



ATPS-Tanzania

*(Institute for Policy Research in Science,
Technology and Innovation)*

**Science, Technology and Innovation for Poverty
Reduction in Tanzania: An Analysis of the Sectoral
Systems of Innovation**

Part I

Final Report

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Acknowledgement

This work was carried out with the financial support of REOPA; we therefore very sincerely thank REPOA for their assistance in this regard. REPOA has also supported the project through organization of two workshops: one for fine-tuning the proposal at the beginning of the project, and other for sharing of the progress report with like-minded organizations. The two seminars were extremely useful in improving the quality of the work.

We would also like to acknowledge the generous support – in terms of materials, and discussion –of some of the organizations in the three sectors that were studied. Worthy of mention is the staff of the Directorates of Research and Development (DRD) and Directorate of Policy and Planning (DPP), both of the Ministry of Agriculture and Food Security and Co-operatives (MAFS), The Institute of Traditional Medicine of the Muhimbili University College of Health Sciences (MUCHS).

Sincere thanks also go to Mr. Joseph Kihedu of the College of Engineering and Technology (CoET) of the University of Dar es Salaam for his assistance in data and information gathering for the project, especially for the manufacturing sector.

Finally, the views expressed in this report are of the authors and not of the organizations and individuals acknowledged above.

Abstract

Tanzania is one of the poorest countries in the world. Like many other poor countries and in particular African countries, it is grappling with the poverty challenge nearly five decades after independence. A growing body of literature on poverty identifies a critical link between poverty reduction, growth and technology. Using the concept of Sectoral Systems of Innovation (SSI) this study examines the deficiencies in the three sectoral system of innovation in the Tanzania national economy. The study is divided into two parts: part one to which this report belong, maps out, analyses and determine the level of adequacy of the supply side of the three sectoral systems of innovation. The study argues that while most of the system elements for all the three sectors are in place, two major challenges are found to be facing the policies. One is that they are not explicit on how to facilitate the interaction of the actors in the sectoral systems of innovation. And second, most of the policies are of the supply side type, with no trace of demand side innovation policies. Part two of the study is envisioned to determine the impact of the supply side elements on the innovativeness of the producers and service providers (demand side of the innovation).

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List of Abbreviations

AfDB	-	African Development Bank
AGITF	-	Agricultural Inputs Trust Fund
AGRA	-	Alliance for a Green Revolution in Africa
AIDS	-	Acquired Immune Deficiency Syndrome
ASDP	-	Agricultural Sector Development Programme
ASDS	-	Agricultural Sector Development Strategy
ASLM	-	Agricultural Sector Lead Ministries
BET	-	Board of External Trade
BIS	-	Basic Industry Strategy
BRELA	-	Business Registration and Licensing Agency
CAMARTEC	-	Centre for Agricultural Mechanization and Rural Technology
CDF	-	Comprehensive Development Framework
CHAWATIATA	-	Chama cha Waganga na Wakunga wa Jadi Tiba Asilia Tanzania
CoET	-	College of Engineering and Technology
CORDEMA	-	Client Oriented Research and Development Approach
CTI	-	Confederation of Tanzania Industries
CVL	-	Central Veterinary Laboratory
DADP	-	District Agricultural Development Plan
DIDF	-	District Irrigation Development Fund
DfID	-	Department for International Development
DRD	-	Division of Research and Development
EAMRC	-	East Africa Medical Research Council
EU	-	European Union
FDIs	-	Foreign Direct Investments
GDP	-	Gross Domestic Product
HIV	-	Human Immunodeficiency Virus
HKMU	-	Hubert Kairuki Memorial University
IHI	-	Ifakara Health Institute
IHRDC	-	Ifakara Health Research and Development Centre

IMTU	-	International Medical Teaching University
IPI	-	Institute of Production Innovation
ITM	-	Institute of Traditional Medicine
LITI	-	
LRC	-	Livestock Research Centre
MAFS	-	Ministry of Agriculture and Food Security
MDGs	-	Millennium Development Goals
MFI	-	Micro Finance Institution
MHPs	-	Modern Health Practitioners
MKUKUTA	-	Mpango wa Kukuza Uchumi na Kupunguza Umaskini Tanzania
PMO-RALG	-	Prime Minister's Office- Regional Administration and Local Government
MTNs	-	Multilateral Trade Negotiations
MTSP	-	Medium Term Strategic Plan
MUCHS	-	Muhimbili University College of Health Sciences
MUHAS	-	Muhimbili University of Health and Allied Sciences
NGO	-	Non-Governmental Organization
NARS	-	National Agricultural Research System
NEPAD	-	New Partnership for Africa's Development
NIMR	-	National Institute of Medical Research
NMB	-	National Microfinance Bank
NSGRP	-	National Strategy for Growth and Reduction of Poverty
NSI	-	National System of Innovation
OECD	-	Organization for Economic Cooperation and Development
PELUM	-	Participatory Ecological Land Use Management
PLHAs	-	People Living with HIV and Aids
PRSPs	-	Poverty Reduction Strategy papers
R&D	-	Research and Development
REPOA	-	Research on Poverty Alleviation
SACAS	-	Savings and Credits Association
SACCOS	-	Savings and Credits Cooperative Society

SIDP	-	Sustainable Industrial Development Policy
SMEs	-	Small and Medium Enterprises
SNV	-	
SSI	-	Sectoral Systems of Innovation
S&T	-	Science and Technology
STI	-	Science, Technology and Innovation
SUA	-	Sokoine University of Agriculture
TTA	-	Tanzania Tea Authority
TAWG	-	Tanga Aids Working Group
TaCRI	-	Tanzania Coffee Research Institute
TBS	-	Tanzania Bureau of Standards
TDTC	-	Technology Development and Transfer Centre
TDV	-	Tanzania Development Vision
TEMDO	-	Tanzania Engineering and Manufacturing Design Organization
TFDA	-	Tanzania Food and Drug Authority
TGT	-	Tanzania Gatsby Trust
TIRDO	-	Tanzania Industrial Research and Development Organization
TOAM	-	Tanzania Organic Agriculture Movement
THPs	-	Traditional Health Practitioners
TRIT	-	Tea Research Institute of Tanzania
TTRI	-	Tsetse and Trypanosomiasis Research Institute
UDSM	-	University of Dar es Salaam
UMADEP	-	Uluguru Mountain Agricultural Development Project
URT	-	United Republic of Tanzania
USAID	-	United States Agency for International Development
VECO	-	
VEW	-	Village Extension Worker
WTO	-	World Trade Organization
ZARDEF	-	Zonal Agricultural Research and Development Fund
ZARDI	-	Zonal Agricultural Research and Development Institute
ZRDC	-	Zonal Research and Development Centre

1. Background

1.1 Introduction

Tanzania is one of the poorest countries in the world. Like many other poor countries and in particular African countries, it is grappling with the poverty challenge nearly five decades after independence. The past two decades have however witnessed renewed interest in the issue as reflected in both national and international initiatives: Millennium Development Goals (MDGs), Comprehensive Development Framework (CDF), New Partnership for Africa's Development (NEPAD), Vision 2025, Poverty Reduction Strategy Papers (PRSPs), popularly known is "Kiswahili" as "Mkakati wa Kukuza Uchumi na Kupunguza Umaskini Tanzania (MKUKUTA)", etc. It is recognized that sustainable socioeconomic development is only possible when significant and sustained reduction of existing and unacceptably high poverty levels occurs. What has emerged over the past few decades of poverty reduction initiatives is that poverty is a complex, multi-dimensional concept. There is income and non-income poverty, even though the two are not mutually exclusive. Poverty varies by geographical location, between rural and urban areas; by age and by gender. It is this multi-dimensional character of poverty that has created the need for better understanding through systematic research and analysis.

The establishment of Research on Poverty Alleviation (REPOA), a national policy think tank, was informed by the need to focus research on poverty issues. REPOA has proposed four key research themes: growth and poverty; vulnerability and social protection; social, political and cultural dimensions of poverty; and environment and agriculture. In addition, REPOA's research programme has three cross cutting themes: gender, governance and technology. Indeed, a growing body of literature on poverty identifies a critical link between poverty reduction, growth and technology. Numerous statistical studies have found a strong association between growth and poverty indicators, using both income and non-income measures of poverty. At the nucleus of the growth-poverty debate, is the contention that growth impact may not always be poverty reducing, and that distributional measures or the quality of growth itself may have to be addressed

to ensure that growth is broadly shared in society and is translated into improved welfare of the poor. However, the sure thing is that growth is a necessary condition for sustainable poverty reduction.

Growth may be accounted for by increasing the level of factors of production or by increasing the level of productivity of these factors. The latter driver of growth is likely to be associated with competitiveness and sustainable rises in the levels of incomes in society. Important contributors to productivity growth and competitiveness are science, technology and innovation. Technology drives productivity which in turn sustains competitiveness and growth of incomes and poverty reduction in society. The experience elsewhere has shown that the most dynamic, competitive products in the world market are increasingly knowledge intensive products coming out of increasingly knowledge-intensive production processes whether in industry, agriculture or services. Given that there are pervasive market failures for science, technology and innovation in most poor countries, government hand in terms of policies for facilitating innovative activities in the national economy is critical. This in turn requires policy research in innovation. Indeed UNCTAD's Least Developed Countries (LDCs)' Report for 2007 argues – in its overall conclusion – that unless the LDCs adopt policies to stimulate technological catch up, they will continue to fall behind other more developed countries and face deepening marginalization in the global economy. To ensure sustainable growth and poverty reduction, Tanzania must therefore be able to develop and successfully implement appropriate innovation policies. Unfortunately, while REPOA recognizes the crucial importance of this type of research, at the level of implementation the components relating to technology and innovation have lagged behind. This study sets out to contribute to reducing this knowledge gap.

1.2 Rationale, Objectives and Methodology

The purpose of this work is to contribute to filling the knowledge gap in growth and poverty reduction strategies and initiatives. It is an attempt to propose better

methodologies and policies for facilitating innovative activities in the productive and service sectors for sustainable growth and poverty reduction.

Traditional methodologies typically assess technological development and innovation following a linear approach. This study adopts a systems approach in which the concepts of National Systems of Innovation (NSI) and Sectoral Systems of Innovation (SSI) are invoked in the analysis. This approach recognizes the fact that innovation is essentially systemic and context specific.

The focus of the work is on three sectors: Agriculture, Industry (manufacturing) and Health. The study is implemented in two phases. The first phase concentrated on the mapping and analysis of the supply side elements, i.e. suppliers of knowledge for innovation and other inputs. Of interest here are the supply side actors and their activities, policies and regulations in the three sectors. The analysis is based on the potential impact of policies, actors and their activities on the innovativeness of the producers. This document is reporting findings from the first phase. The second phase, which is planned to follow soon, will assess the actual implications of these policies, actors and their activities on innovativeness of the producers; i.e. the demand side of innovation. It is important to note here that the work is expected to contribute to the current government's programme on "The National Science, Technology and Innovation System Review".

The first phase of the study has made use of both primary and secondary information. The starting point was literature review that has identified important actors, policies and regulations in the three selected sectors. Information from the existing literature and documents was complemented by field visits to selected actors to update information on their functions and activities. The major analytical tool used in the first phase of this study is essentially content analysis, aided by the conceptual framework presented in section two. The rest of the report is structured as follows: Section two is devoted to developing the conceptual framework for the study. Section three does the actual mapping and analysis of the systems for the three chosen sectors. Section four presents summary, concluding remarks and the way forward into phase two.

2. Conceptual Framework

2.1 Defining the Concept of Innovation

The concept of innovation denotes novelty in terms of the process of introducing a new and useful product and the new product itself. There is wide range of approaches to conceptualizing innovation in the scholarly literature (Fagerberg, et al., 2004). Innovation has also been associated with wide applications in different contexts, including in relation to technology, social systems, economic development, and policy constructs. In addition, reference has been made to innovation in educational curricular as well as in constitutional changes. This study is mainly concerned with innovation in the economic context referring to successful creation, development, and marketing of new products or successful application of new techniques or ways of working that improves the effectiveness of an individual and organization (Archibugi et al., 1994). Four major types of innovation have been identified with this definition:

- Product innovation,
- process innovation,
- market innovation, and
- Organizational innovation.

Innovations can either be identified with small increments or radical change, i.e. something completely new. This distinction is especially applicable for product and process innovations.

2.2 Factors Facilitating Innovation

As earlier discussed, there is a close causal relationship between innovative activities on the one hand, and growth and poverty levels on the other. This notwithstanding, the debate on factors that facilitate innovative activities is far from being settled. The current major policy focus and academic discourse is therefore preoccupied with identifying and analyzing factors which spur innovative activities. In the early days two major models were advanced: '*Technology Push*' and '*Demand Pull*'.

According to the technology push model, innovations are triggered by basic research in science resulting into a wide spread marketing of new products and adoption of new processes (Coombs, et al., 1987; Rosenberg 1982). Hence, the supply of new products and related processes leads demand which is assumed to be created after a new product has successfully been produced. According to the technology push model, the market plays a passive role in innovations following a linear progression from basic research to production and marketing leading to economic success. The model underlines the inventive genius of entrepreneurs whereby the risk taking entrepreneur assumes a decisive role in innovation process (Schumpeter, 1934; Dosi, 1988). The entrepreneur plays the role of successfully marketing the new products and processes. Later the entry of imitators will speed up the diffusion of the innovation to other industries. The model assumes that entrepreneurs will start innovating again once imitation spreads and profitability declines slowing down the process of diffusion. According to Schumpeter, such waves of innovation lead to a process of “creative destructions”, which inflicts serious damages to the existing economic structures as new ones emerge (Schumpeter, 1934). In this model, science is positioned as an endless frontier with policy implications prescribing the creation of a sufficiently large pool of trained and talented scientists with their state-of-the-art labs. The success of the military science during the Second World War, especially the Manhattan Project contributed to giving credence to this model when it was demonstrated that large and hierarchically organized scientific projects could achieve pre-determined goals (Olof, 2009). It is in this context that this view of technology innovations became dominant in the US and in other developed countries in the post-war period (Guston 2000, Olof 2009). While it is not anymore the dominating view in the North, it continues to be embraced in the South as a guide to science and technology policies in spite of its failure in the context of the South as well.

The demand pull model on the other hand, emphasizes the dynamics of the market demand conditions as the driving force in technological change (Schomookler, 1966). According to this model, the changing market conditions and potential drive innovative activities to the most profitable areas. However, supply response to changing demand

conditions requires adequate capacity for science and technology suggesting that neither of the two models by itself can be associated with the successful facilitation of innovative activities. This realization gave birth to the *interactive* model of innovation.

The interactive model of innovation depicts a complex interaction between the ‘supply’ (R&D labs, scientific and technical institutions) and the ‘demand’ (potential and actual users and marketing organizations) *as argued by* Rothwell and Zegveld (1985) and Lovio, (1985). It is in the context of realization of these interactions that the more recent concept of National Systems of Innovation (NSI) has been developed. This concept is robust with its principles derived from direct observation of countries and sectors which have strong track records of innovation (Nelson, 1993). The research presented in this report adopts the NSI model whose main features are presented in the following sections.

2.3 National and Sectoral Systems of Innovation

The systems approach to innovation has evolved over time since its initial appearance in the form of the ‘national systems of innovation’ (NSI) in the pioneering studies by Freeman (1987) and Freeman, Lundvall and Nelson (Archibugi, et al. 1998). Chris Freeman was among the first to use the concept by adopting a historical approach based on modern innovation theory focusing on the interaction between the production system and the process of innovation to explain the development process in postwar Japan. The NSI approach emerged then more broadly in the early 1990’s with the seminal contributions of Lundvall (1992) and Nelson (1993). Lundvall defined the NSI as *that system which is constituted by elements and relationships between those elements, which interact in the production, diffusion, and use of new and economically useful knowledge in a particular nation* (Lundvaal, 1992, pp. 10).

