FOREWORD

Livestock is an important sector that contributes to food and nutrition security, and households’ income in the country. The sector’s contribution to the national Gross Domestic Product (GDP) is estimated at 7.6% (URT, 2019/20). The annual growth rate of the sector is generally low, at approximately 2.2%. This rate reflects an increase in livestock population rather than productivity gains.

The sector is constrained by a number of factors such as poor nutrition, low reproductive rates, high mortality rates and high disease prevalence.

Thus, concerted efforts in research for development and investments that aim at improving animal genetics; pasture production and rangeland management; feeds and feeding; husbandry practices; disease management and public health; socio-cultural and economic aspects and livestock value addition are vital to stimulate the growth and contribution of the sector to the national economy.

Research is necessary in order to inform and guide stakeholders in the sector to utilise scarce development resources efficiently to achieve the desired transformation of the socio-economic status of Tanzanians. To guide research activities in the country, a national agenda is required to specify priority areas and identify stakeholders at a particular timeframe. This National Livestock Research Agenda (NLRA) has been developed to meet this requirement.

The previous livestock research agenda formulated in 2015 was meant to serve for the period 2015-2025. However, the Ministry of Livestock and Fisheries decided to review the current Research Agenda before its targeted period due to absence of important emerging research areas that would address the current needs of the sector. Among the missing research areas include Multiple Ovulation and Embryo Transfer (MOET); invasive plant species; consumer behaviour and
preferences; non-conventional livestock species and livestock value addition as a driving force towards the desired industrial economy in Tanzania. Inadequate linkages between livestock research institutions and stakeholders in livestock development in general also called for this review.

The refreshed National Livestock Research Agenda (NLRA) 2020 to 2025 provides a roadmap that will guide the planning and implementation of identified thematic areas and researchable areas that are in line with demand of livestock stakeholders and national priorities. The outcome of this work will stimulate proper linkage among stakeholders and speed up research implementation, coordination and utilization of research findings for development. The shelved research findings will be retrieved, repackaged and disseminated to the end users. In addition, this research agenda will enable the Ministry to harness expertise and experience from Tanzanians who otherwise would have remained unutilized or underutilized. This will be done through strengthen engagement with students from higher learning institutions at Masters and PhD levels to conduct focused research aiming at solving existing challenges in the sector. Furthermore, regulations will be developed for smooth and rational implementation of the Agenda. In line with that, Masters and PhD students carrying out research in livestock and livestock related matters will be required to write Policy Briefs for Ministry consumption upon completion of their research work.

It is my expectation that the reviewed NLRA will contribute to a significant transformation among producers, processors, consumers and other actors in the livestock sector leading to a Tanzania of middle income and industrial economy.

