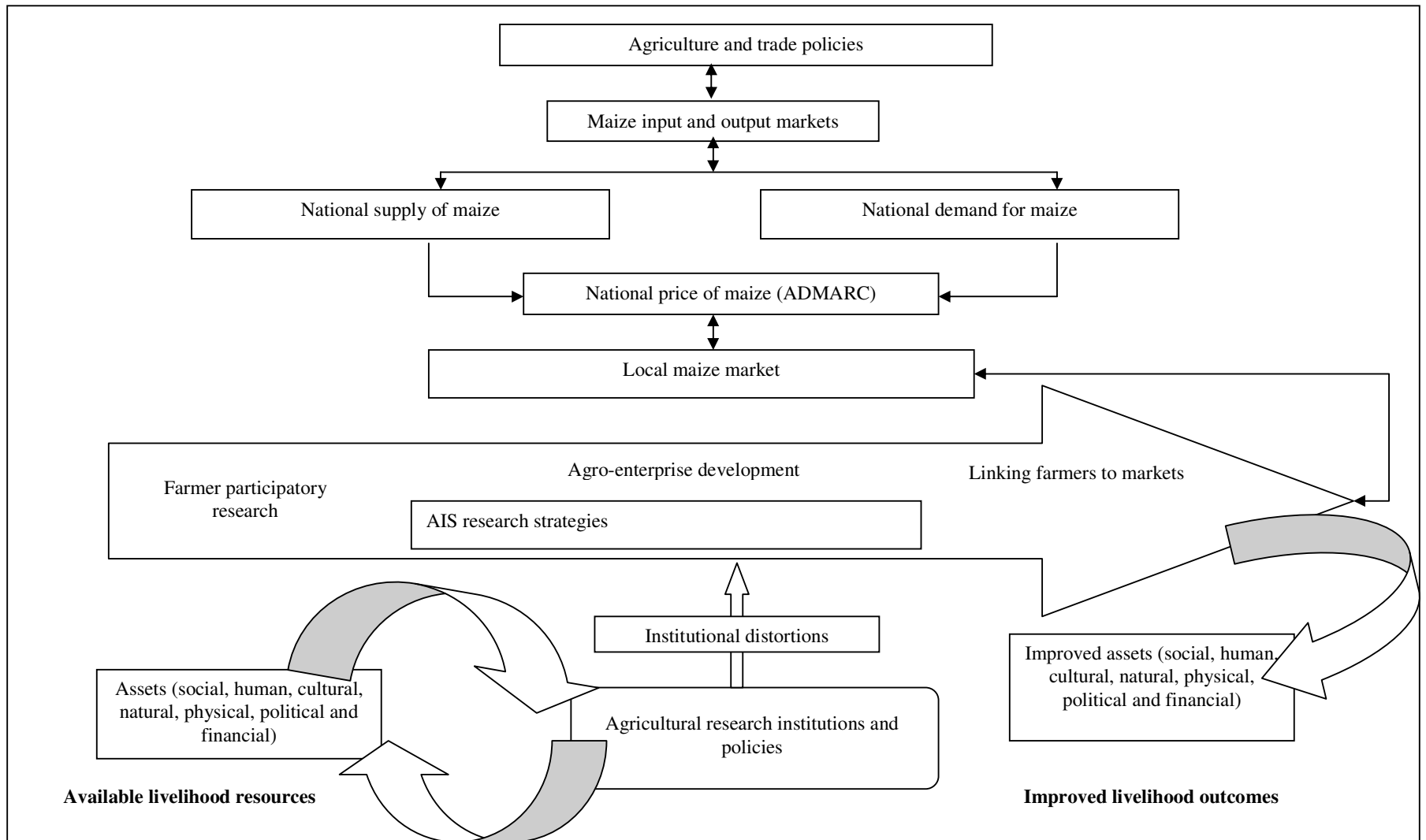


Figure 1-1: Conceptual framework for the study

The rural economy is linked to the national economy in that any changes in national policies brought about by changes in the national political environment or the global policy environment results in sector wide changes and this includes changes in the agriculture sector. Although the agricultural sector in the country has been greatly liberalized, maize is still largely under government price controls and this entails that changes in prices at the national level lead to changes in national input and outputs markets (see Figure 1.1). These changes impact upon the national supply and demand of maize which in turn further leads to changes in national prices. Changes in national prices that are the result of direct government controls or changes in the dynamics of national demand and supply affect the local economy as the national price is the basis upon which local economy market prices are set.