The national systems of innovation approach defines the nation as the appropriate level of analysis focusing not necessarily on the behaviour of actors at the forefront of world’s technology but on the factors influencing national technological capabilities. This choice of the nation as the level of analysis recognizes the importance of the central state

authority and national and cultural idiosyncrasies. National systems are postulated to differ in respect to the structure of the production system and the institutional set-up hence the national idiosyncrasies (Lundvall, 1992, Gu 1999, Nelson, et al., 1993). These may include internal organization of firms, inter-firm relationships, the role of the public sector and institutional arrangements in specific sectors such as the financial sectors and R&D activity.

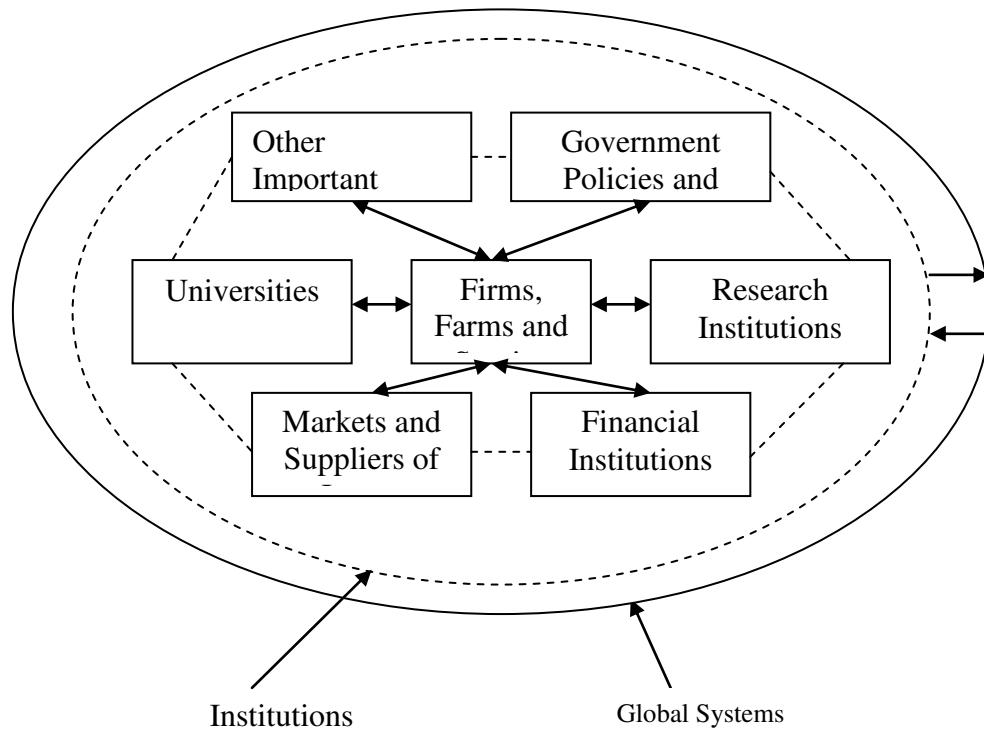


Figure 1: National System of Innovation
 Source: Diyamett, 2010

Figure 1 above depicts a typical national system of innovation in which firms and farms are central to all interactions. Firms interact with the government which formulates policies that impact firms' activities; R&D organizations which conduct applied research including developing prototypes which are finally transferred to firms and farms; the financial system which provides financing for investment in new technologies, markets

where new and/or improved products are sold, universities where basic research to inform innovation processes takes place and other actors with relevant activities that feed into the system. The national systems of innovation approach, therefore, stresses that the pivot of the innovative process is the flow of knowledge and information among people, enterprises and institutions. This analytical framework explores complex relationships among heterogeneous agents, social and economic institutions, and endogenously determined technological and institutional opportunities. It demonstrates the importance of studying innovation as a process in which knowledge is accumulated and applied by heterogeneous agents, through complex interactions that are conditioned by political, social and economic institutions.

Three essential elements in the system of innovation are the actors and their interactive learning and institutions (Agwu, et al. 2008, Francis, 2006)¹.

i) *The actors (organizations and individuals) are involved in generating, diffusing, adapting and using knowledge. These actors include producers, their suppliers, users, and competitors, higher learning institutions, R&D organizations, and financial institutions (Nelson, et al., 1993, Lundval, 1992, Edquist 1997, Gu 1999).*

ii) *The interactive learning that occurs when organizations engage in generating, diffusing, adapting and using new knowledge and the way in which it leads to innovation in the form of new products, processes, services, new organizational forms and new marketing strategies.*

iii) *The Institutions such as policies, rules, norms, conventions, regulations and traditions that govern how this interaction occurs.*

¹ Related to this are the ten functions of an NSI as provided by Edquist 1997. The ten functions can selectively be applied in building systems of innovation depending on the context and extent to which the system has been developed. The functions are especially important in identifying gaps in the required organizations and institutions for a certain system of innovation to perform well. The ten functions are provided as an appendix to this work.

In regard to the actors, what is important are not only the capabilities of individual actors, but the interaction among relevant actors putting interactive learning at the centre of innovation as stressed by Lundvall (1992). In this regard, three forms of learning were identified: learning by “exploring”, learning by “searching” and “learning proper” from routine activities, such as production, distribution, marketing and consumption functions of the firms and farms (Lundvall, 1992). While learning proper (learning by *doing*, *using* and *interacting*) largely results in incremental type of innovation, learning by searching (proactive search for new products, processes and services normally involving formalized R&D activities) largely results in more radical innovations. Learning by exploring to a large extent consists of more basic research, where research is not focused on an immediate application, but instead on the generation of knowledge for future application². The various learning processes interact in creating and sustaining innovative firms and farms. This interactive learning is facilitated and coordinated by institutions in the form of policies, rules and regulations.

Systems of innovation can be conceptualized at various levels: national, regional and sectoral levels. When a researcher seeks to look closely into the system of innovation in a particular sector then a ‘sectoral system of innovation’ can be invoked in the analysis. A sectoral system of innovation and production is a set of new and established products for specific uses and set of agents carrying out market and non- market interactions for the creation, production and sale of those products (Malerba, 2002). Sectoral systems have a specific knowledge base, technologies, inputs and demand conditions. The agents are individual and organizations at various levels of aggregation, with specific learning processes, competencies and organizational structure, beliefs, objectives and behaviors. They interact through processes of communication, exchange, co-operation, competition and command as they are shaped by institutions in place. Sectors have always provided key level analysis for economists, business scholars, technologists and economic historians in the examination of innovative and production activities (Malerba, 2002).

² It is important to note here that in most cases basic research, though not immediately applicable, it is mission oriented where the focus is well guided in a certain direction for future application. Basic research are also conducted in tandem with applied research because of the complementarities that exist between the two

The diagram 2 below depicts this generic representation of these systems. As noted above, this study intends to examine systems of innovation in three sectors namely agriculture, industry and health.

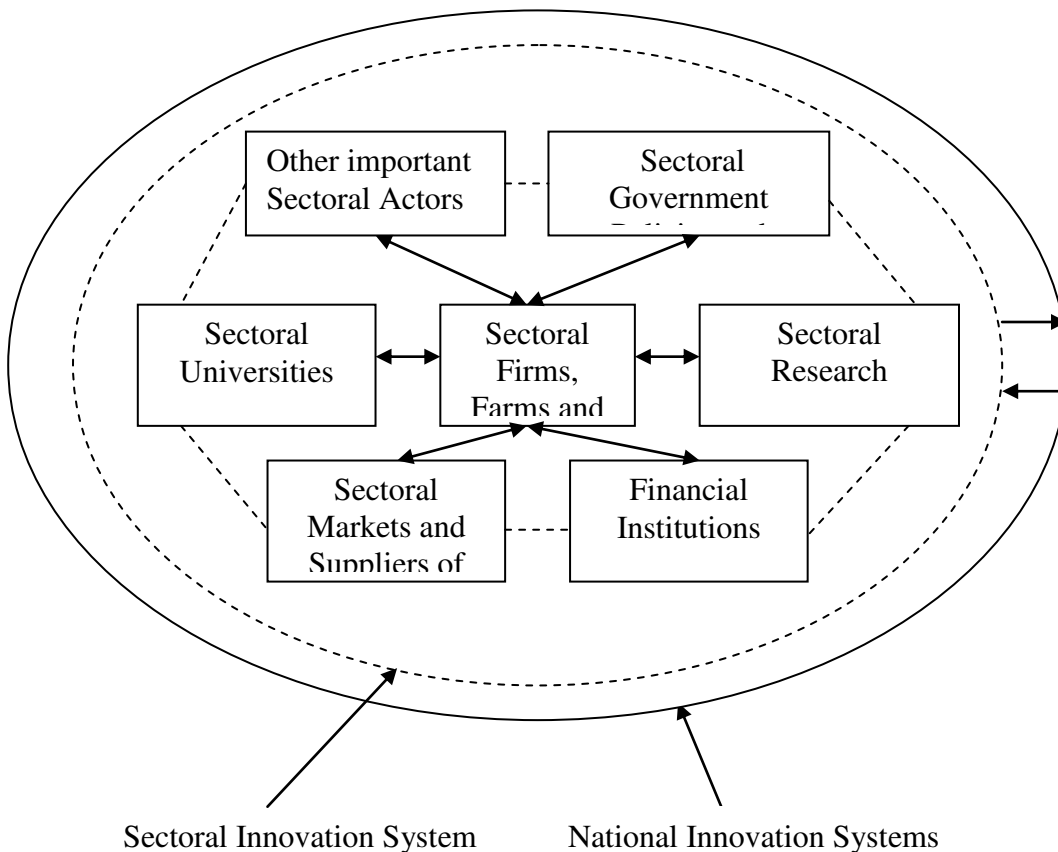


Figure 2: Sectoral System of Innovation.

Source: Adapted from Diyamett, 2010

There is a wide held view that innovation system exist only in more developed countries – that poor countries such as Tanzania cannot have innovation systems. However, to the contrary, inherent in all human beings - since time in memorial - is creativity and innovativeness in human mind. People have continuously improved their means of

production. For this reason, however rudimentary it may be, every nation has some form of systems of innovation at all times. Indeed, according to Parterson et al. (2003), every nation has a “de facto” system of innovation which may be more or less effective. These arguments concur well with the contention by Lundvall (1992) - that innovation is an ubiquitous (omnipresent) phenomenon in the modern economy. Practically, in all parts of the economy, and at all times, we expect to find some on-going processes of learning, searching and exploring, which result in new products, new techniques, new forms of organization and new markets (Lundvall 1992, p.8)

Given the uniqueness of nations, and at different stages of development, action taken by each nation in order to strengthen their systems of innovation should not be informed by external flavor of the month policies but by an assessment of the most favorable set of actions given the resources available and the current condition (Parterson et al., 2003). This fact to a large extent motivated the design of this study.

3. Mapping and Analysis of Sectoral Systems of Innovation

This section maps out and analyses the sectoral systems of innovation in agriculture, industry and health in Tanzania. In the current phase of this study, the focus is on the discussion and analysis of the supply side factors (actors, policies and regulations) by way of assessing the potential capacity of the system to generate innovations in the form of new products and processes as well as new markets and organizational forms. As indicated in the introduction, the analysis of the actual impact of these institutions and organizations on the innovativeness of producers (firms and farms) is the task of phase two of this study.

3.1 Agricultural System of Innovation

3.1.1 Introduction

The agriculture sector is comprised of crops, livestock, fisheries and forestry sub sectors and it is dominated by smallholder farmers. Agriculture, considered the backbone of the national economy, accounts for 26% of the gross domestic product (GDP) and employment to over 70% of the population. A high percentage (85-90%) of the poor in Tanzania lives in the rural areas where the main activity is agriculture. Therefore, the sector has a considerable potential for wealth creation and poverty reduction in the country. Agriculture is also a main source of raw materials for agro-based industries and is a major provider of food security in the country. Considering the food is significant in the national basket of goods and services it is playing a significant role in macroeconomic management. The future of Tanzania's economic growth and poverty reduction as well as socioeconomic transformation is therefore likely to be driven by agriculture. However, despite of all these potentials, the agriculture sector though growing, is performing below its potential.

Over-dependence on rain-fed agriculture, low levels of investment in agriculture, low levels of mechanization (about 70% of farming is done by hand-hoe, 20% by ox-plough and 10% by tractor), low levels of use of technological innovations such as improved seeds, agro-chemicals and fertilizer application (Fertilizer consumption at an average of 8kg/ha), inadequate credit facilities to cater for farm investment and operational requirements, weak research-extension- farmer linkages and poor infrastructure has hitherto been identified as a cause for the dismay growth in agriculture.

However, the overriding factor, as earlier alluded to, can be lack of innovative activities in terms of new products, processes marketing strategies and organizational forms. Advancing agricultural transformation requires knowledge and innovation in technology, institutions, policies and relevant organizations as stipulated in the sectoral system of innovation. The following sections map out and analyze two aspects: First, map out and analyze policies and regulations enacted to increase the performance of the agricultural sector. Second, all actors (organizations) active in the agricultural sectoral systems of innovation and analyze their adequacy in terms of their likelihood in bringing forth innovation. Again, the analysis is based on their potential to influence innovative activities among farmers.

3.1.2 Policies and Regulations

Agricultural production in Tanzania is governed by institutions in the form of policies and regulations which are presented in this section. Overriding in this is rural development strategy, which in a way, carries the rest.

Rural Development Strategy and Rural Development Policy

Following the hitches facing rural Tanzania the Rural Development Policy is aimed at achieving a broad based growth and dynamic economy with the long-term view of eradicating poverty and raising living standards of the people. The RDS aims to create harmony and coordination of implementation of sectoral policies and strategies in order to achieve broad based, widely shared and dynamic rural economic growth that is capable

of raising the standard of living of the rural population. The policy aim is to increase agricultural productivity and growth through improving markets, private sector (PS) investment, physical infrastructure, human capital and demand-driven research and extension

3.1.2.1 Sector Policies and Programmes

(i) Agricultural and Livestock Policy of 1997

The major objective of this policy is to commercialize agriculture so as to increase income levels. The policy has nine general objectives as summarized below:

- (a) To ensure basic food security for the nation, and to improve national standards of nutrition by increasing output, quality and availability of food commodities. In order to achieve this objective, production growth rates of food crops and livestock products will have to be at least 4% and 5 % per annum respectively. Food crops production will be increased through productivity and area expansion while livestock growth will be through encouraging the private sector based initiatives in the industry;
- (b) To improve standards of living in the rural areas through increased income generation from agricultural and livestock production, processing and marketing;
- (c) To increase foreign exchange earnings for the nation by encouraging the production and increased exportation of cash crops, livestock products, other agricultural surpluses, including food crops, by-products and residues;
- (d) To produce and supply raw materials, including industrial crops, livestock, by-products and residues for local industries, while also expanding the role of the sector as a market for industrial outputs through the application of improved production, marketing and processing technologies;

- (e) To develop and introduce new technologies which increase the productivity of labour and land;
- (f) To promote integrated and sustainable use and management of natural resources such as land, soil, water and vegetation in order to conserve the environment;
- (g) To develop human resources within the sector in order to increase productivity of labour and to improve ability, awareness and morale;
- (h) To provide support services to the agricultural sector which cannot be provided efficiently by the private sector; and
- (i) To promote specifically access of women and youth to land, credit, education and information.

(ii) Agricultural Policy

The current agricultural policy response in the food sub sector includes liberalization of all agricultural markets and removal of state monopolies, withdrawal of government from production projects, abandoning the objective of national food self-sufficiency in favour of food security at the national and household levels, and reliance on the private sector for agriculture production and marketing. Others are decentralization of agricultural extension and transfer of administrative and implementation responsibility to district councils and government's continued responsibility for regulation (World Bank 2000). These policies are not as yet being fully implemented and further action or cessation of action is required before the beneficial impact will be fully realised by farmers at the micro-level.

(iii) National Livestock Policy

The overall objective of the National Livestock Policy (2006) is to develop a competitive and more efficient livestock industry that contributes to the improvement of the well-being of the people whose principal occupation and livelihood is based on livestock.

(v) Other Relevant Policies

Other relevant policies include the Agricultural Marketing Policy, the Cooperative Development Policy, the Decentralization Policy and the National Economic Empowerment Policy.