Hon. Luhaga Joelson Mpina (MP)
MINISTER FOR LIVESTOCK AND FISHERIES
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<tr>
<td>AEZs</td>
<td>Agro Ecological Zones</td>
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<tr>
<td>AI</td>
<td>Artificial Insemination</td>
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<td>AIDS</td>
<td>Acquired Immune Deficiency Syndrome</td>
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<td>AMR</td>
<td>Antimicrobial Resistance</td>
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<tr>
<td>ASARECA</td>
<td>Association for Strengthening Agricultural Research in East and Central Africa</td>
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<tr>
<td>ASDP</td>
<td>Agricultural Sector Development Program</td>
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<tr>
<td>CBOs</td>
<td>Community-Based Organizations</td>
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<tr>
<td>CBPP</td>
<td>Contagious Bovine Pleuropneumonia</td>
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<tr>
<td>CCARDESA</td>
<td>Centre for Coordination of Agricultural Research and Development in Southern Africa</td>
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<tr>
<td>CCPP</td>
<td>Contagious Caprine Pleuropneumonia</td>
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<tr>
<td>CIAT</td>
<td>International Centre for Tropical Agriculture</td>
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<tr>
<td>COSTECH</td>
<td>Commission for Science and Technology</td>
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<tr>
<td>CSOs</td>
<td>Civil society Organizations</td>
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<tr>
<td>DADPs</td>
<td>District Agricultural Development Projects</td>
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<tr>
<td>DRTE</td>
<td>Directorate for Research, Training and Extension</td>
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<td>FAO</td>
<td>Food and Agriculture Organisation</td>
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<td>FBOs</td>
<td>Farmer-Based Organizations</td>
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<tr>
<td>FYDP II</td>
<td>Five Year Development Plan Two</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>GHGEs</td>
<td>Greenhouse Gas Emissions</td>
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<td>GHSA</td>
<td>Global Health Security Agenda</td>
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<td>HIV</td>
<td>Human immunodeficiency virus</td>
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<td>HPI</td>
<td>Heifer Project International</td>
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<td>ICT</td>
<td>Information communication and technology</td>
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<td>IHR</td>
<td>International Health Regulations</td>
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<td>ILRI</td>
<td>International Livestock Research Institute</td>
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<td>IPS</td>
<td>Invasive Plant Species</td>
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<tr>
<td>ISABU</td>
<td>Institut des Sciences Agronomiques du Burundi</td>
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<tr>
<td>ITK</td>
<td>Indigenous Technical Knowledge</td>
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<tr>
<td>IVF</td>
<td>In vitro Fertilization</td>
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<tr>
<td>KALRO</td>
<td>Kenya Agricultural and Livestock Research Organization</td>
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<tr>
<td>LGA's</td>
<td>Local Government Authorities</td>
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<tr>
<td>Acronym</td>
<td>Full Form</td>
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<tr>
<td>LSA</td>
<td>Livestock Sector Analysis</td>
</tr>
<tr>
<td>MDAs</td>
<td>Ministries, Departments and Agencies</td>
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<tr>
<td>MLF</td>
<td>Ministry of Livestock and Fisheries</td>
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<tr>
<td>MOET</td>
<td>Multiple Ovulation and Embryo Transfer</td>
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<tr>
<td>MP</td>
<td>Member of Parliament</td>
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<td>NaLIRRI</td>
<td>National Livestock Resources Research Institute</td>
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<td>NDV</td>
<td>National Development Vision</td>
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<td>NEPAD's</td>
<td>New Partnership for Africa's Development</td>
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<td>NFAST</td>
<td>National Fund for Advancement for Science and Technology</td>
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<td>NGOs</td>
<td>Non-Governmental Organizations</td>
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<td>NLP</td>
<td>National Livestock Policy</td>
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<tr>
<td>NLRA</td>
<td>National Livestock Research Agenda</td>
</tr>
<tr>
<td>NM-AIST</td>
<td>Nelson Mandela African Institution of Science and Technology</td>
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<tr>
<td>OIE</td>
<td>World Organisation for Animal Health</td>
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<tr>
<td>PPR</td>
<td>Peste des Petits Ruminants</td>
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<tr>
<td>RAB</td>
<td>Rwanda Agriculture Board</td>
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<tr>
<td>RDS</td>
<td>Rural Development Strategy</td>
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<td>RISDP</td>
<td>Regional Indicative Strategic Development Plan</td>
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<tr>
<td>SADC</td>
<td>Southern Africa Development Community</td>
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<tr>
<td>STI</td>
<td>Science, technology and innovation</td>
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<tr>
<td>SUA</td>
<td>Sokoine University of Agriculture</td>
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<tr>
<td>TADs</td>
<td>Transboundary Animal Diseases</td>
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<tr>
<td>TALIRI</td>
<td>Tanzania Livestock Research Institute</td>
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<tr>
<td>TARI</td>
<td>Tanzania Agricultural Research Institute</td>
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<tr>
<td>TAWIRI</td>
<td>Tanzania Wildlife Research Institute</td>
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<tr>
<td>TLMI</td>
<td>Livestock Modernization Initiatives</td>
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<tr>
<td>TLMP</td>
<td>Tanzania Livestock Master Plan</td>
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<tr>
<td>TPRI</td>
<td>Tanzania Pesticide Research Institute</td>
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<tr>
<td>T-TBDs</td>
<td>Ticks and Tick-Borne Diseases</td>
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<tr>
<td>TVI</td>
<td>Tanzania Vaccine Institute</td>
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<tr>
<td>TVLA</td>
<td>Tanzania Veterinary Laboratory Agency</td>
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<tr>
<td>UDOM</td>
<td>University of Dodoma</td>
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<td>UDSM</td>
<td>University of Dar es Salaam</td>
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<tr>
<td>VPO</td>
<td>Vice-President's Office</td>
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<td>WHO</td>
<td>World Health Organization</td>
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EXECUTIVE SUMMARY

The Ministry of Livestock and Fisheries (MLF) prepared the National Livestock Research Agenda in order to facilitate and prioritize investments in research programmes, projects and activities to guide the conduct of research towards meaningful results and outcomes that contribute to improved livelihoods. The formulation of the Agenda involved consultations and participation of various key stakeholders. These included policy makers; research and academic institutions; livestock farmers; processors; the Commission for Science and Technology (COSTECH); extension agents; financial service providers; input suppliers; traders and Non-Governmental Organizations (NGOs). The holistic livestock research for development agenda developed from consultative meetings with these stakeholders have been synthesised into seven thematic areas, namely animal genetics; animal feeds; health; socio-cultural and economic aspects; non-conventional livestock species; cross-cutting issues; and, value addition for which research priorities have been developed. These priorities underscore the importance of technological and institutional innovations as means to bring about socio-economic transformation.