At the household level, smallholder producers who are linked to both local input and output markets through research interventions that are driven by AIS concepts would hence be affected by price changes occurring at the macro-level because of the linkage between local economy maize prices and national level prices (Figure 1.1). Thus the livelihood outcomes of smallholder rural producers, who are working with research interventions that are driven by AIS concepts, will be impacted upon indirectly by changes at the macro-economy through the price transmission mechanism of the maize market. Furthermore the effects of greater market linkages creates complexities for rural households because they are both producers and consumers hence their livelihood outcomes are affected by both demand side and supply side factors (Chirwa, 2010). This entails that an increase in the market price of the staple food crop maize would mean an increase in income for households that are producers of the crop but for consumers the increased price would mean a decrease in incomes as food would be more costly. For households that play the dual role of both consumer and producer, the impact of such a market price change entails that they can be affected from either the supply side or demand side. In addition, Quisumbing (1996) has demonstrated that price increases of predominantly staple food crops often lead to farming households using the crop as a cash crop at the expense of home consumption. Hence the way in which market forces impact households that play the dual role of consumer and producer depends to a large extent on the nature of their livelihood portfolios (Chirwa, 2010) as well the control of resources and decision making at the household level.

The implications of these inter-linkages and rural household complexities are that research interventions that are driven by AIS cannot work in isolation from either agricultural sector policies or other macro-economic policies. Hence in order to generate credible evidence of the impacts of the use of AIS research and development, it is essential to go beyond quantification of household level impacts.

Therefore given these considerations this study tested the following as a second hypothesis:

The degree to which rural livelihood outcomes are affected by policy shocks; which transmit through maize market prices; will to a large extent depend upon the socio-economic characteristics of the household; participation in AIS driven research interventions as well as the nature of macro-economic and agricultural sector policy coordination.

In summary, the objectives of this study are as follows:

1. To quantify the impacts of AIS driven research interventions on rural livelihood outcomes.
2. To determine the effects of the resultant greater linkages to the macro-economy and to demonstrate the impacts of uncoordinated policy making and implementation on rural livelihood outcomes for participating households.
3. To better understand maize price formation and the inter-linkages between maize markets at the national, local and farm/household level.
4. To formulate relevant policy recommendations for informing food and agricultural policy development and for agricultural research programme formulation and implementation.

1.4 STUDY OUTLINE

The rest of the thesis has been structured as follows. Chapter 2 provides a comprehensive review of the literature pertaining to rural livelihoods and innovation systems. Chapter 3 outlines the theoretical foundations on which macro-micro

modelling is founded and on which this study is based. Chapter 4 presents the empirical results of the impact of agricultural research innovation systems interventions on rural livelihoods, thus providing a proof for the first hypothesis. Chapter 5 gives insight into the dynamics of the maize commodity market in order to show the mechanism through which policy effects are translated to households from the macro-economy to the micro-economy, and to better understand price formation in the country. Chapter 6 presents a simulation analysis of a combination of macro-economic and agricultural policy shocks in order to demonstrate the potential dangers of the lack of coordination between microeconomic, sectoral and macro-economic policies on rural livelihood outcomes. Chapters 5 and 6 serve to provide the proof of the second hypothesis of this study. The thesis concludes with Chapter 7, which provides a summary of all the findings from the study, the conclusions, policy recommendations and future areas of research.

CHAPTER 2

RURAL LIVELIHOODS AND AGRICULTURAL INNOVATION SYSTEMS

2.1 INTRODUCTION

This chapter presents a comprehensive and critical appraisal of the literature pertaining to the concepts of rural livelihoods and agricultural innovation systems. The first part of the chapter aims to provide a greater understanding of the concept of rural livelihoods. The second part provides an insight into the concept of agricultural innovation systems followed by a section that provides examples of the use of innovation systems in agricultural research and development in Africa. Lastly the chapter concludes with a review of the literature that critiques the use of innovation systems in agricultural research and development.

2.2 UNDERSTANDING RURAL LIVELIHOODS

A livelihood is a means by which a household obtains a living for their survival. It differs from mere income in that a livelihood comprises all available resources. These resources include the natural, physical, human, financial and social assets; the activities that the household or individual engages in; and the accessibility to those resources and activities as facilitated by the existing institutions and social relations that jointly determine the livelihood outcomes (Ellis, 2000). In rural African communities, livelihoods are based on a complex system in which agriculture and natural resources are the centre for survival. As such, the diversification and sustainable utilisation of the natural resource base is essential for the long-term viability of rural livelihoods (Bryceson, 2000; Ellis, 2000).