In support of the above policy objectives, there are three sector strategies and programmes that deserve presentation here: *Agricultural Sector Development Strategy (ASDS)*, *Agricultural Sector Development Programme (ASDP)* and KILIMO KWANZA (Agriculture First).

(vi) Agricultural Sector Development Strategy (ASDS)

The Agricultural Sector Development Strategy (ASDS), approved by Government in 2001, sets the framework for achieving the sector's objectives and targets and contributes to both the growth and poverty reduction objectives of Tanzania Development Vision (TDV) 2025 and MKUKUTA (URT, 2005a). The Government Programme Document Vision 2025 envisages raising the standard of living of Tanzanians to those of a typical medium-income country through modernization of agriculture and raising productivity of the sector thereby raising the level of incomes, ensuring food security and increasing export earnings.

The objective of the Agricultural Sector Development Strategy (ASDS) is to achieve a sustained agricultural growth rate of 5 percent per annum primarily through transformation from subsistence to commercial agriculture. The transformation process is to be private sector led through an improved enabling environment for enhancing agricultural productivity and profitability. Private sector investment response in the agricultural sector is to be stimulated through policy and public expenditure. Core features of the strategy are to strengthen public-private partnerships across all levels of

the sector and implementation of District Agricultural Development Plans (DADPs) as the comprehensive tool for agricultural development at district level.

The vision of the ASDS is to have an agricultural sector “modernized” by year 2025 into a commercial and highly productive sector that utilizes natural resources sustainably. The primary objectives of the Strategy are: (i) to create an enabling and conducive environment for improving productivity and profitability of the sector and (ii) to promote agricultural sector investment based on an improved regulatory and policy environment with the aim of encouraging wider participation of private sector. In this respect, it forms the basis for long term improvements of farm incomes, reduction of rural poverty and ensuring household food security.

The ASDS focuses on three main strategies:

- *Increasing agricultural productivity and profitability* by creating favourable conditions for enhanced investment, product diversification to expand the export and local market base into more lucrative non-traditional products, intensification of agro-processing to reduce post-harvest losses and waste.
- *Promoting public-private partnerships as well as processor-farmer partnerships* through fostering sustainable business relationships to ensure access to inputs, technology and markets.
- *Implementing ASDS through District Agricultural Development Plans (DADPs)*, to empower farmers, local communities, civil society and the private sector in general in determining priority interventions in agriculture in their respective districts.

(ii) Agricultural Sector Development Programme (ASDP)

The Agricultural Sector Development Programme (ASDP) Framework and Process Document (2003) is an operational response to the ASDS. The major objectives of ASDP

are to increase productivity, profitability, and farm incomes by (i) enabling farmers to have better access to and use of agricultural knowledge, technologies, marketing systems and infrastructure, all of which contribute to higher productivity, profitability, and farm incomes; and (ii) by promoting private investment based on an improved regulatory and policy environment (URT, 2006).

The objectives of ASDP are to be achieved through a set of complementary interventions aimed at:

- improving the capacity of farmers, including food insecure and vulnerable groups, to more clearly articulate demand for agricultural services and to build partnerships with service providers;
- reforming and improving capacity of both public and private agricultural service providers to respond to demand and provide appropriate advice, services and technologies;
- improving the quality and quantity of public investment in physical infrastructure through more devolved, technically-sound planning and appraisal;
- Improving market institutions, including strengthening the policy framework and coordination capacity at national level.

These results are to be delivered through two components: Local Level Support and National Level Support, whereby local level support will be formulated and implemented through District Agricultural Development Plans (DADPs), while national level support will be guided by the ASLM's Medium Term Strategic Plans (MTSPs). Irrigation is accorded high priority in the implementation of ASDP.

(iii) KILIMO KWANZA

KILIMO KWANZA drafted in 2008 focuses on Tanzania's Green Revolution to transform its agriculture into a modern and commercial sector with four main components:

- Integrating KILIMO KWANZA into the Government machinery to ensure its successful implementation;
- Mobilizing increased quantum of resources towards the realization of KILIMO KWANZA;
- Mobilizing the private sector to substantially increase its investment and shoulder its rightful role in the implementation of KILIMO KWANZA and
- Declaring that the implementation of KILIMO KWANZA will comprise the following ten actionable pillars:
 - Political will to push agricultural transformation.
 - Enhanced financing for agriculture.
 - Institutional reorganization and management of agriculture.
 - Paradigm shift to strategic agricultural production.
 - Land availability for agriculture.
 - Incentives to stimulate investments in agriculture.
 - Industrialization for agricultural transformation.
 - Science, technology and human resources to support agricultural transformation.
 - Infrastructure Development to support agricultural transformation.
 - Mobilization of Tanzanians to support and participate in the implementation of KILIMO KWANZA.

3.1.2.2 Sector Acts and regulations

There are several acts and legislations in the agricultural sector covering seed, agricultural inputs, protection of new crop varieties, commodity/crop Acts (for coffee, cotton, cashew, tea, pyrethrum, tobacco, sisal etc.). Important and relevant in the sectoral systems of innovation are *Crop Acts*, *Crop Development Fund Act*, and *Agricultural Inputs Trust Fund Act*. Below we briefly refer to these:

- (i) *Crop Acts*

The Ministry of Agriculture and Food Security has about seven crop specific Acts that aim at crop improvement in Tanzania. These are: The Cashewnut Board of Tanzania Act, 1984; The Sisal Industry Act, 1996; The Pyrethrum Act, 1997; The Tea Act, 1997; The Coffee Industry Act, 2001; The Cotton Industry Act, 2001; The Sugar Industry Act, 2001; and The Tobacco Industry Act, 2001. The thrust of the Acts is to establish the Crop Boards, to make better provisions for the regulation, research and development and sales promotion. The acts have several provisions that are relevant for promoting innovations but the most important ones are: (i) the establishment of Crop Boards to oversee research and development activities; and (ii) establishment development fund to finance research and other development activities.

Specific activities for the Crop Boards include:

- to advise the government on policies, strategies and all other matters relating to the development of the industry;
- to promote crop development (production processing and marketing);
- to provide for the licensing of persons engaged in the marketing, processing of crop products and by-products;
- to make regulations to regulate quality and control or eradication of pests and diseases;
- to assist directly or through financial support research and development and extension services;
- to ensure competition, fair trade, and to set and monitor indicative prices as established by market forces;
- to provide financial support to research and development and sales promotion;
- to educate stakeholders on mechanism for international pricing;
- to protect the interests of farmers against Syndicate of buyers; and
- To promote the establishment of societies or associations of stakeholders and monitor their activities.

(ii) Crop Development Fund Act

The Crop Development Fund is provided for in the Acts establishing the Crop Boards e.g., “The Cotton Industry Development Fund”. The purpose of the Fund includes support for technology and innovations to the extent it provides for financing knowledge creation and crop improvement activities, namely:

- research and development;
- extension services; market and promotion;
- training and human resource development; and
- subsidizing prices for seeds and agro-inputs;

(iii) Agricultural Inputs Trust Fund Act

This act provides for the establishment of Agricultural Inputs Trust Fund and its management. Under this Act, the management of agricultural inputs such as agricultural fertilizers, certified seeds, agro-chemicals, drugs and chemicals for livestock, and gears necessary for the application of such drugs, chemicals and agro-chemicals and farm implements suitable for small holder farmers are regulated.

The objectives for which the Fund is established include:

- to establish the national demand for agricultural inputs and determine the cost thereof;
- to ensure the availability of funds to finance the procurement and distribution of the agricultural inputs;
- to make available loans for importation and distribution of agricultural inputs;
- to finance consultancy services or any technical assistance in relation to acquisition, distribution and use of agricultural inputs;
- To ensure timely delivery, distribution and storage of agricultural inputs.

3.1.3 Organizations

There are seven types of organizations active in the agricultural sector. These are: research organizations, extension service, training institutions, providers of agricultural

inputs, marketing organizations, financial institutions and farmer associations. The following sections discuss each of these.

3.1.3.1 Research Organizations

The present structure of the Tanzania's National Agricultural Research System (NARS) can be classified into two main categories:

- Public research,
- Private sector research.

(i) Public research

The Division of Research and Development (DRD) under the Ministry of Agriculture Food Security (MAFS) is the largest entity in the National Agricultural Research System (NARS) charged with the development, adoption, adaptation of technology. The basic philosophy of DRD is to undertake client-oriented, demand-driven and cost-effective research for development. The directorate plans and executes public sector agricultural research, as well as disseminates research findings to the clientele involved in agricultural production in Tanzania by providing extension services offered by another department within the ministry. DRD's specific functions are as follows:

- Plan, coordinate, and execute agricultural research programmes in Tanzania in accordance with the national agricultural research priorities;
- Recommend the release of research findings which have been approved scientifically, and in collaboration with extension service, arrange for the research recommendations to reach the end users, especially the small holders;
- Collaborate and cooperate with the relevant regional and international R&D institutions in the relevant fields.

DRD operates through a network of research institutions, centres and substations that covers the main areas of crop research in the country. There are seven Zonal Research and Development Centres (ZRDC) located in seven agro ecological zones, which are responsible for applied and location specific research. These are:

- Eastern Zone (Morogoro, Tanga, Coast and Dar es Salaam regions)
- Western Zone (Tabora and Kigoma regions)
- Central Zone (Dodoma and Singida regions)
- Northern Zone (Arusha, Kilimanjaro and Manyara regions)
- Southern Zone (Mtwara and Lindi regions)
- Southern Highlands Zone (Mbeya, Iringa, Rukwa and Ruvuma regions)
- Lake Zone (Mwanza, Shinyanga, Kagera and Mara regions)

Each zonal centre coordinates a number of research institutes and centres as shown in table 1 below

Table 1: National Agricultural Research Institutes

Zone	Institute/Centre	Programs
National	DRD Hqs	FSR, Policy,
	Central Veterinary Laboratory (CVL)*	Animal health and diseases Animal biotechnology
Southern	Naliendele	Cashewnuts, oil seeds, root and tubers, rice, small ruminants
Western	Tumbi	Tobacco, agroforestry
Lake	Ukiriguru	Root and tubers, cotton
	Maruku	Banana and coffee
Southern Highlands	Uyole	Potatoes, agric engineering, dairy, legumes, maize
	Kifyulilo	Pyrethrum
	Ugano**	Coffee
Northern	Selian	Maize, wheat, barley, beans, banana
	Lyamungo**	Coffee
	Tengeru	Horticulture
	West Kilimanjaro*	Livestock
Central	Mpwapwa*	Beef/Dairy cattle, small ruminants
	Kongwa*	Small ruminants, pasture and forage
	Makutopora	Viticulture
	Hombolo	Sorghum and millet
Eastern	Ilonga	Maize, sorghum, legume sunflower, millet
	Ifakara	Rice
	Kibaha	Sugar cane, root and tubers
	Mlingano	Sisal, soil and water management

	Mikocheni	Coconut, biotechnology, cassava, sorghum, rice, cashew
	Tsetse and Trypanosomiasis Research Institute (TTRI)*	Animal health and diseases,
	Livestock Research Centre*	Beef/Dairy cattle, small ruminants

Notes:

* Livestock research institutes, included above, were removed from the DRD of the MAFS to the newly created Ministry of Livestock Development and fisheries. They include CVL, TTRI, LRC Tanga, Mpwapwa, Kongwa and West Kilimanjaro.

** The Lyamungu and Ugano stations are operating under the newly formed Tanzania Coffee Research Institute (TaCRI).

Zonal research priorities have been prepared and management of the Zonal Agricultural Research and Development Institutes (ZARDIs) is to be improved through the implementation of a Client Oriented Research and Development Approach (CORDEMA) which is essentially reconstitution and expansion of the Zonal Agricultural Research and Development Funds (ZARDEFs).

In this category of public research the research work done in universities is worth mentioning. One important organization under this category is the Sokoine University of Agriculture (SUA) which is funded from public sources. The research priorities of SUA aim at augmenting the national priorities in agriculture, natural resources, health, nutrition and environment. Within SUA there are collaborative research programmes with national and international research institutions. The major sources of funding for SUA are government and donor funds. SUA is engaged in research activities, managing and facilitating the dissemination of research findings and results, maintaining an inventory of research facilities, soliciting and administering research funds.

(ii) Privately funded research

The economic liberalization policies provided for private sector participation in research. Privatization of agricultural research is relatively more advanced in tea and coffee, with each crop having a specialized research institute. *Tea Research Institute of Tanzania (TRIT)* for tea and *Tanzania Coffee Research Institute (TaCRI)* for coffee. The major

sources of research funds in these institutions are levies from sales proceeds of respective crops and donors.

Tea Research-TRIT

The privatization started with tea research in 1996 as an autonomous organization representing the Government of Tanzania and stakeholders in the tea industry. The support resources originally came from UK's Department for International Development (DfID) and European Union's Stabex funds.

The main objective of TRIT is to support the development of the tea industry (both large and small producers) towards realizing appropriate high quality, undertaking of cost-effective research and technology transfer. The institute operates in partnership with producers in all major tea growing areas and manages two research stations, Ngwazi in the Southern Highlands and Marikitanda in East Usambara Mountains. At the same time, an agreement was reached between TRIT and the Kifyulilo Agricultural Research Institute, the former national centre for tea research, whereby selected research on tea farming systems would be commissioned by TRIT on an annual basis.

TRIT activities are funded through government funding (which has replaced a formerly statutory cess) and grant aid from donors. TRIT operates four research programmes which represents key priority themes in the Tanzania tea industry. The research programmes are: Crop improvement, Soil Fertility Management, Crop Water Management and Technology Transfer. Major decisions such as identification of priority areas on tea research, allocation of funds for research are made by the Tea Research Board. The Board consists of members from Tanzania Tea Authority (TTA), Tanzania Tea Board, Tea Agency (an agency for small scale tea growers) and from the Ministry of Agriculture and Food Security. The Executive Director of TTA also serves as the Executive Secretary of TRIT. Therefore the major decision makers on tea research are actually the farmers and tea processors themselves.

Coffee Research-TaCRI

Tanzania Coffee Research Institute (TaCRI) was established in 2000 (became operational in September 2001) following the success in the privatization of tea research. Its privatization approach was modelled on Tea Research Institute of Tanzania (TRIT) with some improvements.

The major objective of TaCRI is rejuvenation of the Tanzania coffee industry, placing a new emphasis on the role of stakeholder-led and client demand-driven Research for Development (R4D). The Institute provides a crucial public service to stakeholders in the country's coffee industry by providing coffee producers with relevant and practical technological innovations and advice aimed at improving productivity and quality contributing to enhancing profitability and livelihoods for coffee producers as well as competitiveness of Tanzanian coffee on the world market.

TaCRI is a not-for-profit organization owned by the stakeholders who it is serving. These include small and large scale coffee growers, cooperative societies and unions dealing with coffee, coffee processors, coffee traders, NGOs, the private sector and Tanzania government. It is funded by government budget, donor contributions, collaborative activities, and the sales of materials and services such as plant materials and publications.

TaCRI is organized in terms of five main programmes: crop improvement, crop productivity and primary processing, crop nutrition, livelihood and income security and technology transfer and training. TaCRI research has identified 36 new varieties that show promise in terms of high yield, quality and resistance to disease and environmental challenges.

3.1.3.2 Extension Services

Extension services are organized in two categories: public and private extension services.

(i) Public Extension Services

Agricultural extension services in this category operate under the Ministries responsible for agriculture. The extensions services provided include: grading and quality control measures, packaging, plant protection methods, chemical application procedures, post-harvest handling of produce, marketing and processing skills. Consistent with the decentralization policy in 1998, the government decided to transfer its entire field staff to local government authorities in order to make the extension system more responsive to local conditions. With the Local Government Act No. 6 of 1999, the local authorities are now the implementing agencies for the agricultural extension services in their respective areas. They work closely with the MAFS and the Prime Minister's Office- Regional Administration and Local Government (PMO-RALG) in implementing relevant policies related to agricultural production. Prior to decentralization of extension services the central government and donors were the main financiers of agricultural extension programmes. However, due to the decentralization of extension services it is expected (as per rationalization of functions) that local authorities will allocate funds from their own sources to cover the costs of extension services.