The researchable priorities that have been considered under livestock genetics and reproductive technologies include livestock breeds inventory; characterization of animals and their production systems; breeding and reproductive technologies such as Artificial Insemination (AI), Multiple Ovulation and Embryo Transfer (MOET) and molecular technologies. Priorities under feeds and feeding systems thematic area include pastures, forages and feed resources inventory and characterization; germplasm introduction, evaluation and monitoring; pasture and forage breeding and multiplication technologies; management and control of invasive plant species (IPS); animal feeds and feeding systems, feed conservation strategies and feed quality and safety. Priority areas under animal health, disease management and public health include parasitic; vectors and vector-borne diseases; fungal; bacterial; and viral diseases; biological and vaccine development; ethno-veterinary as well as research on zoonotic diseases.
and antimicrobial resistance (AMR) that follow the One Health approach.

Similarly, socio-cultural and economic conditions have profound influence on the type, amount and quality of livestock and livestock products. Hence, priorities on this area include land use conflicts, markets and marketing systems that promote value chain development; communication pathways; technology transfer and adoption; indigenous technical knowledge (ITK); consumer behaviour and preferences as well as socio-economic values and benefits. On the other hand, priorities under value addition include finishing of animals according to consumer demands and preferences; products and by-product processing; handling; packaging; branding; biophysical; pre and post-harvest losses and diversification of livestock products. Priorities under non-conventional livestock species include characterization on phenotypic and genotypic attributes, mapping of their production and marketing systems as well as ethical issues. Cross cutting issues of importance include livestock related policies and legislations; environment and climate change adaptation; limitation of greenhouse gas emissions (GHGEs); biotechnology; nanotechnology; bio security and bio-safety measures; gender issues; animal and human welfare and HIV/AIDS.

Implementation of the National Livestock Research Agenda will require collaborative efforts from all stakeholders and development partners. Among key stakeholders are livestock research and training institutions, higher learning institutions, and Non-Governmental Organisations.

It is my hope that the implementation and outcomes of this Livestock Research Agenda will make a significant contribution towards transforming the livestock sector and increase its contribution to the welfare livestock keepers and consumers as well as the national GDP. These outcomes will also contribute to livestock-based industrial development and transformation of the country from subsistence to a middle-income economy.
CHAPTER ONE

INTRODUCTION

1.1 Background

The National Livestock Research Agenda (NLRA) is an initiative of MLF designed to serve as a guide for planning and undertaking livestock research programmes. The research agenda of 2015 – 2025 has been reviewed to meet the current needs of the sector, and addressing emerging constraints, such as unpredictable climatic change and variability and ever-escalating demands for livestock products, due to increased human population. This agenda will cover the period from 2020 to 2025.

Livestock sector in Tanzania plays a key role in ensuring food and nutritional security as well as economic gains at households and national levels. This led the Government of Tanzania to embark on the transformation of the livestock sector through adopting the Tanzania Development Vision 2025. The vision specifies that, “By the year 2025, there shall be a livestock sector, which to a large extent shall be commercially run, modern and sustainable,
using improved and highly productive livestock to ensure food security, improved income for the household and the nation while conserving the environment”. To achieve this vision, several livestock development initiatives were established. These include the National Five Years Development Plan 2015-2020; Livestock Modernization Initiatives (TLMI) 2015; Agricultural Sector Development Program (ASDP II) 2016 and Tanzania Livestock Master Plan (TLMP) 2020-2025. All these initiatives intend to improve livestock productivity and increase contribution to the growth of National Gross Domestic Product (GDP).

Appropriate livestock technology development and dissemination is an essential foundation for social and economic development of the livestock sector. Equally, the dissemination of appropriate technologies based on rigorous research and technology development is a crucial element in the livestock improvement and sustainability.

The government recognizes efforts undertaken by research and development institutions, which are key players in conducting on-station and on-farm research associated with livestock. These
include Tanzania Livestock Research Institute (TALIRI), Tanzania Wildlife Research Institute (TAWIRI), Tanzania Agricultural Research Institute (TARI), Sokoine University of Agriculture (SUA), Nelson Mandela African Institution of Science and Technology (NM-AIST), the University of Dar es Salaam (UDSM), the University of Dodoma (UDOM), Tropical Pesticides Research Institute (TPRI), and Non-Governmental research partners. Moreover, regional and international institutions and agencies usually work in collaboration with local researchers in developing, evaluating and testing various technologies that are vital for improving livestock and agricultural productivity. Collaborating Institutions in Eastern and Central Africa include: the Kenya Agricultural and Livestock Research Organization (KALRO), National Livestock Resources Research Institute (NaLIRRI)-Uganda, Mozambique Inst. Agricultural Research (IIAM) – Mozambique, Rwanda Agriculture Board (RAB) and Institut des Sciences Agronomiques du Burundi (ISABU)–Burundi. Others include International Livestock Research Institute (ILRI), the International Center for Tropical Agriculture (CIAT), the Centre for Coordination of Agricultural Research
and Development in Southern Africa (CCARDESA) and the Association for Strengthening Agricultural Research in East and Central Africa (ASARECA) just to mention a few.