The complexity of a livelihood system is described by Niehof (2004) as being one that is composed of separate components which must be in place in order for the household to obtain a living from the available assets. The first component of any livelihood system is inputs, which are the different types of resources. In the case of agricultural-based communities,

these would comprise of natural resources, such as water, forests and land. These inputs are transformed into livelihood outcome using different strategies and efforts that the household exerts in order to obtain the livelihood outcome. The transformation of inputs into livelihood outcome takes place within a context in which the livelihood system interacts with other systems and existing institutions. This context includes all aspects that make the livelihood system vulnerable and it includes the greater policy, political and environmental context.

The inputs are combined differently through various strategies and this makes up the livelihood portfolio. The different activities in a household's livelihood portfolio are often complimentary and, although actual written farm business plans do not exist in many rural settings, the household plans extensively in order to determine the type of activities that make up the livelihood portfolios. This process of planning is crucial and determines not only the livelihood outcomes but also the control and utilisation of available resources, which in turn determines the intra-household vulnerability of different household members. The combination of activities in the livelihood portfolio is done in such a way as to reduce the vulnerability of the livelihood outcomes to shocks arising from the environment. In many rural households in which the basic needs of food, shelter and clothing have not been met, the driving force or purpose for generating a livelihood is to meet these basic human needs. A livelihood system is deemed sustainable when it is able to improve the assets of the household and to maintain its ability to provide for the household not only in the present but also for the future, while at the same time not undermining the natural resource base (Farrington, *et al.* 1999).

Complex livelihood systems have been in place since time immemorial in different societies all over the world. They differ depending on spatial, geo-political, cultural and social conditions (Ellis, 2000). In Malawi, rural livelihoods are characterised by a narrow range of risky and low productive activities (Dorward & Kydd, 2004) that are made more vulnerable by poor infrastructure, low education and literacy levels, and poor health (Peters, 2006). Another distinct feature of livelihoods in Malawi is that the majority of farmers within the maize-based farming system are faced with seasonal food shortages which they overcome through the utilisation of residue moisture in the short dry winter season (Mloza-Banda & Banda, 2003). Like many other rain-fed farming systems in Africa, livelihoods in Malawi are characterised by low access to agricultural services such as inputs, markets, extension and low resource endowments (Dixon & Gulliver, 2001).

In post-colonial Malawi, the single-party government closely controlled rural household economies through the regulation of the pricing and marketing of agricultural inputs and produce, as well as the regulation of the type of cash crops grown. These controls led to both positive and negative livelihood outcomes. On the negative side, they limited the opportunities faced by rural producers and discouraged private-sector involvement in the agricultural marketing of inputs and produce. On the positive side, the government ensured the availability and affordability of the staple food crop maize for urban consumers while guaranteeing an output market for rural producers (Chirwa, 2010).

2.3 THE CONCEPT OF AGRICULTURAL INNOVATION SYSTEMS

An innovation system is a network of actors and organisations that are linked by a common theme with the aim of developing new agricultural technologies, methods and forms of organisation for use by the end users of agricultural technology to tackle identified problems (World Bank, 2007b). An innovation system is governed by the prevailing institutions and policies that affect performance of the actors involved and the regulation of the technologies developed (World Bank, 2007b). Agricultural innovation systems are therefore research platforms whose main focus is solving challenges pertaining to agriculture. They consist of interdisciplinary research teams of agricultural scientists from both private and public sectors working with the end users of agricultural technologies as well as other relevant stakeholders such as agribusiness owners, policy makers and extension agents. The innovation systems concept embraces not only the scientists who are traditionally involved in agricultural research but also the end users of technologies and the interactions that take place between all the actors in the research process (World Bank, 2007b; IAC, 2004:141).

A representation of an agricultural innovation platform is given in Figure 2.1. The agricultural innovation platform represents an interface where different actors, including interdisciplinary teams of scientists, end users, extension agents, agribusinesses, and other stakeholders, interact in order to identify agreed-upon problems for which innovations need to be developed. The interaction in the innovation platform is non-linear in nature with the different actors networking freely with a component for institutional and human capacity development being key (Jones, 2008). Once problems are identified, actors work together to develop and

adapt technologies to the local environment. This leads to improved production and ultimately, enhanced livelihood outcomes.