In order to improve extension services, the Government has prepared a four-year training plan and recruitment programme to acquire the desired level of human resources in extension service provision. So far, about 1,252 extension workers for crops and livestock have been recruited. The number of extension workers has increased from 5,960 in 2007 to the current level of 6,268. Extension implementation guideline/standards have been prepared and disseminated. All LITIs buildings have been rehabilitated to accommodate 1,007 students. A total of 1965 Farmer Field Schools have been established to enhance access of agricultural technologies to farmers. A total number of 8 Ward Resource Centres have been established and 5 oxenization centres constructed.

(ii) Private

Prior to 1988, the government was a major provider of agricultural extension services with hardly any participation of the private sector and civil society (Rutatora and Matee, 2001). Since the mid-1980's, greater space is being provided for the participation of non-state actors notably the private sector and the civil society. The research institutes which have widened private sector participation have also extended into private extension services. For instance, TRIT is contracted by various Tea processing companies to provide extension services at cost.

It is estimated that currently there are more than 300 NGOs involved in various types of agricultural extension programmes, either as a major activity in itself, or as part of integrated rural development programmes. Most NGOs have the region and the district as their entry points but some operate at division and ward levels.

Extension services are also provided by private agribusiness firms such as those which distribute and market agricultural inputs such as implements, seeds, agro-chemicals and equipment; those which deal with processing; and those which procure agricultural products, especially cotton, coffee, tobacco, cashewnut and other cash crops.

3.1.3.3 Training Organizations

The agricultural sector has several training organizations for the researchers and extension services, which include universities and research institutes. The largest is the Sokoine University of Agriculture (SUA).

3.1.3.4 Providers of Agricultural Inputs

Tanzania has more than 5000 agro dealers involved in production and/or distribution of agro inputs such as agro chemicals, seeds, implements and equipments. Companies involved in seed production and distribution include TanSeed, Cargill Hybrid Seeds, Pioneer Hybrid International and Paunar and Rotian Seeds Company. Recently a

programme supported by Alliance for Green Revolution in Africa (AGRA), Tanzania Agrodealer Strengthening was initiated in Tanzania. The goal of the Tanzania Agrodealer Strengthening Program is to transform Tanzania's fragmented input distribution system into an efficient, commercially viable input supply infrastructure, thus enabling smallholder farmers' greater access to productivity enhancing inputs and technologies. The Government has provided input subsidies (fertilizer, improved seed and agrichemicals).

Contract farming including out grower schemes reliable markets, stable prices and technology development that can lead to an increase in smallholder productivity. Agricultural inputs and other technology services are provided by contract farmers such as sugar factories and tobacco large scale growers. For instance, Tanzania Breweries Ltd has taken up the initiative to use barley contract farming through the use of cooperatives whereby members would have to apply for farm inputs and the company would provide the funds. In addition, the company provides loans for agricultural inputs as well as extension service to the farmers.

3.1.3.5 Marketing Organizations

Marketing of agricultural products has been dominated by cooperatives, marketing boards and private sector. Crop marketing has been liberalized and private traders and farmers' organizations compete to provide marketing services to farmers. The marketing function that has been carried out by either cooperatives or marketing boards for many years has given space for private sector participation following liberalization of the export crops and agricultural inputs and a redefinition of the role of marketing boards. The private sector participation in the marketing of agricultural products has increased competition in the market. In spite of the cooperative policy being in place the role of cooperatives is currently at very low level.

Processors and agribusiness operators play an important role in absorbing the farmers' produce. However, this is a very diverse group comprising small, medium and large-scale

actors such as farm produce buyers, transporters, processors and exporters of agricultural produce. The agri-business community is playing a key role in engendering growth through the procurement, processing and marketing of agricultural products.

3.1.3.6 Financial Institutions

In Tanzania as a whole, only 6% of all people have access to financial loans from banks, and the agricultural sector only accounts for 1% of the loans issued by banks. Borrowing in the agricultural sector is an especially large problem because of the inability of farmers to secure collateral and the risk involved in agriculture especially rain fed agriculture.

Key institutions that provide such kind of finance are: some banks, SACCOS, and microfinance institutions mainly NGOs.

(i) Commercial Banks

There are three banks that are currently active in financing agricultural activities: First is *Exim Bank (Tanzania Limited)*, which has specialized in pre-export crop financing as well as trade and financial services to small and medium enterprises. The bank has a credit portfolio that covers Agriculture, Fishing and Forestry. Exim Bank has a line of credit with HSBC Bank-USA which supports the bank's active participation in financing procurement, processing and packing of various export crops especially coffee, cashews and cotton as well as non-traditional crops such as sesame and pulses, and also in financing procurement and distribution of agricultural inputs. The government of Tanzania has been working together with Exim Bank and other commercial banks in Tanzania to encourage borrowing

The National Microfinance Bank (NMB), provides access to a full range of financial services to the rural and (peri)-urban population in Tanzania, with special attention for micro entrepreneurs, small and medium sized enterprises (SMEs), rural enterprises and agriculture. The NMB has been providing credits directly through credit schemes or in

collaboration with other partners. For instance, the National Microfinance Bank (NMB) in partnership with the Alliance for a Green Revolution in Africa (AGRA) unveiled a USD 6.1 million farm input credit scheme to benefit poor Tanzanian farmers and improve the country's network of rural agro-dealers.

CRDB Bank Limited provides agricultural financing through its newly formed CRDB Bank Microfinance Company (MFC) Limited which offers to intermediary Microfinance Institutions formed by individuals, normally as Savings and Credit Cooperative Societies (SACCOS), Savings and Credit Associations (SACAS), Financial NGO's, and Community Banks. The beneficiary MFI's, in turn provide financial services to their individual customers. The bank also works in collaboration with development partners to develop innovative financing programmes. The most recent is the 2008 partnership relationship that was signed between CRDB bank, the African Development Bank (AfDB) and the United States Agency for International Development (USAID) to enhance provision by the Bank of medium and long-term loans to facilitate private sector investment in agriculture.

(ii) Savings and Credits Cooperative Societies

Saving and Credit Cooperatives Societies (SACCSs) are part of the larger scheme of microfinance and are "user-owned financial intermediaries". Because they are rural-based they can access farmers more easily. SACCOSs seem the most convenient and/or viable option for the provision of funds in the agricultural sector in Tanzania. SACCOSs not only allow those in the agricultural sector to borrow despite low, or lack of, collateral, but they also encourage savings. These institutions operate under the Co-operative Society Act of 1991 in offering savings and credit services to members. The responsibility of supervision of SACCOSs has been placed in the hands of Ministry of Agriculture and Food Security (MAFS). It is envisaged that stronger SACCOS will evolve into community banks, join together to form cooperative bank or form alliances with other financial institutions.

(iii) *The Agricultural Inputs Trust Fund*

The Agricultural Inputs Trust Fund (AGITF) was established in 1994 through the Agricultural Trust Fund Act, 1994 (Section 2.2.4) as a form of government support to the financing the supply of agricultural inputs. It provides for soft loans to farmers, therefore allowing for easier borrowing.

3.1.3.7 Farmer Associations

There are several associations that are at various levels of strength in terms of size, effectiveness and visibility in the agricultural sector. The associations are grouped into professional and small-scale farmers' associations.

Under professional category there is the Tanzania Chamber of Commerce, Industries and Agriculture (TCCIA), Agricultural Council of Tanzania (ACT) and Tanzania Chamber of Agriculture and Livestock (TCAL). These represent the medium and large-scale farmers and agri-business. In addition, there are professional associations for technicians, such as the Agricultural Economists Society of Tanzania (AGREST), the Tanzanian Veterinary Association (TAV), the Tanzanian Women Leaders in Agriculture and Environment (TAWLAE), and the Tanzania Society of Animal Production (TSAP).

Under small-scale farmers' association category associations are emerging at both local and national levels. There is commercial producers' association such as the Tanzania Milk Processors Association (TMPA), and the *Mtandao wa Vikundi vya Wakulima Tanzania* (MVIWATA). At lower and/or community level a multiplicity of associations are also found in various regions.

3.1.4 Assessment and Observations

The major objective of this section is to evaluate the potential adequacy of the elements in the innovation system in agriculture. The main elements are institutions as policies and

regulations and organizations as the supply side actors. The assessment of policies and regulations are made in respect of how well they are laced to build the capabilities of the actors in the sector and how they are set to facilitate and coordinate the interaction among the actors.

As indicated in the above review, agricultural sector is rich in the supply side elements. Given the amount of efforts that has gone in strategizing for this sector, it is surprising that the sector is not growing as it should. What could have gone wrong? Detailed answer to this question can only be provided by the part II of this work. However, for the time being, some short comings of the supply side elements can be identified. First is the extension service: Although extension service that caters for linkage between research outputs and farmers, and training organizations that train both researchers and extension service providers seems to be in place, policies and regulations fall short of providing a clear policy and guidance on how extension service should interact with farmers. The aim of the extension service is to connect with farmers and this has adequately been stated in their objectives. However, there is concern that the modality of contracting private service provider to provide extension service is not clear to most LGAs. While there are several actors in the agricultural extension system there is no single policy or regulations that provide guidance to how the private and NGO extension service providers are to be formally integrated into the national extension system. The public private partnership principle has not taken root in practice in many areas in agricultural research and extension and the delivery of other agricultural services.

In addition to the above extension shortcomings, the top down approach is still dominant where researchers conduct research following priorities set and extension officers take to farmers the output of research which they do not influence. Models where farmers have been enabled to participate in setting research priorities seem to have worked quite well (see for instance Wangwe et al., 2009) but these good practices have not been mainstreamed into policies and regulations.

The operationalization of agricultural policies and strategies has largely been carried out through the ASDP. However, according to discussion with some of the agricultural sector stakeholders, there are several concerns on the efficacy of ASDP. First, there is concern that the ASDP has yet to be widely disseminated to stakeholders to make sure they understand it. Second, implementation is still being fragmented at national level. Third, there is concern that co-ordination of key activities and departments is still weak and important synergies and institutional linkages between research, extension, marketing, and farmer empowerment activities are not effectively tapped. It is partly in response to these weaknesses that KILIMO KWANZA has been introduced to complement the ASDP.

The Agricultural Inputs Trust Fund has been in place since 1994 but still AGITF has had limited success in spurring development in the agricultural sector. This is mainly caused by ineffective loan recovery and lack of adequate funds to support the program.

As regards the actors, the agricultural system of innovation contains all the necessary organizations. Research organizations have been engaged in producing new improved seed varieties for various crops such as cashew nuts, maize, wheat and beans which have been released and distributed to farmers. New technologies have also been disseminated including cloned coffee, banana, improved chicken, goats and pig keeping. Research on various animal diseases such as Newcastle disease has been undertaken including vaccination. Collaborative and partnership arrangements that are operating in tea and coffee are promising with the key stakeholders in the system participating. However, according to existing literature, there are still some concerns, and four are worth mentioning. First, most of the new technologies that have been disseminated have not been adopted and replicated in a systematic and sustainable manner within the respective districts and beyond. Second, there is concern that the participation of smallholder farmers and most food crops producers have yet to be empowered to influence research activities of R&D organizations. Capacity building of smallholder farmers has not been provided to smallholder farmers to enable them participate more effectively in priority influencing research priorities and other innovation related agricultural activities. Third,

in many cases technology packages are still presented without minimally adequate analysis of economic returns. The definition of appropriate and profitable technology packages for districts via farmer forums has yet to take first steps in evaluating profitability. Fourth, there is the concern that while universities conduct agricultural research the relationship between university research and that of R&D organizations has not been articulated clearly in terms of their division of labour.

Training institutions are in place with SUA at the highest level. However, training at the technical level still suffers from the interruption of the 1980s and 1990s when training at this level was suspended during reforms hoping that the private sector would come in. The private sector did not respond as expected as there were no support policies put in place to facilitate the expected private sector response.

The folding of most cooperative activities has left a major gap in the provision of agricultural inputs as well as marketing of agricultural products. The response of the private sector in these marketing activities has been slow and support to stimulate private sector response has not been forthcoming from the government. While space for private sector participation has been enhanced, there is concern that private traders normally have a tendency of operating in accessible areas and very rarely they operate in remote rural areas. The role of cooperatives and other associations meant for collective action in marketing is still valid. The decision of the government to revamp cooperatives in a renewed and more responsive form has not been operationalized.

There are also financial institutions which provide finance to agriculture but at too small scale to make a difference. Although some microfinance institutions have their presence deep down into some rural communities their coverage is still very small. Financing of agriculture is still below investment and working capital requirements for the modernization and commercialization of agriculture. In recognition of these shortcomings two important proposals have been made. First, is the proposal to establish an agricultural development bank. Second, the Agricultural Council of Tanzania has proposed the establishment of an Agricultural Business Development Fund, to be led by the private

sector. Such a Fund could finance capacity building of farmer organizations and commodity associations, support technical and management capacity building of SMEs in agriculture, which provide a bridge to bankable projects.

3.2 Health Systems of Innovation

3.2.1 Introduction

Tanzania's healthcare system has undergone significant transformation in the past century from its humble beginning during the 1880s. Having started with a handful of expatriate doctors/researchers from Germany it expanded to cover almost the entire country with a combination of government, mission and privately owned health facilities – hospitals, health centres and dispensaries. Early medical researches led to the discovery of tropical diseases such as malaria and trypanomiasis. At the time of independence in the early 1960s the government inherited a relatively modest healthcare system characterized by some disparities especially between urban and rural areas. The post-independence government made access to healthcare a top priority health policy agenda with disease being identified as one of the three 'national enemies' others being poverty and illiteracy. The three, however, are not mutually exclusive. Thus the 1960s and 70s witnessed concerted efforts to bring health services closer to the people especially in rural areas where the majority live but were underserved during the colonial period. The long-term goal had been to bring the services to within 5-10 km. The Ujamaa policies pursued by the government reinforced by the basic needs approach to development at the time were driving forces allowing for provision of "free" health services for most poor people who otherwise could not have afforded.

The expansion of healthcare services proceeded hand in hand with the development of human resources and building capacity for conducting medical research and development (R&D) within the health sector. Training of medical doctors, clinical officers, nurses and medical auxiliaries was undertaken in government and mission owned training institutions. The government inherited a number of research facilities which were operating under auspices of East Africa Medical Research Council (EAMRC) until the

breakup of East African Community in 1977. The National Institute of Medical Research (NIMR) was established by Act of Parliament No. 23 of 1979 and became operational in 1980. It was entrusted with the task of overseeing all health research institutions in the country. The second half of the 1970s witnessed deteriorating economic conditions characterized by declining agricultural output, falling commodity prices and rising oil prices. Coupled with the demise of the East African Community, the situation culminated into a full-blown economic crisis in the early 1980s. Subsequent efforts to deal with the situation led to the adoption and implementation of a series of structural adjustment measures during the remainder of the 1980s and early 1990s with far-reaching implications on the healthcare system.

The impacts of SAPs on the delivery of healthcare services and other public services are now well-documented (Mwangu, 2003; Lorenz and Mpemba, 2004). In short, reduced flow of public resources to the sector led to deterioration of existing health facilities and acute shortage of essential drugs among other things. The achievements of the 1960s and 70s were systematically undone leading to lowering of quality of services, while at the same time raising concerns over access and equity. Also medical research suffered significantly in the process as flow of public funds dwindled reflecting general deterioration of the economy (Wangwe, et al., 2009). The 1990s witnessed the introduction of a wide range of healthcare reforms as a way of coping with changes in economic situation and its impact on the delivery of healthcare services. The once public dominated sector was subsequently ‘liberalized’ allowing for enhanced role for non-state service providers both for profit and not for profit. Cost-sharing or user fee was introduced as a way of coping with rising costs of providing healthcare services amid dwindling public resources. Introduction of health insurance schemes, National Health Insurance Fund (NHIF) and Community Health Fund (CHF), also became part and parcel of the health sector reforms (Kamuzora, and Gilson, 2007). Numerous studies have shown that health reforms have had far-reaching consequences on the service delivery especially for vulnerable and/or disadvantaged groups, children, pregnant women and mothers, and old people and those living in poverty.