1.2 Rationale

Livestock production is an important component of agricultural activities in Tanzania. It is the most imperative agricultural activity among households in Tanzania. Livestock are kept for various purposes including, milk, meat, eggs, draught power and for various cultural uses. They complement cropping activities through the provision of manure for soil fertility maintenance, draught power for cultivation, transport, cash and food.

Livestock play an important role in many areas particularly in agropastoral and pastoral production systems, as they offer opportunities for risk coping, farm diversification and intensification, as well as providing significant livelihood benefits. Livestock production in Tanzania is constrained by various factors, which include, low livestock genetic potential in production traits; feed shortages; high incidences
of diseases and unavailability of water to mention a few. Other factors include weak livestock farmer’s organizations, inadequate technical support services and weak market chains for livestock and livestock products. All these factors interact and affect sector’s growth and contribution to the National Economy.

This compels, National and International research institutions to address these constraints by undertaking livestock research activities based on their respective mandates, availability of research funds, or even conditions set up by the collaborating institutions, due to lack of National livestock research guidelines. Consequently, the end users for achieving the overall national goal of sustainable development and poverty reduction do not utilize some of the generated technologies. In this context, a National Livestock Research Agenda (NLRA) that encompasses both stakeholders’ demand and preferences; and national interests is needed to facilitate the conduct and coordination of livestock research in the country.

The research agenda is not only vital for local institutions, but also crucial for regional and international collaborating institutions and
agencies who conduct livestock related research in Tanzania. In this regard, the Ministry of Livestock and Fisheries (MLF) has reviewed the National Livestock Research Agenda (NLRA) of 2015 - 2025 to support and prioritize investments in research programmes, projects and activities, to propel Tanzania to become an industrialized economy and middle-income status country by the year 2025. The implementation of research activities by various Institutions and partners should recognize the key role played by oversight institution in Science, Technology and Innovation (STI) in the country that is the Tanzania Commission for Science and Technology (COSTECH), which coordinate the National Research Agenda (NRA) for all sectors.

The reviewed research agenda of 2020 to 2025 provides a roadmap that will guide the planning and implementation of the identified key areas and themes necessary for decision making in line with stakeholders demands, sectorial needs and national priorities. This agenda includes more new areas of economic importance, which were not considered in the previous research agenda. The new thematic areas under the current research agenda include Multiple Ovulation and Embryo Transfer (MOET); invasive plant
species; Socio-cultural and Economic aspects, Non-conventional livestock species and Livestock Value Addition.

Research on Socio-cultural and economic aspects focus on understanding the socio-cultural and economic diversity along the livestock value chains. Hence, research on this thematic area is crucial, particularly in analyzing inter and intra dynamics of stakeholders in various aspects, including land use conflicts, markets and marketing systems, and communication pathways. This will enhance the implementation of innovative livestock programmes, projects and activities that contribute to the transformation of the livestock sector. On the other hand, research on Livestock Value Addition aims at addressing matters related to reduction of post-harvest losses through increased product shelf life; quality and biosafety; meeting consumer preferences and increased income to key actors along the entire livestock and livestock products value chain. Value addition also considers consumers’ demands based on products processing, handling, packaging and branding.
1.3 Legal Framework

There are major developments in the strategic context of livestock research in Tanzania, which provide opportunities and challenges for an effective Livestock Research Agenda. These developments are related to the evolving legal, policy and strategy frameworks and international instruments. They are also related to roles, interests and capacities of key stakeholders on implementation of the Agenda.

The formulation of this Agenda has taken into consideration the National Livestock Policy (NLP) 2006, the National Research Agenda, as well as other National and International policies, strategies and legislations. This research agenda has also considered the developed Tanzania Livestock Masterplan (TLMP, 2017).

1.3.1 The National Livestock Policy (NLP) 2006

Section 3.12, of the NLP aims at developing appropriate technologies for the livestock industry in order to increase production and productivity through equitable use of available resources to sustain the livelihoods. The policy insists on encouraging, promoting and supporting investment in livestock research. It also intends
to strengthen infrastructure and facilities for livestock research, research-extension, farmers’ linkages and coordination, as well as collaboration among stakeholders in national and international livestock research.