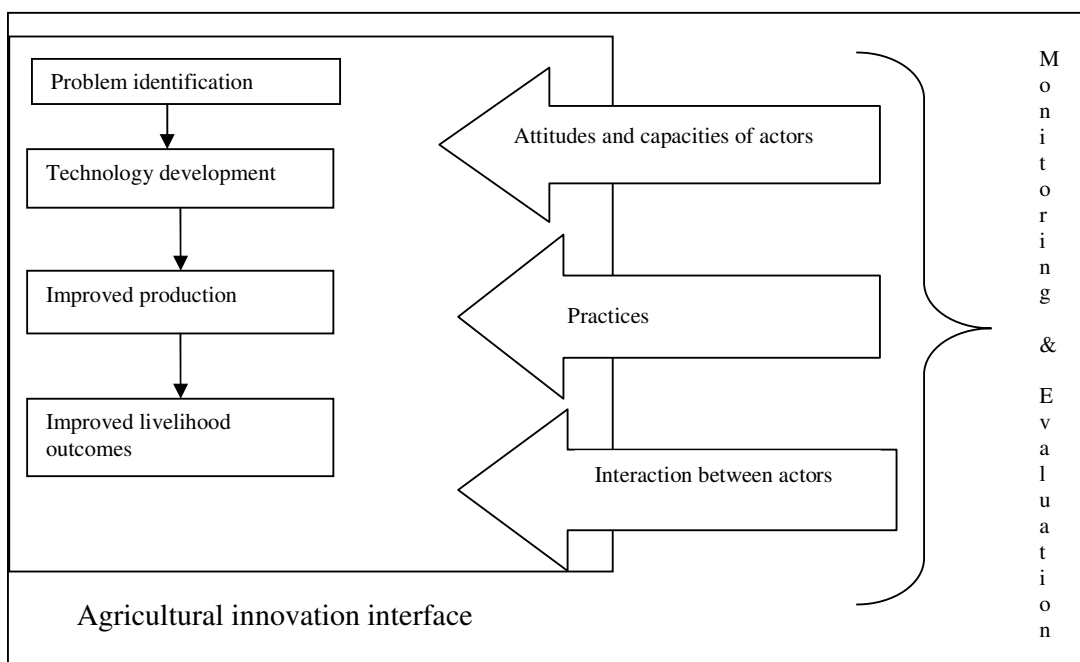


Figure 2-1: Representation of an agricultural innovation platform
(Source: own compilation)

Throughout this process, there is constant feedback using mechanisms that are put in place at the onset of the innovation platform. In addition, changes in the attitudes, knowledge, skills, practices, and interactions taking place between actors are monitored. The results of evaluations of these aspects are used to develop strategies for improving the capacity of actors to enable them to improve their innovation.

There are many forms of innovation, which can also exist in different sectors. Rural innovation in the sphere of agriculture is based on the concept that research programmes should work towards identifying the needs of producers and determine how they utilise knowledge either at the farm or enterprise level (GFAR, 2001). This entails a shift in the research paradigm from the transfer of knowledge that is generated by research, to research on how knowledge itself is utilised and translated into outcomes by the end users. Furthermore, innovation in the agricultural sphere is conceived as an increase in productivity or competitiveness for a given product; with the improvement in productivity or competitiveness arising from a change in either the production technology or marketing strategy. Innovation is desired to either introduce a new agricultural product on the market or to ensure that

producers may become more competitive with an existing product, thus gaining access to more lucrative markets (GFAR, 2001). Hence, rural innovation essentially puts agro-industries as the basis for socio-economic development in rural areas.

Furthermore, the concept of rural agricultural innovation is rooted in the philosophy that thinking should shift from a farm or production systems perspectives, in which the ultimate goal is to produce sufficient food for subsistence, to an agribusiness perspective, in which the goal of agricultural production is to create rural agro-enterprises (Njuki, *et al.* 2008; Kaaria, *et al.* 2008, GFAR, 2001) that create employment and income. This would fulfil subsistence food requirements and achieve food security and the creation of thriving rural economies.

The concept of agricultural innovation is not new. Rather, it is a continuum of experiences and approaches from past agricultural research paradigms. According to Hall (2002), origins of the concept of innovation systems can be traced back to the notion of national systems of innovation. In the 1990s, the Agricultural Knowledge and Information Systems (AKIS) concept dominated practice and conceptualisation of agricultural research (World Bank, 2007a). AKIS focused on the linkages between research, education, extension and the identification of farmers' priorities for new technologies. AKIS recognised that apart from research, there are other ways of generating and gaining access to information. This included scientists building research agendas upon indigenous or rural technical knowledge which encompassed the knowledge, beliefs and customs that people innately possess (Farrington & Martin, 1988).