Thus health sector reforms raised the issue of accessibility and/or affordability of health services among the poor. Indeed, the link between poverty and inability to access or afford 'modern' healthcare is now a well established fact. In a situation where costs of health services are spiraling out of control while incomes are either stagnant or declining the tendency is for people not to make frequent use of such services. The alternative is for people to seek for cheaper, accessible and affordable sources. For most developing countries a most common alternative is what has been described as the 'traditional healthcare', or 'alternative/complementary healthcare'. This is true for Tanzania as for many African countries.

3.2.2 Traditional Medicine: Definition and role it plays in Health Care

Traditional medicine or traditional medicinal knowledge has been defined as the health practices incorporating plant-based medicines, spiritual therapies, manual techniques and exercises, applied singularly or in combination to treat, diagnose and prevent illness or maintain well-being (WHO, 2006). According to WHO 2000, a traditional medicine practitioner is a person who is recognized by the community where he or she lives as someone competent to provide health care by using plant, animal and mineral substances and other methods based on social, cultural and religious practices. It is generally acknowledged that traditional medicine plays an important role in healthcare in many developing countries. It is estimated that 80 percent of people in low income countries rely on traditional medicine for their primary healthcare needs. In sub-Saharan Africa, traditional healers far out number modern health practitioners and the majority of the population uses traditional medicine. The situation in Tanzania is not much different from that in many other African countries. It is estimated that there are between 75,000 and 80,000 traditional health practitioners in the country giving the ratio of 1:400 which is more than the one in modern healthcare which is approximately 1:25,000 (Magola, 2008).

3.2.3 Integration of Traditional and Modern Medicine

For our purpose in this study of health systems of innovations the focus is on the role and place of ‘traditional medicine’ in the overall sectoral systems of innovation, especially the integration between the traditional and modern medicine. The traditional medicine has been chosen for this study because of its double benefit – improvement of the health care system and growth of the economy through manufacturing and marketing of drugs from medicinal plants that are plenty in Tanzania. This can most likely happen when the traditional and modern medicines are successfully integrated. According of WHO 2000, there are three meaning of integration:

First, it may mean incorporation of traditional medicine into the general health service system. The government recognizes the practice of traditional medicine and the use of traditional medicine is incorporated into the mainstream of health service system. Traditional medicine therefore becomes an integral part of formal health service system in the country. This is already happening in some countries; good example is China. Second, it may mean integration of the practice of traditional medicine with that of modern medicine. In fact, many medical doctors who have adequate knowledge of traditional medicine have tried to incorporate remedies used by traditional medicine into their daily work. In some places, traditional and modern medicines are practiced side by side. Studies have also shown that many patients use both traditional and modern medicine. Interesting here is also whether modern health practitioners are referring their patients to traditional health practitioners, and vice-versa. Third, it may mean the integration of traditional and modern medicine as two branches of medical science. Efforts are geared towards synthesizing the two branches in order to form a new branch of medical science, incorporating elements of both.

The focus of this study is level of integration between traditional medicine and modern medicines in Tanzania in regard to meaning one and two, which are more or less complementary.

While ‘traditional medicine’ has been practiced in Tanzania and many other African countries for generations, it is only recently that much attention is being accorded to it. The past two decades have witnessed flurry of activities aimed at raising the profile of traditional medicine leading to a body like OAU to declare the decade of 2001-2010 as the decade of African Traditional Medicine. Indeed, interest shown by the World Health Organization (WHO) in the process has provided impetus and urgency of bringing traditional medicine from the fringes to the mainstream of health service delivery.

Apart from being part and parcel of African culture and tradition a number of factors are known to be contributing to the enhanced importance of traditional medicine. First and foremost is the inability of modern healthcare to provide coverage to the whole population especially in the rural areas. The first noted above is the rising costs of modern Western medicine fuelled in part by high drug and equipment prices. With most African countries faced with economic crises they are forced to spend lesser and lesser on importation leading to scarcity/shortage of essential drugs. On the other hand, as a number of people living in poverty increases it means that affordability of modern medical care has emerged as a critical socio-economic and political issue. Secondly, the challenge posed by diseases such as HIV/AIDS, malaria and tuberculosis has put much burden on the healthcare systems in many African countries. They are overwhelmed by high costs of treating opportunistic diseases and caring for people living with HIV/AIDS with little hope for cure. For people in poverty in rural areas where access is limited and affordability is always a problem search for alternative is a priority issue. That is, people are increasingly relying on the traditional medicine as alternative or complement to modern medicine. Despite increased reliance on traditional medicine not much is known about its scope, efficacy and safety, policy and legal frameworks in which it is operating, and more important, its level of integration with modern health care system so as to contribute to poverty reduction.

The situation narrated above calls for better understanding of the traditional health care system and its associated system of innovation, especially its level of integration with the modern health care system. The following section maps out the health systems of

innovation with the focus on the traditional medicine and its interface with the modern medicine.

3.2.2 Policies and Regulations

The performance of health systems of innovation in Tanzania is a function of a number of policies and regulations in place. These policies and regulations are designed not only to promote traditional health systems but also to protect its users and sources of indigenous knowledge. These are addressed in the following section.

3.2.2.1 National Health Policy

The current policy is essentially a revised version of the 1990 national health policy which put emphasis on the need for community participation in the development of health sector and improved access and equity in health and health services. The vision is to improve health and wellbeing of all Tanzanians with a focus on those most at risk, and to encourage the health system to be more responsive to the needs of the people. The vision is the provision of equitable, quality and affordable basic health services, which are gender sensitive and sustainable and delivered for the achievement of an improved health status (URT, 1990; 2003).

The objectives of the policy can be summarized as follows:

- a) Reduce the burden of disease, maternal and infant mortality and increase life expectancy through provision of adequate and equitable maternal and child health services facilitate the promotion of environmental health and sanitation, promotion of adequate nutrition, control of communicable diseases and treatment of common conditions.

- b) Ensure that the health services are available and accessible to all the people in the country (urban and rural areas).
- c) Train and make available competent and adequate number of health staff to manage health services with gender perspective at all levels.
- d) Sensitize the community on common preventable health problems and improve the capabilities at all levels of society to assess and analyze problems and design appropriate action through community involvement.
- e) Promote multi-sectoral approach and cooperation in addressing health problems faced by communities.
- f) *Promote traditional medicine and alternative healing system and regulate the practice.*

As can be observed above, the national health policy recognizes the role of traditional medicine and intends to promote and regulate its use. Accordingly, traditional and alternative healing services and modern health services are complementary to each other. In this connection the health policy is designed to ensure that:

- The traditional health practitioners are made accountable to their own prescriptions, remedies and therapies.
- The Village Community Government takes responsibility to appraise, assess and recommend in particular locality traditional practitioners for registration by an approved authority.
- Legislation provides for regulation of practitioners, therapies and remedies and other related treatments.

As far as research is concerned the health policy has entrusted the National Institute of Medical Research with the responsibility of coordinating and disseminating medical

research information. More important, support is accorded to research in traditional medicines focusing on the identification of traditional remedies, screening of traditional herbal and medicinal materials and assessing the efficacy and safety of the products. Overall, it can be argued that the health policy recognizes the role of traditional and alternative healthcare practices, and supports its promotion and use. This not with standing however, the policy is not clear on the possible integration of traditional and modern medicine.

It should also be noted that the health sector in Tanzania has undergone wide-ranging reforms that have significantly transformed the way health services are delivered. The system is designed to improve quality of health services and the same time enhances equity in terms of accessibility and utilization. The reforms have important bearing on the management of the health innovation system with the new actors coming into play. It is envisaged that the reforms will be reinforced by reforms of the health research through *establishment of a health research users fund and propagation of demand oriented research in the health sector.*

3.2.2.2 Traditional and Alternative Medicine Act

After many years of unregulated practices the government put in place the Parliament Act No. 23 of 2002: *Traditional and Alternative Medicines Act* which, among other things, establishes the Traditional and Alternative Health Practice Council whose functions are:

- To supervise and control the practice of traditional and alternative health practitioners;
- To promote the practice of traditional and alternative health;
- To coordinate the efforts undertaken in different areas to develop traditional and alternative health science;
- To promote the maintenance and enforcement of traditional and alternative health care;

- To regulate and set standards, where possible, for traditional and alternative health material remedies and practices; and
- To provide for the protection of Tanzanian medicinal plants, and other natural resources of medicinal value.

The *Act* provides for registration of all traditional health practitioners upon which they are entitled to engage in traditional and alternative health practices. The national law requires that practitioners in traditional medicine be registered with the Registrar of the Council.

3.2.2.3 Environmental Policies for Medicinal Plants

It is generally acknowledged that there is a close relationship between traditional health practices and the environment. Biodiversity is a major source of drugs and medicines that are used not only by traditional health practitioners but also those developed by pharmaceutical companies. The national environmental policies must ensure sustainable exploitation and use of medicinal plants in order to conserve them and prevent loss of biodiversity. Such loss more often leads to reduced access to local medicine among the poor.

3.2.2.4 Tanzania Patent Act

Since traditional medicine deals with indigenous knowledge and natural resources there has always been pressure to protect sources of knowledge and resources. *Tanzania Patent Act* of Parliament Act No. 1 of 1987 provides for such protection. Protection to traditional health practitioners is critical for the performance of the health system of innovation. The reasons for protecting Tanzania's traditional medicinal knowledge are as follows:

- To prevent misappropriation of traditional knowledge, that is, bio-piracy;
- To preserve traditional practices and cultures;
- To promote traditional knowledge and its importance in traditional medicine;

- To preserve medicinal plants, genetic resources and biodiversity;
- To promote fair and equitable distribution of the benefits derived from technologies and innovations based on traditional medicinal knowledge.

3.2.2.5 Tanzania Food, Drugs and Cosmetics Act

The Act of Parliament No. 1 of 2003 provides a legal framework for production, sale and consumption of food products and drugs including ‘herbal drug’ defined as “*any labeled preparation in pharmaceutical dosage form that contains as active ingredients one or more substances of natural origin that are derived from plants*”. Under Section 51(1) it gives the Tanzania Food and Drugs Authority (TFDA) power to approve the registration of herbal drug if it considers that:

- The availability of that drug is in the public interest;
- It is safe, efficacious and of acceptable quality;
- The premises and manufacturing operation comply with the current ‘good manufacturing practices’ requirements; and
- It complies with any other requirements as may be prescribed by the Authority.

3.2.3 Organizations

There are several active organizations responsible for supplying inputs (knowledge, products, processes and services) that are needed to sustain systems of innovation in the health sector. These include:

3.2.3.1 R & D Organizations

National Institute of Medical Research

The National Institute of Medical Research (NIMR) is at the centre of the national health innovation system in Tanzania. As noted above it is a parastatal service organization

under the Ministry of Health and Social Welfare established by the Act of Parliament No. 23 of 1979 following the breakdown of the East African Community. Its establishment was in recognition of the need to generate scientific data and information required in the development of better methods and techniques of enhancing disease management, prevention and control in the country.

The functions of the NIMR include the following:

- To carry out, and promote the carrying out of, medical research designed to alleviate disease among the people of Tanzania;
- *To carry out, and promote research into various aspects of local traditional medical practices for the purpose of facilitating the development and application of herbal medicine;*
- To monitor, control and coordinate medical research carried out within Tanzania, or elsewhere on behalf, or for the benefit, of the government of Tanzania, and to evaluate the findings of that medical research;
- To establish a system for registration of, and to register, the findings of medical research carried out within Tanzania, and promote the practical application of those findings for the purposes of improving or advancing the health and general welfare of the people of Tanzania.

The Institute's research activities are carried out at its headquarters in Dar es Salaam and in various research centres and stations often specializing in some specific diseases. NIMR has ordered its research priorities as follows: *Malaria, Filariasis, Trypanosomiasis, Onchocerciasis, Schistosomiasis*, and sexually transmitted infections including HIV/AIDS. While the focus is mainly on mainstream and conventional research on modern medicine the Institute has a unit specializing in traditional medicine. In collaboration with other research institutions such as Universities and Institute of Traditional Medicine, much progress has been made in the area with potential for medical innovations of far-reaching consequences on the welfare of majority of Tanzanians.

The Institute of Traditional Medicine

Established in 1974 as a Traditional Medicine Unit under then Faculty of Medicine, University of Dar es Salaam, the Unit was elevated to an Institute of Traditional Medicine in 1991 through an Act of Parliament No. 9 when the Faculty acquired a University College status, Muhimbili University College of Health Sciences (MUCHS). The Institute has been given the mandate to research into traditional healing systems in the country and identifying *materia medica* which can be modernized and developed into drugs and useful traditional healing practices which can be adopted for improvement of the health of the people. As such it stands at the forefront of the integration between modern and traditional health systems in the country.

The main functions of the Institute are:

- To promote the use of traditional medicines and traditional methods of healing;
- To promote commercial exploitation and conservation of medicinal plants;
- To contribute to the discovery of drugs;
- To contribute to the local production of pharmaceuticals; and
- To disseminate knowledge on traditional and plant derived medicines.

Ifakara Health Institute (IHI)

Ifakara Health Institute (IHI), formerly Ifakara Health Research and Development Centre (IHRDC), is an autonomous, non-profit, district-based health research and resource Institute has its headquarters located in Ifakara town in Kilombero district, Morogoro Region. It was established in 1956 as Field Laboratory for Basel-based Swiss Tropical Institute (STI) that grew into “Ifakara Centre”. In 1991 it became an affiliate of the National Institute of Medical Research (NIMR) and in 1996 it was registered as a Tanzanian Trust under the leadership of Board of Trustees chaired by the Ministry of Health. In 2008 it was renamed *Ifakara Health Institute*.

The Institute lists the following as its objectives:

- To develop and evaluate health system interventions to improve the coverage, quality, equity and efficiency and effectiveness;
- To evaluate interventions against diseases of public health importance;
- To understand health determinants of the leading public health problems;
- To monitor and evaluate the impact of national and global initiatives in improving population health;
- To promote evidence-based policy formulation and translate research results into public health action;
- To strengthen human resource capacity through executing joint training programmes with universities;

Specialty areas include entomology, malaria, schistosomiasis, socio-economic studies (e.g., monitoring and evaluation of voucher scheme for insecticide treated nets) and *traditional medicine*. Even though IHI receives funding from the government (Ministry of Health and the one responsible for Science and Technology) it constitutes less than 5 percent of total research expenditure. International donors are the major sources of funds for research. They include the World Bank, USAID, SIDA, DFID, among others.

3.2.3.2 Universities (public and private)

Medical universities and research units within them, and natural/physical science departments in universities are important sources knowledge useful in sustaining to innovations in the national health systems and with potential impact on poverty reduction. Muhimbili University of Health and Allied Sciences (MUHAS) especially its Institute of Traditional Medicine (ITM), has for long time been the main source of university-based medical research. Other medically-useful knowledge especially in the field of traditional medicine has been generated in the departments of chemistry and botany at the University of Dar es Salaam and Sokoine University of Agriculture (SUA).

Recently, however, a number of private medical universities have been established. These include: International Medical and Technology University (IMTU); Mikochei Mission Hospital's Hubert Kairuki Memorial University (HKMU); Kilimanjaro Christian Medical College of Tumaini University and Bugando University College of Health Sciences, raising the potential for privately funded medical research and its contribution to health systems of innovation. Together, the public and private universities constitute important potential sources of knowledge to feed into the health systems of innovation. Interestingly, traditional medicine has recently been attracting private and donor funded research thus contributing to product and process innovations.

3.2.3.3 Producers of Traditional medicines

Ngoka Herbal Products

This Moshi-based company is engaged in herbal product research and manufacturing for over ten years now with some interesting outcomes. Researches undertaken by the company has led to a number of interesting products that are being marketed in Tanzania and some neighboring countries. Even though it has identified more than 200 herbal medicines it is best known for its *Ngoka Eleven* which is claimed to cure numerous ailments. The company has sophisticated packaging technologies and aggressive marketing approach of its products including maintenance of website.