The policy addresses low genetic potential of indigenous livestock in production traits, poor infrastructure, and inefficient marketing system. Further, it addresses high prevalence of animal diseases, inadequate feed resources, weak livestock farmers’ organizations, inadequate researches, insufficient extension services and extremely poor information dissemination. The policy also insists on overstocking, overgrazing, and incomplete designation of grazing lands. Thus, continued research in these and other relevant areas for better-targeted management interventions is necessary.

Other National policies and legislations considered include; the Rural Development Strategy (RDS) of 2001; Rural Development Policy 2003; National Trade Policy 2003; Livestock Stakeholders Resolutions of 2001 and 2009; and the Agricultural Sector Development Strategy (ASDS) of 2001. Besides, it also include; the Agricultural Sector Development

1.3.2 Legislations related to livestock Research
Tanzania Commission for Science and Technology (COSTECH) was established by Act of Parliament No. 7 of 1986, as a successor to the Tanzania National Scientific Research Council. COSTECH became operational in 1988. The responsibilities of COSTECH are to co-ordinate and promote Science, technology and Innovation (STI) activities in the country. The Commission acts as the chief advisory organ to the Government on all matters pertaining to science and technology and their application to the socio-economic development of the country. On the
other hand, Tanzania Livestock Research Institute (TALIRI) is a corporate body established by Parliamentary Act No. 4 of 2012. The Institute’s mandate is to conduct and coordinate livestock research, and other related matters in Tanzania Mainland.

1.3.3 Stakeholders in Livestock Research
In the course of implementation of livestock research Agenda, many stakeholders have been considered. Among the key stakeholders of this agenda include:-

i) Ministries, Departments and Agencies (MDAs);

ii) Regional Secretariats and Local Governments Authorities;

iii) Policy makers;

iv) Public and private research, academic institutions and Consultancies;

v) Livestock farmers, processors, consumers, traders, input suppliers and their associations;

vi) Non-Government and Civil Society Organizations (CSOs/CBOs/FBOs)

vii) Financial Institutions

viii) Regulatory boards and coordination institutions;

ix) Professional associations; and
x) Development partners.

1.3.4 Key Challenges and Opportunities

1.3.4.1 Challenges

i) Inadequate investment and funding of livestock research;

ii) Insufficient facilities and infrastructure for research;

iii) Scarce Human resource and managerial expertise in livestock research;

iv) Poor dissemination of livestock research results and their adoption by the end users;

v) Weak linkage and collaboration between farmers, extension and research

vi) Weak linkage and collaboration among research institutions and development partners;

vii) Limited private sector participation in research; and

viii) Poor climate change adaptation and mitigation
1.3.4.2 Opportunities

i) Existence of the National Livestock Policy 2006 and other related policies and strategies that promote the need to address livestock issues;

ii) Existence of Research Funds to facilitate research (DADPs, National Fund for Advancement for Science and Technology - NFAST);

iii) Presence of national, regional and international institutions, agencies, and networks willing to fund and collaborate in livestock research;

iv) Political will to strengthen research and development; and

v) Ratified international conventions related to livestock production.
CHAPTER TWO

VISION, MISSION, OBJECTIVES AND VALUES

This chapter describes the vision, mission, goal and specific objectives of the Livestock Research Agenda.

2.1 Vision Statement

The vision of the National Livestock Research Agenda is to have a research system that shall improve livestock productivity, and hence contributing significantly to food security and poverty reduction by 2025.

2.2 Mission Statement

The mission of the Livestock Research Agenda is to guide planning and implementation of the livestock research activities leading to development of appropriate technologies that are economically, socially and environmentally sustainable in order to ensure that, the livestock resources are managed sustainably for improved productivity, economic growth and human livelihood.
2.3 Overall Objective

To improve the livestock sector through development and application of appropriate technologies so that the sector contributes to poverty reduction, improved food security and increased national income.

2.3.1 Specific Objectives

a) To identify livestock research thematic areas to ensure that resources are allocated and utilized efficiently;
b) To facilitate implementation of issues on livestock research in the National Livestock Policy 2006 and other related policies and legislations;
c) To guide development of appropriate technologies in order to increase livestock productivity sustainably;
d) To guide formulations of research strategies, programmes, and action plans;
e) To strengthen linkages and collaborations among National, Regional and International research organisations; and
f) To enhance the institutional capacities for livestock research in the country.
2.4 Core values

The following are core values of the NLRA:

2.4.1 Professionalism - Pursuit of excellence in livestock research through rigorous scientific approaches to attain optimal results.

2.4.2 Integrity - Practice and advocate courtesy, moral values, work ethics, respect and honour in conducting livestock research.

2.4.3 Transparency and Accountability - Pursuit openness, honesty, culture of timeliness and being answerable for quality services.