The incorporation of rural and indigenous technical knowledge in the agricultural research processes was the result of experiences and assessments of agricultural research of the 1980s, at a time when participation of farmers took precedence. Farmer Participatory Research (FPR) was implemented mainly through the National Agricultural Research System (NARS). FPR dominated agricultural development and research and involved farmers to a great extent in technology development (Okali, *et al.* 1994). FPR can be seen as the base on which current agricultural innovation systems are founded as the FPR concept aimed at not only generating and disseminating technologies but also at changing the orientation of research and development structures in order to build grassroots research capabilities (Okali, *et al.* 1994). The NARS, which used FPR as a means of linking with farmers, involved the strengthening of research supply through the provision of infrastructure, capacity development, and management and policy support at national levels (World Bank, 2007a).

The commonality between the NARS and AKIS was that both focused on research supply which strengthened research systems. However, the increased supply of new knowledge in itself was an insufficient condition for creating greater capacity for innovation in the agricultural sector (Rajalahti, *et al.* 2005). Additionally, the NARS approach assumed a linear relationship in the transfer of knowledge from the researcher via extension to the farmer under the assumptions that the institutions through which this process was taking place were stable (Spielman, 2005:9). AKIS remedied some of the shortcomings of the NARS approach, as it incorporated the processes of knowledge flows. However, AKIS failed to take into account the diversity of research actors (Spielman, 2005:10).

As such, the paradigm shift in agricultural research practice and conceptualisation from the NARS and AKIS to the prevailing agricultural innovation systems concept was the result of these limitations and the realisation that, without the actual intellectual involvement of the end users of agricultural technologies, attempts to develop new technologies and to increase their dissemination and adoption would be futile. In the African context, this research approach has largely focused on enabling mainly subsistent and semi-subsistent households to innovate for the market; thus shifting their livelihoods from a subsistence orientation to one of market orientation.

In general innovation systems are transitory in the sense that the actors that come together under an innovation platform will move on after the objectives they set out to achieve have been met (Daane, 2010). In addition they are context specific and as such although the key principles remain the same, the practical manifestation will differ depending on the actors involved and their capacities, the objectives of the innovation platform as well as the social, economic and environmental context within which the innovations systems is established. Because of this, it is therefore important to understand the specific innovation system that is under study. This study used the Enabling Rural Innovation (ERI) initiative as a case study. ERI was an agricultural research innovation system that was developed by the International Centre for Tropical Agriculture (CIAT). It was piloted in three districts in the Central Region of Malawi; one of which is the Lilongwe District in which this study was conducted. ERI was an innovative research framework for linking smallholder farmers to markets and its focus was on strengthening the capacity of resource-poor smallholders to access market opportunities. Sanginga & Chitsike (2005) and Ferris *et al.*, (2006) provide in depth

guidelines on the use of ERI as a framework for implementing research and development programs. They also provide insight of the roles of different players within the innovation interface from Figure 2.1.

The main aim of the ERI initiative was to create an entrepreneurial culture in rural communities of Africa (Kaaria, *et al.* 2008; 2009).

The ERI approach was driven by innovation systems concepts as described above (e.g networks of different actors) and it was governed by the resource to consumption framework, which, according to Kaaria *et al.* (2009), has the following principles:

1. Technology development and research agenda setting is based on the needs and interests of the beneficiaries as well as available resources and market opportunities.
2. Technology development is guided by a comprehensive beneficiary diagnosis that aims to identify the variations in intra-household allocation and control of resources with the aim of understanding the constraints and opportunities to technology adoption and reinvestments in natural resources.
3. Gendered differences in roles and perceptions and differences of roles between stakeholders are explicitly integrated into the technology development process to ensure equity in accessing the technology as well as in the distribution of benefits.
4. The approach builds a community's skills in identifying and analysing market opportunities and, in so doing, enabling community's to match existing market opportunities with the available community assets.

In addition, the ERI approach had six key components that governed its field implementation (Kaaria, *et al.* 2009) as follows:

1. *Agro-enterprise development and participatory market research.* The focus is on building skills and knowledge of community members, farmer organisations and local service providers to allow them to engage effectively with markets.
2. *Farmer participatory research and natural resources management.* Involves the decentralisation of research agenda setting to the communities through the creation of farmer research committees who articulate the demands of the community and who ensure adapting of technologies to suit local conditions.