Its research activities include:

- Collecting information/data on medicinal plants and herbs
- Determining the curative ability of all medicinal plants and herbs
- Establishing that medicinal plants or practices do not produce side effects
- Establishing the chemical contents and intrinsic nutrients in plants and herbs

The example of this company is a clear potential for efficient and safe manufacturing of drugs from medicinal plants and mainstreaming this into modern health care system in Tanzania.

3.2.3.4 Donor Funded Projects

CINS-AAF Project

This is the project funded by the Italian Ministry of Foreign Affairs on the ‘Conservation and Valorization of Phyto-Genetic Resources and Traditional Medicinal Knowledge in Tanzania’ undertaken in collaboration with the National Institute of Medical Research (NIMR) and local traditional health practitioners. It is based in Ngongongare village, Arumeru district, Arusha (CINS-AAF, 2007). The objectives are contribution to poverty reduction and improvement of health conditions of local communities through knowledge, valorization and sustainable use of local biodiversity.

Tanga AIDS Working Group (TAWG)

This Tanga-based non-governmental organization is being hailed as a ‘success’ story of the attempt to integrate modern and traditional health practices. This collaborative venture brings together traditional healthcare practitioners (THPs) and their counterparts in modern healthcare practice (MHPs) to address HIV/AIDS pandemic in the region. In the project people living with HIV/AIDS (PLHA) are being handled by both groups and their progress carefully monitored. Patients are cross-referred between THPs and MHPs and knowledge shared among them about effectiveness of local remedies.

TAWG’s objectives are summarized as follows:

- To provide home-based care and support to people living with AIDS and their families;
- To prevent the spread of HIV through community-based educational programmes targeting vulnerable groups;
- To collaborate with traditional healers in prevention, care and research on traditional medicinal plants; and
- To provide guidance and assistance to other NGOs working on HIV/AIDS.

Emerging from the project is the need to integrate traditional healthcare practices into the modern healthcare system and in so doing enabling actors in traditional sector to enhance their knowledge while earning more income hence poverty reduction.

3.2.3.5 Financial Services Institutions

Unlike in industry or agricultural sectors where there are organizations offering specialized financial services there are no similar services to support innovations in the health sector. The participation of public and private financial organizations in promoting or supporting research in the health systems of innovation is lacking. A plausible explanation is that unlike in the other two sectors where one may claim to tangible product, product or process, in the medical research claim to intellectual property right can be quite cumbersome. It is much more difficult in traditional medicine with its diffused sources knowledge and uncertain claim to right of ownership of widely available plants and herbs.

3.2.3.6 Practitioners Associations

With such large number of practitioners, 75,000-80,000, and working in wide ranging conditions often in isolation from one another support organizations have important role to play in the process. In this connection knowledge/information sharing among stakeholders is crucial in sustaining the system. So far few such organizations have emerged to provide the much needed services.

CHAWATIATA

Chama cha Waganga na Wakunga wa Jadi Tiba Asilia Tanzania, or CHAWATIATA, is an umbrella organization for traditional health practitioners in Tanzania. It serves as a link not only among practitioners but also between traditional and modern health practices. It is proving quite useful in not only promoting traditional medicine but also in

ongoing integration efforts. The main goals of the organization are summarized as follows:

- a) To coordinate all traditional healers using means to improve the wellbeing of the people;
- b) To protect, promote, maintain and increase the general knowledge of services provided in traditional health care;
- c) To ensure that regulations in traditional healing and medicine are maintained;
- d) To reunite traditional healers and to bring them in contact with modern doctors through meetings and discourses and to enhance the views and knowledge to clear any misunderstandings between them;
- e) To protect the rights and gains of the members as well as that of the clients who should be informed of the merits and disadvantages of traditional medicine and healing;
- f) To enhance research in cooperation with the government and other organizations so as to promote traditional medicine and healing;
- g) To protect and recognize the rights of origin of the medicines on which research is done and to check on any misuse out of greediness or dishonesty; and
- h) To improve the usage of traditional medicine and healing and coordinate activities involving storage, cultivation and preparation of herbal medicine.

3.2.4 Assessment and Observations

What emerges from the discussion above is the fact that traditional medicine which is part and parcel of the national health systems of innovation has recently undergone some interesting developments. Its possible integration in the national health system though challenging, seems to be possible, especially considering the following elements (as identified WHO 2000) as possible requirements for integration: access to information by practitioners, patients and governments; appropriateness and vigor in clinical trials (to ensure safety in the use of traditional medicine); collaboration between practitioners and researchers; and level of respect for traditional practices in research. In the following

discussion three aspects of the systems are singled out for analysis and assessment: Policies and Regulations, Organizations and actors and their activities and interactions.

It should be noted that modern and traditional health practices have operated side by side as separate entities for a long time with little or no connection between them. No wonder that recent attempts to integrate the two are being met with skepticism from both sides. On the one hand, policies and regulations have not come out clearly to support or facilitate the process of integration and coordination between the two sides. There is concern that although for example, the Traditional and Alternative Medicine Act has been in place for the past ten years, and its objectives are advocating for the safe use of traditional medicine, there is no clear strategy to disseminate information on the contents of the Act especially its aims and objectives to practitioners. The implementation of various other laws, e.g., patent, food and drug laws, is proving difficult further complicating the integration process. Furthermore, there is concern that the process of integration and interaction among the actors has not been stipulated in policy and regulations. In fact the majority of traditional health practitioners are working in isolation from each other and being protective of their knowledge on medicinal plants and herbs, and the practice itself being location or community-specific.

On the part of actors, when compared with the other two systems of innovation, health systems of innovation is faced with dearth of actors devoted to traditional health practices – for one thing, there is only one national institution specializing in research on traditional medicine per se. Most of the other actors are university-based as part of education and training, mainly in modern medicine or natural sciences: medical schools teaching and research are specializing in conventional, modern medicine and researches are mostly likely to concentrate on similar issues; and science departments are facing more or less similar predicaments especially considering shortage of funding sources. On the other hand those outside the university system are undertaking traditional medicine research as a marginal activity.

Although this only one national traditional research institute has adequate staffing and facilities to enable it to approach traditional healthcare in a systematic, scientific manner, for a country where the use of traditional medicine is increasingly popular alternative to most people, the scale of ongoing activities is very far from being adequate. At the same time organizations offering support services including training and commercialization process that is necessary for the innovative system to be sustained are largely missing.

While the potential for enhanced activities is in place, more is needed to be done if the integration process is to succeed. At the moment it seems the efforts are scattered between research organizations, universities and practitioners of traditional medicine; and very little effort on the part of the pharmaceutical companies. Most of these companies are concentrated in the manufacturing of generic drugs. Concerted effort has yet to be made to encourage the companies to invest in the manufacturing of drugs that are the result of the national R&D outputs. Part II of the study will venture into factors that are hampering possible integration between modern and traditional medicine, particularly focusing on the health care providers in both the modern and traditional sectors.

3.3 Industrial (Manufacturing) Systems of Innovation

3.3.1 Introduction

Tanzania is a late comer to the process of industrialization. First steps towards industrialization were taken after World War II in the form of processing of primary products for export markets and with some manufacturing of simple consumer goods for the local market expanding in the mid-1950s (Rweyemamu, 1973, AfDB/OECD, 2006). The manufacturing sector contributed 3.5 percent to GDP at factor cost in 1961 (Central Statistical Bureau, 1964). The manufacturing sector grew respectably in the 1960s and 1970s albeit from a very low level, stagnated in the 1980s and began to recover in the 1990s. During 1990-2008 the sector grew at an average of 7%. (Economic Survey, various years). However, despite this, the impact on employment and incomes has

remained small, partly because of its small size and limited linkage with the rest of the economy; especially the agricultural sector.

Tanzania Development Vision 2025 seeks to transform the economy from a low productivity agricultural economy to a semi-industrialized one with a modern agriculture by 2025. Advancing industrial development along the lines stipulated in Vision 2025 and in the Sustainable Industrial Development Policy requires concerted efforts to improve the operating environment of the sector and its innovation system. In this context, this study addresses the knowledge and innovation in technology, institutions, policies and relevant organizations as stipulated in the sectoral system of innovation. During this phase, the analysis of the existing system of innovations is limited to the supply side of innovation equation.

In the following sections we will map out and analyze the two major aspects of the system: First, we will map and analyze policies and regulations enacted to increase the performance of the manufacturing sector. Secondly, we will map the actors in the form of organizations and their activities in the manufacturing sectoral system of innovation and make an assessment and observations on the likelihood that the system is adequately placed to enhance innovative activities of firms.

3.3.2 Policies and Regulations

Important policies which are influencing the development of the manufacturing sector are specifically the Sustainable Industrial Development Policy (1996) and the SME Development Policy (2003).

3.3.2.1 The Sustainable Industrial Development Policy (SIDP)

The expiry of the Basic Industrial Strategy (BIS) in 1995 and the fact that the macroeconomic policy environment and the approach to economic management had changed substantially necessitated the formulation of a new policy that would take

cognizance of the new policy environment. For instance, the government has made a major policy shift from state led industrialization to industrialization in a private sector driven market economy. It is in this context that the Sustainable Industrial Development Policy (SIDP) was designed and launched for implementation over a twenty-five year period 1996 – 2020.

The objectives of the new policy include overall contribution towards human development and creation of employment opportunities; economic transformation for achieving sustainable economic growth, external balance of payments; environmental sustainability and equitable development. The SIDP was to be implemented in three phases. Phase I (1996-2000) contained a short term priority programme focusing on rehabilitation and consolidation of existing industrial capacities through restructuring including divestiture. Phase II (2000-2010) is a medium term priority programme paying attention to creation of new capacities in areas with potential for creating competitive advantages through the application of efficient technologies and adopting processes of learning. In this phase promotion of intermediate goods and light capital goods was to be initiated. Phase III (2010-2020) would be devoted to a long term priority to fully fledged investments in basic capital goods industries with a view to ensuring sustainability and consolidation of the industrial structures developed in the first two phases.

The private sector was assigned a central role in the implementation and realization of the SIDP's objectives and goals consistent with the reformed economic management system. The role of the government would be to provide a conducive environment for the nascent domestic private sector to make investments, ensure fair competition and develop the necessary social and economic infrastructure for the private sector to function effectively. It was recognized that to implement SIDP will require that capacity and capabilities of government and the private sector needed to be strengthened.

Furthermore, SIDP contained promising statements on the enhancement of sustainable competitive technological progress through strengthening the basic scientific research

and development (R&D) activities and its linkage to the industrial sector. In this regard, SIDP proceeds to propose the following as a way to address the linkage problem:

- Promote R&D organizations with adequate and highly trained human and financial resources, infrastructural facilities and schemes for retention of technical experts;
- Facilitate effective rationalization and synchronization of R&D organizations' activities;
- Articulate areas for collaboration through a mutual mechanism between manufacturers and the local R&D network, particularly regarding financing and management of R&D organizations (section 3.4.13 of SIDP, pp. 30-31).

The policy also recognizes the role of standards and quality assurance in sustaining competitiveness of industrial firms. In section 3.4.7, (pp. 22) it is stated that in order to improve competitiveness of industrial products, both in domestic and export markets, the government will do the following:

- a) strengthen the implementation of national standards and quality assurance as well as weights and measures (metrology) by provision of more legal power, adequate facilities and equipment and manpower;
- b) promote the formulation of new standards;
- c) allow qualified quality assurance units through ways of accreditation in areas of specialization;
- d) Develop the packaging technology.

3.3.2.2 National SME Policy

The SME policy has a vision to realize a vibrant and dynamic SME sector that utilizes domestic resources with a view to attaining accelerated and sustainable growth. The policy had a mission of stimulating SME growth and development and achieving competitiveness. The objective of the SME policy is to create jobs, generate incomes and attain competitiveness. The policy envisages removing discrimination against SMEs, enhancing the growth of SMEs, facilitating the provision of services, promoting the

development and institutionalization of public-private partnership and clarifying the roles of various key actors. The policy aims to create an environment in which SMEs and households can participate in viable productive activities of their choice by responding to labour or product market opportunities rooted in a globalising economy.

The policy has quite a number of policy statements and strategies for achieving growth and competitiveness in this sector. The most relevant ones relate to technology, marketing and training.

Technology

The government recognizes the role of technology and innovation and proceeds to state: “Government will facilitate acquisition and adaptation of technologies as well as enhance networking between R&D institutions and SMEs in a bid to upgrade technologies. The policy document identifies the following strategies to realize the policy statement:

- Establish the mechanism for enhancing networking between SMEs and technology providers;
- Facilitating joint ventures aimed at technology upgrading and transfers;
- Facilitate capacity building of industrial support organizations and other service providers;
- Facilitate establishment of innovation incubators.

Marketing

The policy statement indicates that the government is committed to facilitating support programs aimed at improving SMEs access to markets using the following strategies:

- (i) Promote business linkages between large and small enterprises;
- (ii) Strengthen marketing agencies and institutions that support SMEs;
- (iii) Create SMEs bulk provision systems through cooperative mechanisms;
- (iv) Facilitate SME participation in local and international markets through trade fairs and missions;
- (v) Facilitate SMEs to meet standards;
- (vi) Establish exhibition centers;

(vii) Facilitate training in trade issues

(viii) Facilitate SME benefit from government procurement needs and activities.

Training

In recognition of weak human capacities in business development in the sector, the policy expressed commitment to enhance the capacity of institutions providing business training to SMEs; and the following are strategies to achieve this:

- Embark on capacity building of business training institutions aimed at improving quality of service provided
- Facilitate tailor-made business training programmes for startups and for strengthening existing businesses.

3.3.3 Organizations

This section examines the types of organizations that are closely related to the manufacturing sector such as the R&D other service organization, training, professional organizations and financial institutions.

3.3.3.1 R&D Organizations

There are four R&D organizations established for the purpose of servicing the industrial sector. Three public R&D organizations put in place by the Acts of the parliament, and a university based center. In the following paragraphs we present these.

Tanzania Industrial Research and Development Organisation

Tanzania Industrial Research and Development Organization (TIRDO) is a parastatal organisation established in 1979 with the purpose of conducting industrial research and offering consultancy services to industries. The core of TIRDO's operations had been to promote technology utilisation in economic ventures, encouraging use of indigenous raw materials, engaging in energy saving innovations, and designing, fabricating and testing

industrial parts using local materials. TIRDO's main services to industry are in the field of instrumentation, maintenance and repair, chemical analysis, energy management, material and property testing; trouble shooting and advisory services; cleaner production techniques; welding and fabrication and provision of industrial information

Centre for Agricultural Mechanisation and Rural Technology

Centre for Agricultural Mechanization and Rural Technology (CAMARTEC) is a parastatal organisation under the Ministry of Industries, Trade and Marketing with its headquarter in Arusha. It was established in 1981. It aims to improve rural life through development, adaptation and implementation of appropriate technologies in the field of agricultural mechanisation, water supply, building construction and sanitation, rural transport and energy. CAMARTEC carries out applied research to facilitate the designing, adaptation and development of machinery and equipment suitable for use in agricultural sector and rural development. Other aims of CAMARTEC include developing and manufacturing approved prototypes and components of farm implements, and evaluating their suitability for local use; performing tests on all types of machinery and equipment intended for use in agricultural and rural development in the country. It also offers consultancy services on designing, testing and other technical aspects of agricultural mechanisation.

Tanzania Engineering and Manufacturing Design Organization

Tanzania Engineering and Manufacturing Design Organization (TEMDO) was established under the Act of Parliament No. 23 of 1980, and became operational in June 1982. It is charged with the task of designing and promoting engineering equipment and services as well as providing technical extension services including training aimed at increasing the technical skills of workers at all levels and all establishments in the country and enabling industry to produce new products and processes for commercial manufacturing.

The Technology Development and Transfer Centre

Technology Development and Transfer Centre (TDTC) is a center for technology transfer within the College of Engineering and Technology (CoET), University of Dar es salaam. The center emanated from the semi-autonomous Institute of Production Innovation (IPI) within the University. IPI was established in 1981 in accordance with the provision of the University of Dar es Salaam (UDSM) Act of 1970. The mandate of the centre is to carry out product innovations up to the stage of marketable prototypes and subsequent transfer to industry. Currently, the thrust of the work of the centre is to provide technological support especially to small and micro enterprises.