2.4.4 Equal opportunity - promoting equality for all

2.4.5 Ethical considerations - up-holding ethical standards in human and/or animal participation in livestock research.

2.4.6 Collaborative efforts - Team work to avoid duplication of efforts.
CHAPTER THREE

METHODOLOGY

The formulation of the research agenda for 2020 to 2025 involved consultations and participation of the key stakeholders. These included policy makers, research and academic institutions, livestock farmers, processors, extension agents, financial service providers, input suppliers, traders and Non-Governmental Organizations (NGOs). It also identifies linkages and gaps in livestock research for better utilization of resources and effective monitoring and management of livestock research activities in the country. During the discussion various issues arose that are linked to opportunities and challenges affecting progress of the livestock industry.

The identified opportunities include diverse livestock populations; livestock producers with different production systems; huge rangelands and feed resources; various agro-ecological zones; high demand for livestock and livestock products at national, regional and international levels. Other opportunities encompass; processing facilities; livestock related policies
and legislations; research and training institutions; development partners and financial institutions. However, several challenges were highlighted that include low livestock productivity; food and nutrition insecurity; livestock-human-plant diseases; climate change; land use conflicts; indistinct institutional frameworks and arrangements; undefined markets and marketing systems; socio-cultural challenges; post-harvest losses and other crosscutting issues (differentiated gender needs, HIV/AIDS, food quality and bio-safety).

Therefore, National Livestock Research Agenda 2020-2025 shall focus on research interventions that address livestock genetics and reproductive technologies, feeds and feeding systems, animal health and disease management, public health, and livestock value addition. In addition, addressing the challenges of market and marketing systems, socio-cultural and economic aspects, livestock related policies and legislations, animal and human welfare and climate change. Research interventions in these areas coupled with vigorous data capturing and feedback systems will improve total production and productivity in the key livestock value chains for cattle, poultry, pig, sheep, goats and other
conventional and non-conventional livestock species.
CHAPTER FOUR
THEMATIC AREAS

4.0 Priority Research Thematic Areas

Identified research thematic areas reflect analysis that shows the targets of the sector by 2025 and what research to be undertaken to realize the set targets. Given the importance of the livestock sector for food and nutritional security, and economic gains, the thematic areas deserve adequate public and private sector investments to attain meaningful results and anticipated performance. The thematic areas shall focus on:

i) Livestock genetics and reproductive technologies
ii) Pastures and Forages, Feeds and feeding systems
iii) Animal health, Disease management and Public health
iv) Socio-cultural and economic aspects
v) Livestock value addition
vi) Non-conventional livestock species
vii) Cross cutting issues
4.1 Priority researchable areas

Implementation of priority researchable areas for improved livestock productivity shall involve participation of stakeholders who are thoroughly engaged in various livestock value chains. Similar, holistic systems and approaches associated with Public-Private Partnerships (PPP) are critical in conducting research and dissemination of research findings.

The researchable areas in each of the above thematic areas are equally important. However, within the thematic areas they are listed in descending order described as follows:

4.1.1 Thematic area I: Livestock Genetics and Reproductive Technologies

Tanzania has an estimated population of about 32.2 million cattle, 20 million goats and 5.5 million sheep. Other livestock include 2 million pigs, 38.5 million local chickens and 40.6 million improved chickens. About 90% of the livestock population is of indigenous types. The nation’s average annual per capita consumption is estimated at 12 kg of beef, 45 litres of milk and 75 eggs, which is below the world food organization’s standard of 50 kg of beef, 200
litres of milk and 300 eggs per annum. Overall, livestock contributes to 7.6% of the country's GDP. However, indigenous livestock have low productivity. For example; indigenous Cattle grow slowly and reach market weight at seven years, have low mature body weights between 200-300kg, produce less milk less than 2 Litres of milk per day, have higher age at first calving of about four years and long calving interval of 18-22 months.

Low production and reproductive performance of indigenous breeds of livestock can be improved through various measures including adopting appropriate breeding programmes and reproductive technologies such as the use of Artificial insemination (AI), Multiple Ovulation and Embryo Transfer (MOET), as well as In vitro Fertilization (IVF). Absence of defined livestock breeding programmes in the country has substantially hindered the availability of improved breeds. Moreover, there has been no coordinated recording programme.

The available improved breeds are crosses of various exotic breeds. However, their performance is against the expectation because there is no matching of the right genotype with
the right environment. Moreover, recently, there has been an increasing demand for improved breeds, but the supply side fails to meet the demand.