3. *Social and human capital.* Group development is nurtured in order to ensure effective performance of local farmer organisations, thus strengthening the social and human capital in the communities.
4. *Gender equity and empowerment of women.* This is an integral part of the ERI process and involves the use of proactive strategies and gender sensitive facilitation skills to ensure that the capacity of both men and women is enhanced.
5. *Community-based participatory monitoring and evaluation systems.* These are put in place to enhance group functioning, participation as well as to improve local decision making. This involves the development of measurable indicators by the communities; which can be used to measure change.
6. *Effective development and management of partnership.* The ERI approach aims to build effective local partnerships between relevant stakeholders who have a working relationship with communities and those who have the potential for scaling up the use of the ERI approach.

Using the ERI guiding principles, CIAT established one of three pilot innovation platforms in Malawi in the Ukwé Extension Planning Area (EPA) in Lilongwe District. This consisted of a multi-disciplinary team of CIAT social scientists; extension agents from the Department of Agricultural Extension Services as well as local extension staff based in the community; researchers from the Department of Agricultural Research Services; and other agricultural social scientists from the Ministry of Agriculture based in Lilongwe Agricultural Development Division. The innovation platform worked together to select an appropriate community within the EPA for piloting the ERI initiative based on a criteria that included all year-round road accessibility; availability of a motivated local-level extension agent; willingness of other development partners working in the community to take an active role in the initiative; and the existence of interest in the community for further agricultural research and development (Sangole, *et al.* 2003).

Once the community was selected, the innovation platform, together with the community, conducted a participatory diagnosis of the community challenges and opportunities. This process was the initial way of engaging the communities in order to sensitise them to the ERI initiative and also to develop a shared vision for the future of the community (CIAT, 2007). The outcome of the participatory diagnosis was the development of a collective plan of action for overcoming identified problems using available community resources and assets.

After the participatory diagnosis, the Ukwe innovation platform implemented the community action plan by starting with the formation of farmer research and market groups within the community. The leaders from these groups represented the community in the innovation platform. This was followed by a participatory market analysis of existing market opportunities which culminated in the selection of an agro-enterprise based on existing social and wealth differences as well as gender preferences within the community. The selected farmer market group was trained in market research. In the study area, piggery was chosen as the agro-enterprise to be developed as a cash enterprise and maize as the food security enterprise. Finally, the innovation platform through the farmer research groups planned and implemented simple research experiments around various other agro-enterprises. This was done in order to build capacity of the community to conduct research experiments to enable them to better understand their farming enterprises and, in so doing, to demystify the process of agricultural research experimentation and hence build their ability to innovate. Apart from the ERI initiative, the study community also had on-going government extension programs.

2.3.1 Innovation systems practice in African agriculture

Apart from the ERI initiative which was piloted in several countries including Malawi by the International Center for Tropical Agriculture (CIAT) and which is used as the case study in this research; there are many other agricultural research and development initiatives on the continent that are driven by innovation system concepts. These innovation system interventions are context specific and are initiated to meet specific goals but they are all guided by innovation systems principles. Table 2.1 provides examples of some of the initiatives, agricultural research and development programs in Africa that are driven by innovation systems concepts. Table 2.1 is not exhaustible as there are numerous initiatives in agricultural rural innovation in Africa (Hall, 2007:10). The various programs and initiatives in Table 2.1 show that there is a wide diversity of the application of innovation systems in Africa. Despite this diversity, the goals of the programs show that innovation systems concepts are mainly applied in the African context in order to promote and enhance the commercialization of traditionally low productive subsistence agriculture.

2.3.2 Studies of agricultural innovation systems in Africa

From Table 2.1, it is possible to see that the use of innovation systems concepts in agricultural research and development; and policy has become widespread in Africa. Despite this, empirical studies that show quantitative improvements in household welfare arising from the use of innovation systems concepts in agricultural research and development are rarely found. However there are a few studies that exist. Kaaria *et al.* (2008) assessed the use of the Enabling Rural Innovation (ERI) initiative, an innovative agricultural research approach for linking smallholder farmers to markets and for improving livelihood outcomes, using case studies from Uganda and Malawi. The study employed multiple regression modelling to assess the determinants of income amongst rural households in two pilot sites. The results indicated that greater linkages of farmers to markets improved household incomes. The improved incomes led to farmers accumulating more household assets and increasing their investments in their farm enterprise.