3.3.3.2 Business Development and Regulation Services Organizations

Small Industries Development Organisation

Since its establishment in 1973 Small Industries Development Organization (SIDO) has been the leading business advisory services providers for small and micro-enterprises in the country. For the past 36 years of its existence, it has been the only institution advocating for SME's development in the country. It has a credit channel for lending to SME's. SIDO also is engaged in capacity building, training and consultancy (mainly providing technological services) to micro-enterprises. SIDO has its headquarters in Dar es Salaam that does the thinking, planning and overall management as well as procurement and clearance of imports for twenty regional offices. Besides, SIDO has industrial clusters in 16 regional centres, although some of the clusters are at the moment not operational. Some of these clusters e.g., Dar es Salaam and Arusha are well equipped and serviced with all necessary industrial supportive infrastructures.

Business Registrations and Licensing Agency

Business Registration and Licensing Agency (BRELA) is a semi-autonomous agency in the Ministry of Industry and Trade. It is responsible for business facilitation and regulation. Specifically, BRELA's main functions include registration of companies; registration of business names and registration and granting of patents. Others include

overseeing copyrights and neighbouring rights administration as well as business and industrial licensing.

Tanzania Bureau of Standards

Tanzania Bureau of Standards (TBS) was established by Act of Parliament in 1975 which was subsequently amended in 1977. It is a specialised parastatal organisation servicing in the field of standardisation, certification, quality assurance, metrology service and training in standardization and quality control.

It has well equipped laboratories for testing chemicals, materials, food, metrology, textile and leather goods. So far TBS has published more than 500 standards and has issued more than 150 licenses to local manufacturers. Following are main functions of TBS:

- Formulation and promulgation of Tanzania Standards in all sectors of the economy.
- To implement the promulgated standards through third party certification schemes.
- To improve the quality of industrial products both for export and domestic consumption through various certification schemes like pre-export/pre-import inspection and testing, the tested product certification scheme and quality system registration.
- To promote standardization and quality assurance, quality improvement and laboratory techniques.
- To test product samples drawn by TBS inspectors in the course of implementing standards (certification samples) or requested by manufacturers (type-testing samples)
- To undertake calibration of industrial and commercial measuring equipment and instruments in the area of mass, length, volume, energy, temperature, etc.

3.3.3.3 Training Organizations

Training of human resources for the manufacturing sector is carried out at the Universities, Technical colleges and the artisan level.

Training at the level of universities takes place in all universities (public and private) in the country although the bulk of the degree level technical personnel come from the University of Dares salaam and Dares Salaam Institute of technology. Training of technicians takes place in several Technical Training Colleges in dares Salaam, Arusha and Mbeya. Training at the level of artisans is provided by training centres under the public owned Vocational Education Training Authority (VETA) as well as in many private sector training institutes. In the past (two decades ago) each major industry used to have its own training centre to develop specialized human resources for its own sector. Examples of these were Saruji Training Institute for the cement industry and Sugar Training Institute for the sugar industry. However, these institutes are no longer functional.

3.3.3.4 Professional Associations

Confederation of Tanzania Industries

Confederation of Tanzania Industries (CTI) is an independent, self financed, legally constituted non-governmental organization that serves its members by speaking out on their behalf and generally representing their interests. It was launched in 1991 with the aim of ensuring that there is a conducive legal, financial and economic environment within which industry can operate effectively, compete, prosper and contribute to national wealth creation and development. The present membership of CTI embraces the following categories:

- Manufacturing, Processing and Assembling Companies;
- Communication, Construction and Consultancies;
- Finance and Hospitality industries (Hotel and Tourism);
- Media and Information

- Technology, Transportation and Utilities.

The Following are specific objectives of CTI:

- To present the views of members, and co-operate with the government of the day, local government authorities and other bodies essential to the industry;
- To promote a competitive business environment in Tanzania in which sustained development is possible;
- To act as a primary source of information about manufacturing and associated industries for its members, the government, potential investors and media;
- To collect, disseminate and make available statistics and other information on matters affecting or concerning the industry;
- To gather and maintain information from the members in regard to matters related to industry for subsequent translation into policies;
- Encourage and promote membership in CTI and ensure that the organization is adequately financed.

As can be noted from above, CTI does not explicitly state its involvement in the innovative activities of its members as industrial firms, although in a way this is implied in the above general objectives. However, CTI awards prizes to the best performers in product innovations. The signal conveyed here is that innovations are important although there is no mechanism in place with CTI of promoting innovations.

Specific Subsector Associations

There are sub-sectoral professional associations catering for specific needs of the respective sub-sectors within the manufacturing sector. Their mandate is very similar to that of CTI in their own sub-sectors. Examples of these sub-sector associations are Edible Oil Manufacturers Association; Soap and Detergents Manufacturers Association; Motor Vehicle Body Builders Association; Textile Manufacturers Association; and Iron and Steel Association.

3.3.3.5 Financial Institutions

Financial institutions here include all the Commercial Banks. It also includes other forms of finance for small entrepreneurs discussed for agriculture. Worth of mention here is the Tanzania Gatsby Trust (TGT), which is a charitable organization, established in 1992. The trust is committed to the support of SMEs and the alleviation of poverty in Tanzania through credit provision, marketing development training and technology transfer. TGT receives funding from the Gatsby Charitable Foundation and the Ashden Trust of the United Kingdom. The Tanzania Investment Bank which specializes in development financing is being revamped so it can effectively provide investment finance.

3.3.4 Assessment and Observations

The assessment and observations of policies and regulations and supply side actors and their activities as well as their interactions is carried out based on the conceptual framework developed in section 2 and contents of section 3.3. The actors and their activities are assessed in terms of how well they fill all the necessary gaps in the system of innovation while the policies and regulations are assessed in terms of building the capabilities of the actors and facilitating and coordinating the interaction among actors.

Policies and Regulations

The assessment and observations on policies and regulations are based on their content in terms of coverage and likeliness to influence the development of technological capabilities of individual organizations and linkage facilitation. In this regard, there are several concerns and observations to be made here:

- First, the emphasis of Sustainable Industrial Development Policy (SIDP) on structural transformation of the economy is commendable. However, its concern over shifting from production of the consumer goods to the production of the producer goods leaves the balance between the two categories of goods unclear.
- Secondly, in the phase of trade liberalization the policies and regulations do not come out clearly on how to strike a balance between permitting competition with

imports in order to promote competitiveness is not balanced appropriately with the need for selective protection from imports in order to permit firms to develop their capacity to compete. Many industries have suffered considerably from imports and domestic innovative activities have been deterred in the process. The policy has not come out clearly on how it is to enhance sustainable competitive technological progress.

- Thirdly, the policies and regulations have identified strengthening of the basic scientific research and development (R&D) activities as one of the top priorities and they recognize challenge of forging linkages between industrial firms and R&D organizations. However, the policies address this challenge by emphasizing the role of basic research (SIDP, 1996 pp. 30-31). The policy does not recognize other factors influencing these linkages. Some of these factors are discussed in Wangwe, et al. 1998).
- Fourthly, the SME policy is well meaning and is geared to facilitating the development of SMEs in many useful ways. However, there is concern that its implementation is either faltering or is being unduly delayed since 2003.

Organizations

The assessment shows that the manufacturing sector has all the important organizations that are essential for the systems of innovation, which include R&D organizations, training organizations, business development and regulatory organizations, professional associations and financial institutions.

However, there are concerns to be addressed and observations to be made.

- First, there is concern that the Acts establishing most of the R&D organizations have not been reviewed since they were established in the early 1980s where the government was the major investor and economy was being managed along the lines of central planning, import controls and public sector led development. Under these circumstances the R&D organizations and the industrial firms under the same owner were institutionally linked and firms approached R&D organizations to solve their technological problems. The existing R&D

organizations were set up with the major objectives of developing new technologies. However because of the excessive reliance on the traditional linear model of innovation, most of the prototypes developed by these institutions have not made their way to commercialization (Wangwe, et al., 1998). In the post liberalisation era, even the development of prototypes has slowed down as R&D institutions have faced financial constraints and are being forced to diversify into other income generating activities such as consultancy services. In 1998 the government categorically advised these institutions to restructure in line with the free market economy in order to be raise their levels of self reliance. However there is concern that this approach may distort their orientation towards technological innovations and further undermine their role in the system of innovations.

- There is concern that under the new conditions of private sector led development, market oriented economy and trade liberalization the mandate and activities of R&D organizations needed to be reviewed and redefined.
- Secondly, it has been observed that there is no clear demarcation and linkage between university-based research and activities of R&D organizations. The anticipation is that a university, being a centre of excellence in research, will have activities different from but complementing those of the R&D organizations. According to Mwamila et al., (2009) the society expects the work of the university to be unique, distinguishable from the work of any other organization. However, there is no policy designed to promote the linkage between the universities and R&D organizations; and how together the two entities can - through synergy - influence innovative activities of firms.
- Thirdly, there is concern that SIDO and the Act establishing it have not been comprehensively reviewed to cope with the emergence of new players in the private sector and the market oriented approach to economic management. It is expected that the on-going study on revisiting the structure SIDO and its Act will address this challenge.
- Fourthly, there is concern that while technological innovations are a major driver of competitiveness, the organizations in the business development organizations

like SIDO and professional associations like CTI would be expected to have strong technology development departments. SIDO also is engaged in capacity building, training and consultancy to micro-enterprises. Its strength in regard to technological innovations is questionable. CTI has made a positive move to award innovative firms but there is concern that it does not have a department or mechanism for facilitating and promoting innovations development. This observation is corroborated by the fact that the objectives of CTI are geared more towards lobbying and advocacy than facilitation of innovative activities of its members. CTI has taken a positive step to start an initiative for developing linkages with SMEs. However, this initiative has not been defined clearly as a means for the promotion of subcontracting and technology transfer and as a driver of growth and competitiveness.

- Fifthly, The Business Registrations and Licensing Agency (BRELA) has been doing a commendable job in reducing the time it takes to grant licences and is engaged in granting and enforcing patents rights. However, it is not clear how it is geared to facilitating the development of patents in the first place or how it relates to innovative activities of firms.
- Sixthly, TBS is assessed in terms of the role of standards and its functions. The role of standards in innovative activities has three components: material or substance; concept, norm, or principle; and written definition, limit, or rule approved and monitored for compliance. In this regard, standards are a form of embodied technical knowledge accessible to all types of business for more effective product and process development. Standards are a core part of the infrastructure that supports efficient innovation through codified information and diffusing technological knowledge to firms. The assessment of TBS indicates that there limitations in its capacity to use standards to support innovative activities. However, if its objectives and functions are fully implemented along the lines suggested here, TBS has great potential to influence innovative activities in Tanzania.
- Seventhly, financial institutions are performing very well for industrial and technological development. There are general credit limitations in financial

institutions, especially the banking sector to the manufacturing firms for both investment and working capital but more so for investment finance. Credit is still costly with interest rates hovering around 15-20%. In the absence of finance at competitive cost, many firms are severely constrained in their ability to make investments which are needed for firm level competitiveness to be built. Three related observations are in order:

- Investment finance suffered greatly when TIB was restructured towards merchant banking leaving a vacuum in investment finance.
- There is concern that the existing financial instruments and products are not diversified sufficiently to address the needs of industrial enterprises (micro, small, medium and large).
- There is concern that the linkages which TIB had with the international development finance institutions in the 1970s and 1980s facilitated its capacity to screen, evaluate and implement viable projects.

However, with the severance of these linkages the capacity to mobilize international finance is not sufficiently anchored in any institution. It is hoped that the on-going second generation financial sector reform and the revamping of the Tanzania Investment bank will go a long way in addressing these challenges.

3.4 Cross-Cutting Issues

3.4.1 Introduction

In this section we will review policies and organizations that cut across all the three sectors.

3.4.2 Policies and regulations

3.4.2.1 Introduction

Three policies are selected here for their relevance to the national system of innovation. These are: the National Investment Policy, Trade Policy, the economic empowerment policy and the National Science and Technology Policy. The experience elsewhere points to the role these policies play in boosting innovative activities and competitiveness among national firms and farms (see for instance, OECD, 2008: <http://OECD.org/trade>). This is largely through export where national firms learn from sophisticated buyers, and incentives through expansion of markets for the products. Investments are a major source of technology development.

3.4.2.2 The National Investment Policy

The national investment policy (1997) stresses the role of technology and innovation by encouraging the transfer of appropriate technologies and human resource development, including the enlargement and development of local scientific technological capacity with a view to transforming Tanzania from rural based subsistence agricultural economy to more diversified industrialized one.

The objectives of the policy in relation to technology innovations is to encourage and facilitate the adoption of new technologies in activities that especially have direct bearing on productivity, quality and increased competitiveness and to encourage the development of local capacities in the field of science and technology, and transfer of appropriate and new technology. The objectives also stress the promotion of linkages among various economic sectors involved in the production of goods and services.

The policy document presents five strategies for the implementation. These are: provision of effective and efficient institutional framework; provision of fiscal and non fiscal incentives; provision of the legal framework; provision of adequate and reliable

infrastructure; and encouraging growth of export. Among the strategies outlined by the policy, the following strategies have been identified here as most likely to impact positively on the innovative activities of firms:

- The strategy that relates to the role of the strategy to make sure that the Authority facilitates investment through the provision of assistance in the sourcing of finance in forming joint ventures and making other business arrangement.
- The strategy relating to fiscal incentives that would stimulate sectoral linkages as well as adaptation of new technologies with priority accorded to investment with significant export orientation, local employment and the use of domestic materials and resources.
- The strategy to promote sectoral linkages. For the purpose of this study, the policy should have the strategy to promote linkages between agriculture, health and industry.

3.4.2.3 National Trade Policy

The major aim of the National Trade Policy (2003) is to influence the direction and pattern of the trade development, with vision to transform the economy from a supply constrained one into a competitive export led economy. The objective is to raise the level of efficiency, widen linkages in domestic production and build a diversified competitive export sector for growth and development.

The specific objectives are:

- 1) Establish an improved physical market place infrastructure and stimulate dissemination of market information and increasing access to markets;
- 2) Embark on economic transformation towards an integrated, diversified and competitive entity capable of participating effectively in the MTS;

- 3) Stimulate and develop value adding activities as a means of increasing incomes from primary products;
- 4) Stimulate investment flows into export oriented areas which have comparative advantages with a view to inducing technology and innovations in the production system;
- 5) Attain and maintain positive balance of payments by increasing export and higher efficiency in the utilization of imports.

The application of trade policy instrument is guided by the need to stimulate domestic production, promote export, safeguard domestic industry against dumping practices and protect consumers. The main instruments in use are tariffs, the Duty Draw-Back (DDB) Scheme and Export Development and Promotion. The instrument are expected to facilitate capacity building for providing supporting export development services such as market research, demand surveys, market and product adaptation, prices and quality delivery systems.

3.4.2.4 National Economic Empowerment Policy

The Economic Empowerment Policy was formulated in 2004 and is being implemented through the Economic Empowerment Act of 2004. The main objective of the economic empowerment initiatives is to address barriers to economic empowerment of the disadvantaged Tanzanians and enable them to effectively participate in their own economic development and the national economic development in general.

These economic empowerment measures that have been proposed include support in the area of technology development and innovations.

3.4.2.5 National Science and Technology Policy

The national Science and Technology Policy contains broad general objectives as well as specific objective for the respective sectors. The S&T broad policy objectives and strategies put emphasis on the technology development appropriate for the economy and provide the institutional and legal framework and linkages that would facilitate the implementation.

The institutional and legal framework that is provided for in the policy includes the following:

- Science and technology adviser to the president;
- Science and Technology Committees which will be responsible for the analysis of science and technology needs in their relevant areas of competence, identifying priorities and resource requirements. The committees include:
 - Cabinet Committee on Science and Technology
 - Inter-ministerial Technical Committee on Science and Technology
 - Parliamentary Committee on Science and technology
 - Village, Districts and Regional Science and Technology Committee.
- A defined legal framework to facilitate harmonious functioning of all institutions dealing with the promotion, development, transfer and utilization of science and technology.
- Defined structural and functional linkages to harmonize and synchronize all the functions of various S&T institutions.