Much of the breeding efforts need to address breed inventory and characterization of conventional livestock types such as cattle, goats, sheep and poultry. Genetic improvement can be done through selection within indigenous livestock; crossbreeding and selection of livestock breed-types according to agro-ecological zones (AEZs) and special market needs. In addition, there is a need to increase multiplication of improved germplasm and conservation of farm animal genetic resource as well as development of appropriate breeding systems and strategies. In addition, there is a need to establish a national performance recording system that can facilitate the implementation of the national breeding programmes.
The research priorities under this thematic area are:

a) Livestock breeds inventory, characterization of animals and productivity / production systems
b) Breeding and reproductive technologies (i.e. Artificial insemination (AI), Multiple Ovulation and Embryo Transfer (MOET), molecular technologies and use of improved genetics)
c) Genetic improvement of livestock breeds in various Agro Ecological Zones (AEZs) (selection, crossbreeding interbreeding, inbreeding)
d) Conservation of farm animal genetic resources
e) Data capturing, management and feedback systems

4.1.2 Thematic area II: Pastures and Forages, Feeds and Feeding systems
Tanzania is endowed with abundant natural resources such as rangelands, grasslands, woodlands, bush and shrub lands in which a large resource base for animal feeds including natural forages and legumes are found. Additionally, the cultivated land is an important
source of feeds in form of crop residues and later industrial by-products. The availability and use of feeds largely depend on rainfall, temperature and humidity variations, which in turn vary with agro-ecological zones and the livestock production system.

A basic shortcoming of natural grasslands as a source of feed for ruminant livestock is their low production in terms of dry matter yield due to a combination of the negative effects of inadequate rainfall and the dearth of soil nitrogen on plant growth (Wigg et al., 1973; Mwilawa et al., 2008). The seasonality of plant growth, which reflects the annual rainfall distribution pattern, further restricts the availability of herbage for grazing animals to four or five months of the wet season over most of the natural grasslands. Another shortcoming of the natural grassland is the low quality of the herbage.

Planted pastures are much more productive than natural grasslands and form the basis of the non-traditional dairy industry in the country (Kusekwa et al, 1992). According to Tanzania Livestock Master Plan (TLPM 2017) the average feed balance is -59,592,936 tonnes DM whereas the current resource available was 20,964,780
tonnes DM and the requirements were 80,557,716 tonnes DM.

Similarly, the country produces substantial amounts of cereals and root crops. Because of their high content of readily digestible carbohydrates, they are valuable feeds for livestock, especially the monogastrics. However, they are produced primarily for human consumption and some of them are in short supply in the country. Appreciable quantities of cereal grains are also exported to neighbouring countries, hence creating more deficit. Climate change is significantly affecting the availability of feeds resources. Extended dry seasons, frequent droughts, erratic rainfall manifested by shifts in onset and cessation of rain and increased temperatures have drastically reduced availability of both roughages and concentrates feeds.

Thus, the research efforts are highly needed to improving quality and quantity of livestock feed resources by introducing improved forage crops and improved feed management practices, as well as increased access to existing lands available for grazing.
The research priorities under this thematic area are:

a) Pastures, forages and feed resources inventory and characterization (Update database)
b) Management and control of invasive plant species (IPS)
c) Rangelands inventory and management
d) Pasture and forage germplasm introduction, evaluation and monitoring in various agro-ecological zones leading to
e) Pasture and forage breeding and multiplication technologies
f) Forage seeds, Seed certification and Forage seed systems
g) Climate smart pastures and forages, and mapping
h) Pasture and forage improvement, harvesting, conservation and utilization
i) Pastures and forages seed bulk production techniques
j) Feeds quantity, quality and safety
k) Feed formulations
l) Alternative feed resources
m) Water for livestock (quantity, quality and safety)
n) Livestock-Wildlife-Crop interaction
...o) Plant pathology and emerging pasture and forage diseases (e.g. stunt and smuts)
p) Early warning and crisis mitigation for feed resources availability

4.1.3 Thematic area III: Animal health, Disease management and Public health

The livestock sector in Tanzania is confronted with many challenges including diseases such as ticks and tick-borne diseases (T-TBDs), parasitic, viral and bacterial diseases. However, most of the indigenous breeds are resilient to some of the diseases especially the adults. On the contrary, young animals such as calves and kids have high mortalities due to lack of immunity and inefficient animal health services. Animal health service is challenged by inadequate supply of drugs, inadequate regulatory activities of drug supplies, frequent outbreak of Transboundary animal diseases (TADs), Trypanosomosis, and production diseases e.g. mastitis. TADs hamper the economy of the country because of restriction on international trade. Most of the TADs are controlled by vaccination.

However, current local vaccine production is limited to only six diseases out of 11 earmarked priority diseases. The country is currently...
producing six vaccines namely anthrax, Blackquarter, contagious bovine pleuropneumonia (CBPP), brucellosis (S19), combo of anthrax and black-quarter (Tecoblax), and against Newcastle disease (Temevac). Ticks and TBD cause about 72% of annual cattle mortality and are controlled by acaricide application and chemotherapy, while diseases like Contagious Caprine Pleuropneumonia (CCPP) and Peste des Petit Ruminants (PPR) are decimating a number of small ruminants, but can also be controlled by vaccination. Thus, more researches are required to develop and produce more vaccines as well as developing technologies and diagnostic techniques that will help to control livestock diseases of economic and public health importance.