Other studies by Kaganzi *et al.* (2009) demonstrate that using an iterative market-led learning process based on innovation systems concepts and applied under the ERI initiative led to small-scale farmers in south-western Uganda being linked to high value markets. Using the innovative approach of developing agro-enterprises under the ERI framework, smallholder farmers were able to enter the market and sustainably meet rigorous quality requirements for the market. Barham & Chitemi (2009) evaluated an innovative agricultural development approach called the Agricultural Marketing Systems Programme, which uses innovation systems concepts to strengthen the marketing abilities of producer groups in Tanzania. Using differencing techniques, the study shows that the innovative intervention led to statistically significant improvements in the marketing performance of farmer groups. However, groups that were better off in terms of natural resource endowments were more likely to be successful in being effectively linked to the market, as compared to worse off farmer groups.

Table 2.1: Selected examples of innovation systems driven initiatives in Africa

Name of AIS initiative	Country	Main goal	Lead institute	Actors involved
Enabling Rural Innovation (ERI)	Malawi, Uganda, Zimbabwe, Mozambique, Rwanda, Burundi, DR Congo	To improve the livelihoods of households through the creation of rural agro-enterprises	International Centre for Tropical Agriculture (CIAT)	Various actors in each country and in specific research sites. These included local farmer groups, government (rural sector support project), private and government research services (International Service for National Agricultural Research, DARS), private sector, NGO's (CARITAS, Plan, Africare, Africa2000Network, academia)
Partnership for Agricultural Development (PIAD) or the National Innovation Coalition	Sierra Leone, Malawi, Rwanda, Zambia, Nigeria, Tanzania	A national innovation coalition that works to advocate policy makers	Research Into Use (RIU)	Various representatives from various government departments, NGO's in various innovation platforms that have been established in each country (over 30 innovation platforms exist in the six countries)
Floriculture Agricultural Science Technology and innovation systems	Kenya	Aims to maintain competitiveness of the cut flower industry in Kenya		Flower farmers, research and training institutions, credit and finance institutes, government agencies, input suppliers, industry associations, bureau of standards
Sustainable intensification of maize-legume cropping systems for food security in Eastern and Southern Africa (SIMLESA)	Malawi, Zimbabwe, Mozambique, Ethiopia, Kenya, Tanzania, Uganda, South Africa	An agricultural research initiative that aims to use innovation platforms to test and promote new agricultural practices	International Maize and Wheat Improvement Center (CYMMT)	National Agricultural Research Services; Australian Centre for International Agricultural research; Murdoch University; Queensland Department of Employment, Economic Development and Innovation; Ministries of Agriculture and Food Security; International Crops Research Institute for the Semi-Arid Tropics; South Africa Agricultural Research Council; Association for the Strengthening Agricultural Research in Eastern and Southern Africa
Promoting Local Innovation (PROLINNOVA)	Burkina Faso, Ethiopia, Ghana, Kenya, Mali, Mozambique, Niger, Nigeria, Senegal, South Africa, Sudan, Tanzania, Uganda	An NGO initiated program that aims to build a global network to promote local innovations in agriculture	Various NGO's	Donors include the Netherlands Government and the Rockefeller foundation. Working partners and donors include World Bank Indigenous Knowledge (IK) program; Action Aid International; CGIAR; Technical Centre for Agriculture (CTA); Duras project, Global Forum on Agricultural Research; International Fund for Agricultural Development; Misereor; Swiss Centre for Agricultural Extension
Fodder Innovation Project (FIP)	Nigeria	Aims to strengthen the technical capacity of fodder practices thus increasing livestock fodder to improve the livelihoods of peoples that are dependent on livestock	International Livestock Research Institute(ILRI)	The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT); The International Institute of Tropical Agriculture (IITA); United National University –Maastricht Economic and Social Research Institute on innovation and Technology (UNU-MERIT)
Sub-Saharan Africa Challenge Program (SSA-CP)	Zimbabwe, Malawi, Mozambique, Rwanda, Burundi, Uganda, the Sahel, Sudan, Northern Guinea	An innovation systems driven agricultural research framework that encourages the engagement of various actors in the value chain in order to promote innovation in an agricultural system	Forum for Agricultural Research in Africa (FARA)	Various partners in each country/pilot learning site and region including farmer originations, national agricultural research institutes and International Agricultural Research Centres, Universities

Magreta *et al.* (2010) used participatory gross margin analysis to demonstrate how linking farmers to markets using innovation systems concepts in agricultural research improved farmer's livelihoods through increased gross margins in the rice-based farming systems in Southern Malawi. Increased incomes from rice marketing led to improvements in household food security, asset accumulation and housing.