3.4.3 Organizations

3.4.3.1 Tanzania Commission for Science and Technology

Tanzania Commission for S&T (COSTECH) is an advisory body to the government and other stakeholders on the process S&T policy formulation and implementation. COSTECH also has the mandate of co-coordinating all the R&D activities being undertaken in the country.

3.4.3.2 Training Institutions

There has been rapid expansion of tertiary education and secondary education. The expansion of technical education and vocational education and training has increased too though at a slower rate. Industry specific training institutes which were established under specific public sector parastatal organizations have been closed following privatization. Even then the institutes had been geared to cater for basic and low level skills oriented towards operation of existing plant rather than for adaptations, innovations and improvements on imported technology. With regard to training, it seems that Tanzanian firms do not attach due importance to training, especially formal and long term training for the low cadre employees. In many companies little thought is given to designing training programmes for employees in the less tangible measurable outputs such as quality control and maintenance personnel.

Three challenges remain in this education and training. First, is the challenge of quality education as opposed to quantity. Second, is the challenge of expanding technical and artisan level technical training to match the degree level of training that is being offered. This imbalance is aggravated by the recent cases of conversion and upgrading of training institutions at technical and diploma level to universities at the risk of leaving a human resource gap in that middle level of training. Third, is the challenge of providing training that is consistent with human resource requirements for the development challenges of

the economy. For instance sectors which have grown fast recently such tourism and mining have outstripped the rate of expansion of trained personnel.

3.4.3.3 Tanzania Investment centre

Tanzania Investment Centre (TIC) was established in 1997 by an Act of Parliament. Its main objective is to be a primary agency of Government to co-ordinate, encourage, promote and facilitate investment in Tanzania.

Under normal circumstances, investors conduct private cost-benefit analysis to determine profitability of alternative investment options.

The role of TIC is to receive and process project applications from potential investors. Before approving projects TIC is required to make sure that specific criteria are met. After approval TIC is required to stipulate post-investment measures to ascertain whether the approved investors are doing what the application said they would do and to provide feedback on fulfilling investment goals and aspirations. TIC is also required ascertain that investments are consistent with national goals (Tanzania Vision 2025 and MKUKUTA) in terms of employment, output, consumption, savings, foreign exchange earnings, income distribution and other important national objectives. In addition, TIC must be satisfied that investments contribute skills development, technology development and technology transfer, managerial techniques and linkages with other sectors of the economy.

In the case of FDI, TIC is supposed to check that the investment does not crowd out local investors and local skills.

TIC is also responsible for monitoring the post-investment operations to ensure that three objectives are met. Firstly, to ascertain whether the approved investors are operating according to the investment certificate. Secondly, to provide feedback on fulfilling investment goals and aspirations. Thirdly, to provide opportunity for closer co-operation between TIC and investors in resolving operational challenges so as to foster greater impact of investments.

3.4.3.4 Board of External Trade

Tanzania established the Board of External Trade (BET) in the 1980's to perform these export promotion function.

3.4.3.5 Tanzania Private Sector Foundation

The establishment of TPSF in 1998 came after consultations among a diversity of private sector actors. The Foundation groups all private sector business organisations, economic NGOs and key public institutions established to spearhead the development initiatives of the private sector in Tanzania. The Foundation is voluntary, consultative and charitable. Tanzania Private Sector Foundation is the apex private sector with members from other associations in the sector. TPSF provides a forum for addressing issues pertaining to private sector development in Tanzania. Hence the purpose of the Foundation is to contribute to the collective socio-economic development efforts in Tanzania by providing member associations with needed services, and acting as a platform for the business community to engage in productive dialogue with the government. In this way the business community is able to influence public policy and contribute to improving the business environment.

3.4.3.6 Tanzania National Business Council

The Tanzania National Business Council (TNBC) was established in April 2001 and operationalised in March 2002 as an independent forum for dialogue, consultation and addressing of constraints to investment and development of a strong and competitive economy in Tanzania. The ultimate aim is to create a conducive environment for private sector led development. The TNBC provides a forum for public/private sector dialogue with a view to reaching consensus and mutual understanding on strategic issues relating to the efficient management of development resources in Tanzania and to promote the goals of economic growth with social equity and even development. TNBC also reviews and proposes changes in the policy environment to enhance the attractiveness of

Tanzania products in the world market, an attribute which is driven by technological innovations.

3.4.3.7 Banks and Other Financial Institutions

The number of banks and financial institutions has increased tremendously in Tanzania in the past decade following financial sector liberalization. The new banks are diversifying their financial products and are beginning to finance investments but the scale of such operations is still small. Many investors in technology and long term investments are still not having adequate access to the banking and financial services.

3.4.4 Assessment and Observations

3.4.4.1 Policies and regulations

The policies and regulations cutting across sectors are supposed to facilitate linkages within the STI system. Indeed it has been observed that the policies and regulations state that they are encouraging linkages among system actors. The investment policy for instance stresses the issue of linkage in its objectives; most importantly it stresses the much needed linkage between the industrial and agricultural sector by emphasizing establishment and promotion of agro-processing. In addition the policy stresses the promotion of joint ventures which is one way of facilitating linkage between and among firms. Furthermore, in its incentive structures, the investment policy provides for fiscal incentives for those investments that are associated with high levels of sectoral linkages.

However, there is concern that the investment policy is not clear about promotion of linkages between foreign direct investment (FDI) and domestic investment especially for purposes of facilitating national firms to access knowledge or information on technology. Such technology spillovers from foreign countries can be important for transferring technology and knowhow to domestic firms thereby increasing productivity levels.

The National Trade Policy encourages investment in technology as well as sectoral linkages when it states that the government will raise efficiency and widening linkage in the domestic production and building a diversified competitive export sector as the means of stimulating higher rates of growth and development. It also states that the government will stimulate and encourage value adding activities in primary exports as a means of increasing the value incomes from those activities.

The national economic empowerment policy (2004) has not really taken off as implementation has been delayed. There is concern that implementations need to begin soon and its mainstreaming in all sectors where the indigenous groups are operating deserves priority. Little or no progress has been made in terms of pursuing implementation of the national economic empowerment policy, developing the SME sector or paying attention to the transformation of the large informal economy into vibrant private sector activities.

There is concern that much of the cross cutting policies relating to investment, trade and S&T are encouraging the promotion of efficiency and competitiveness as well as linkages, they have not specified mechanisms for developing the capability of firms with a view to making them competitive exporters into the region and the world market.

3.4.4.2 Organizations

The organizations that cut across sectors have exhibited wide coverage of what is required for a functioning national system of innovations. However, their effectiveness is impaired by lack of adequate funding. There was supposed to be a financial facility committed to innovation in technology but such a facility has not been put in place. The only funding available to R&D and the innovation process is from government and donors. The government's contributions have been too low following years of structural adjustment policies and cut back on public expenditure. The bulk of finances for R&D (about 70%) have been coming from donors. The recent announcement by the President

that allocation to science and technology should be increased from the current 0.3% of the GDP to 1% is a positive move. The improved funding of S&T should reduce the gravity of this problem. However, there is a further challenge in determining priorities for the use of the funds and for coming up with S&P programmes which can stimulate innovations and competitiveness of the actors especially the firms.

Tanzania Investment Centre has responsibility to co-ordinate, encourage, promote and facilitate investment in Tanzania and to ensure that investments are consistent with the national goals both at the pre-and post-investment stages. The fact that it is specifically stated that TIC must ensure that investments contribute skills development, technology development and technology transfer, managerial techniques and linkages with other sectors of the economy is commendable. However, there is concern that in practice TIC has not developed the capacity required to monitor considerations technology and related post-investment operations. The second concern is that TIC has developed capacity to process FDI it has not developed the requisite capacity to handle domestic investment especially SMEs. Third, TIC does not have adequate capacity to prepare feedback on fulfilling investment goals and aspirations including those relating to technological development and innovations. Fourth, the complementary relationship between FDI and domestic investment remains a major gap in practice much as it is provided for in the objectives of TIC.

The Tanzania Private Sector Foundation has assessed and found that it could more effective if it had adequate capacity in terms of human and financial resources. It is facing challenges of providing member services more broadly and building institutional capacity, positioning in the market and consolidate its private sector outreach and development programmes. Its member associations include the formal private sector and mostly medium and large firms. However, the micro and small enterprise businesses sector – which is substantial in the Tanzanian economy – does not appear represented effectively in the dialogue process.

TNBC has filled a very important gap in terms of policy dialogue which potentially would include negotiations in technology and innovations to the extent they are deemed important issues for private sector development and competitiveness. However, there are several concerns that have been expressed. First, TNBC institutional set up has yet to strengthen its policy dialogue in the regions and districts where the majority of SMEs are located. Second the representation of SMEs in the Council meetings is still on the low side. Third, financing of the activities of TNBC has been uncertain and has always fallen below requirements. Fourth, the operation of the TNBC has been acknowledged as one factor, along with initiatives taken in reforming the public service, which has helped to change the mindset of many government officials but there is still a long way to go to change the mindset of both the public and private sector in order to make the policy dialogue more effective. Fifth, more can be done to promote domestic investment and forging linkages and facilitate strategic alliances between domestic investment and FDI especially in the area of technology and innovations.

4. Conclusion and Way Forward

This section is devoted to providing the conclusion of the study and charting the way forward to phase II of this study.

4.1 Conclusion

This study was motivated by two main considerations. First, poverty is most effectively reduced through growth and sustainable growth is driven by increasing the level of productivity of the factors of production. This kind of growth is likely to be associated with competitiveness and sustainable rises in the levels of incomes in society. The study postulates that it is technology and innovation that primarily drives productivity growth and sustains competitiveness and growth of incomes and poverty reduction in society. The second consideration is REPOA's research programme. Two components of the research programme (growth and poverty and technology) have a major bearing on innovations yet the level of implementation of these components has lagged behind and this gap in implementation is raising concern. This study has set out to contribute to reducing this knowledge gap.

In undertaking this study, the conceptual framework based on the systems of innovation has been adopted. The national systems of innovation approach define the nation as the appropriate level of analysis focusing on the factors influencing national technological capabilities. This choice of nation as the level of analysis recognizes the importance of central state authority and national and cultural idiosyncrasies. National systems are postulated to differ in respect of the structure of the production systems and the institutional set-up hence the national idiosyncrasies. The national system of innovation approach postulates that the actors and their relative importance, the way they interact and the institutions are specific to the nation and its social cultural setting. In this regard, the study starts with mapping and analyzing Tanzania's systems of innovation which are conceptualized at the national level as the national system of innovation and sector level

as the sectoral system of innovation in order to more specifically unravel the system of innovations as the level of specific sectors.

In order to permit more in-depth analysis, the study has focused on mapping out and analyzing sectoral systems of innovation three sectors, namely, agriculture, industry and health. Agriculture is a major source of livelihood for the majority of the poor in Tanzania, health is critical for meeting basic needs in human development and the industrial sector is instrumental in structural change and transformation of the economy including transformation of agriculture.

A comprehensive study of the systems of innovation requires that both the supply and demand side of the innovation equation be addressed in the analysis. This is what the study has set to do, but in two phases. The current report represents work of phase I. In this phase the researchers have confined the discussion and analysis on the supply side factors (organizations and their activities, policies and regulations) with a view to assessing the potential capacity of the system to generate innovations in the form of new products and processes as well as new markets and organizational forms. The current report is the final output of Phase I. As indicated in the way forward in the next section, Phase II will examine the demand side of the innovation equation. It will examine the actual impact of these institutions and organizations on innovativeness of producers.

This phase of the study has found that all the three sectors selected for this study have necessary supply side actors in place with the agricultural sector being the most diverse, possibly for historical reasons, and the health sector the least diverse. The three sectors contain R&D organizations, training institutions, professional associations and financial institutions. In addition to R&D and professional associations, agriculture has extension services that cater for the linkage between research outputs and farmers, and training organizations that train both researchers and extension service providers. There are various input suppliers and agro dealers that provide farmers with inputs required in their production activities. There are also financial institutions whose presence goes deep down into the rural community but with marginal coverage. However, there are still

serious gaps in operationalising public-private partnership, access to financial services, and in the functioning of input and output markets.

The health system of innovation is faced with dearth of actors devoted to traditional health. There is only one institution specializing in research in traditional medicine per se with those undertaking traditional medicine researches playing a marginal role. It was found that the process of integration and interaction among the various actors is limited as the majority of traditional health practitioners are working in isolation from each other and being protective of their knowledge on medicinal plants and herbs. Shortage of staff and facilities at the Institute of Traditional Medicine at MUHAS is reducing its effectiveness and there is a glaring absence of organizations offering support services including training and commercialization process that is necessary for the innovative system to be sustained are largely missing. To date little effort has been made by pharmaceutical companies invest in the manufacturing of drugs that are the result of the national R&D outputs.

As regards the industrial system of innovation, a major finding is that all the necessary actors are present in the system of innovation. The major challenge is that a large part of the system was established three decades ago in a socioeconomic environment that is very different from the current environment of market orientation and private sector led development. Their Acts and positioning has not been updated to cope with the new challenges. Furthermore, the effectiveness of most actors in the system of innovations has been impaired by lack of adequate funding. There was supposed to be a financial facility committed to innovation in technology but such a facility has not been put in place. It was found that some of the R&D institutions have been forced by circumstances to engage in non-core business even without successfully pursuing their core business. It is hoped that the recent announcement by the President that allocation to science and technology should be increased from the current 0.3% of the GDP to 1% is expected to reduce the gravity of this problem. However, there is a further challenge in determining priorities for the use of the funds and for coming up with S&T and innovation

programmes which can stimulate innovations and competitiveness of the actors especially the firms

Policies and regulations for the three sectors and those which are cross-cutting have gone a long way to put in place conditions for systems of innovation to function. However, two challenges were found to be running through most policies. First, they are not explicit on how the policies and regulations are to facilitate the interaction and coordination of the actors in the system of innovations. There is concern that even where existing policies are encouraging the promotion of efficiency and competitiveness as well as linkages, they have not specified strategies for implementation with no indicators for monitoring and evaluation. Second, most of the policies are of the supply side, with no trace of demand side innovation policies. Demand side innovation policies are those that trigger and/ or enhances demand for innovative products, processes and services from the general public.

4.2 Way Forward

The current report marks the completion of Phase I of the study and has laid ground for Phase II. While Phase I has addressed the supply side factors, Phase II will examine the demand side of the innovation equation. Specifically it is designed to illuminate on the actual impact of the reviewed policies and activities of the supply side organizations. It will endeavor to assess whether or not the producers and service providers are in contact with all the organizations mentioned in respective sectors, how this contact is coordinated and what impacts can be discerned from such interactions. It will further assess the extent to which these contacts facilitate their innovative activities. The phase will identify other informal organizations and factors that are instrumental in facilitating innovative activities.

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Appendix: Ten Functions of an NSI as provided by Edquist 1997

1. Provision of R&D and creating new knowledge.
2. Competence building (provision of education and training, creation of human capital, production and reproduction of skills, individual learning) in the labor force to be used in innovation and R&D activities.
3. Formation of new product markets
4. Articulation of quality requirements emanating from the demand side with regard to new products.
5. Creating and changing organizations needed for the development of new fields of innovation, e.g. enhancing entrepreneurship to create new firms and entrepreneurship to diversify existing firms, creating new research organizations, policy agencies, etc.
6. Networking through markets and other mechanisms, including interactive learning between different organizations.
7. Provision (creation, change, abolition) of institutions, e.g. IPR laws, tax laws, environment and safety regulations, R&D investment routines, etc. that influence innovating organizations and innovation process by providing incentives or removing obstacles to innovation.
8. Incubating activities, e.g. providing access to facilities, administrative support, etc. for new innovating efforts.
9. Financing of innovation process and other activities that can facilitate commercialization of knowledge and its adoption.
10. Provision of consultancy services of relevance for innovation process, e.g. technology transfer, commercial information and legal advice.