Although studies that aim to assess the use of innovation systems in agricultural research and development are few and mainly qualitative in nature; as a collective they demonstrate that innovation systems concepts foster the creation of linkages between rural households and the market economy. These linkages entail the strengthening of market involvement of rural households and greater exposure of the household to macro-economic shocks.

2.3.3 Skepticism surrounding Agricultural Innovation Systems

As innovation systems concepts have become widespread in African agricultural research and development, there has also been the emergence of challenges and criticisms. This section presents the three broad challenges and criticisms of the use of innovation systems concepts in agricultural research and development in the African context.

Firstly, the use of innovation systems concepts in African agriculture is confounded by significant operational challenges brought about by the lack of practical guidelines for translating the key principles of innovation systems into practical use for the varied contexts of African agricultural systems (Ergano *et al.*, 2010). This is because the use of innovation systems in African agriculture is at an early stage. At the same time, innovation systems evolve in response to the context in which they are being applied. Hence this entails that practical guidelines covering the diversity of African agriculture are unlikely to be developed. The operational challenges of the use of innovation systems concepts in African agriculture is more, therefore, a reflection of the lack of capacity on the part of practitioners to fully comprehend, use and translate innovation systems concepts in the African agricultural context.

Second, there is lack of sufficient resources to support rural innovation. This arises from the 'smallness of the market for smallholder innovation' which makes it difficult to attract private investment (Jones, 2006). This has further been confounded by a reduction in agricultural

research funding from both international and national sources due to disappointment with the impacts of agricultural research in the past (Jones, 2006; Igbatayo, 2010). Apart from the reduction in funding for agricultural research and development, Hall (2007a) further argues that both private and public investment have not fully responded to the paradigm shift in agricultural research and development towards an innovation systems orientation. This he attributes to the inability of innovation system advocates to create a functional, consistent and influential platform for lobbying public policy makers and private investors. Instead what one observes in practice is pockets of different and competing innovation systems interventions that are implemented at relatively small scale (e.g. at farmer group level) which sometimes fail to be scaled up and out.

Thirdly, the inability of agricultural innovation systems in Africa to attract funding can be linked to the lack of empirical evidence that provides conclusive policy recommendations and which shows the usefulness of innovation systems in African agriculture (Spielman, 2006). This lack of evidence is the result of the difficulties associated with measuring the complexities of agricultural innovation interactions and performance (Spielman & Kelemewonk, 2009). These complexities result into the use of non-diversified descriptive methods to assess the outcomes of the application of agricultural innovation systems in the developing country context (Spielman, 2006). The problem with this is that evidence generated from such assessments is not relevant for policy makers as it does not provide concrete policy recommendations to allow for the development and implementation of strategies nor does it facilitate the allocation of resources for promoting the use of innovation concepts in agriculture by policy makers (Spielman, 2006; World Bank, 2007b; Spielman & Kelemewonk, 2009). Hence in order for innovation systems thinking to become relevant to policymaking and to contribute towards poverty reduction, there is need to generate robust empirical evidence.

Despite the criticisms and challenges to the use of innovation systems in African agriculture, the focus by the global agricultural research and development arena and policy makers worldwide is on innovation and innovation systems (Hall, 2007); as a key in unlocking African agriculture and in creating self-sustaining agricultural systems. However in order for innovation systems to be effective in this regard, there is need to harness the diversity of innovation systems experiences and conceptualization to create a diverse but unified platform of what Hall (2007a) terms collective innovation or innovation diversity. One component to

working towards this collective innovation; is understanding the impacts of the use of innovation systems in different contexts on the continent. As this would enable the creation of context specific evidence on which effective unified platforms for lobbying policy makers would be created. This study is one step towards that.

2.4 CHAPTER SUMMARY

In conclusion, this chapter has demonstrated that the importance accorded to innovation systems in agricultural research has only begun to be tangibly demonstrated by empirical evidence. The available empirical evidence consists mainly of household-level evaluations of changes in livelihood outcomes arising from the use of innovation systems in African agricultural research and development initiatives. Studies that go beyond the household level to assess the consequences of greater innovation and the resultant market linkages are not found in literature. Herein lies the uniqueness of this study, which; in addition to quantifying the household level effects; aims to quantitatively assess the impact of macro-economic and agricultural sector policy shocks and policy sequencing on rural smallholders, given the work of agricultural research interventions that are driven by innovation systems concepts. In so doing, the study will contribute to the on-going debate about the role of innovation systems in promoting agricultural and rural development in Africa.