The research priorities under this thematic area are:

a) Parasitic, vectors and vector-borne diseases
b) Biological and vaccine development
c) Trans boundary Animal Diseases (TADs)
d) Zoonotic diseases; Anti-Microbial Resistance; Drug residues (One health approach)
e) Other fungal, bacterial, and viral diseases
f) Non-infectious diseases
g) Early warning systems and surveillance of animal diseases
h) Disease diagnostic and quality assurance management systems
i) Ethno veterinary

4.1.4 Thematic area IV: Socio-cultural and Economic aspects

Livestock Sector Analysis (LSA) of 2017 showed a high production potential with additional investment. For instance, the livestock contribution of 7.6% of the country’s GDP could be improved through proper interventions. These included improvement of feed quality and quantity resources, improvement of genetic composition, addition of animal health services and fostering friendly policy environment that encourages investors. For instance, the Internal Rate of Return (IRR) could increase significantly if there is an improvement of traditional cattle small-scale from 34 IRR to 87% IRR and fattening from 72% IRR to 4,696% IRR (LSA, 2017). In other studies, LSA (2017) revealed that, meat production will increase “with additional combined investment” from 3.2 million metric tonnes from 2031/32 which is 199% increase from the without additional
investment scenarios. Meanwhile, Shirima et al (2016) showed that, feedlot in sheep increased market weight of indigenous sheep from 18 to 30 kg live weight in a period of three months’ time.

The research priorities under this thematic area are:

a) Land use conflicts and conflicts management
b) Community innovation platforms
c) Markets and marketing systems
d) Technology transfer and adoption
e) Communication and value chain pathways
f) Traditions, norms, customs, rules and attitudes
g) Extension delivery systems and institutional arrangements
h) Indigenous Technical Knowledge (ITK)
i) Social economic values and benefits
j) Input-output relationships
k) Consumer behaviour
4.1.5 Thematic area V: Livestock Value Addition

Livestock value addition has a paramount importance because it reduces post-harvest losses through increased products’ shelf life, quality and biosafety. Besides, it attracts consumer preferences and increases income to key actors along the value chain. Despite awareness on the importance of adding value to livestock and livestock products, yet little has been done. Therefore, research related to value addition including proper animal finishing according to consumer demands, livestock products processing, handling, packaging, branding and biosafety control will be addressed in order to improve the economy of individual actors and the nation at large.

Moreover, Livestock by-products of economic importance include milk, meat, hides and skins, blood, bones, horns, wool, hooves, bristles, feathers, hair, and fur. Hides and skins are among important by products of livestock, which can form an important input to the industrial sector and export market. The potential raw material available in Tanzania is about 2.6 million cattle hides and 2.5 million goat/sheep skins. However,
Tanzania exports 95% of raw hides and skins. Few available tanneries are working below capacity resulting to export of processed hides in the form of wet blue being less than 60,000 pieces per annum. The existing leather capacity is limited to merely six tanneries, some of which are not working or working below 30% of their installed capacity. The slaughtering of animals and subsequently the flaying of hides and skins is carried out under poor conditions using improper flaying tools and therefore, they are often damaged. Poor conditions also apply during curing and preservation process. Therefore, there is a need for research to be undertaken to develop appropriate technologies for improved livestock by-products from healthy animals, handling, storage, value addition and manufacturing of various products.

The research priorities under this thematic area are:

a) Biophysical, pre and post-harvest losses
b) Product processing, handling, hygiene and safety
c) Standards and protocols for quality control
d) Products packaging and branding
e) Traceability and performance records
f) Diversification of livestock products
g) Antibiotics and additives residual effects

4.1.6 Thematic area VI: Non-conventional Livestock Species

Non-conventional livestock species such as donkeys, rabbits, cavies, ostriches, Insects and camels are valuable genetic resources that has traditionally been used as sources of animal protein, fibre, transport and draught power. However, little has been done to develop their commercial exploitation, partly due to climatic and ecological diversity, and different levels of economic development in various parts of the country. Moreover, the availability of large number of other animal species, which are potentially suitable for domestication and commercial production add to the constraints. Nevertheless, non-conventional livestock are adapted to harsh environments, can utilize natural resources that conventional stock cannot, are suitable for complementary production with conventional species, are more efficient on recycling of nutrients through integrating them into intensified production systems, are easy to feed, manage and handle, and can therefore be raised by landless and smallholder farmers.
The critical limitation to the use of non-conventional livestock include; insufficient information about genetic resources for specialized production systems. Also, limited genetic progress, due to lack of breeding strategies, small population sizes, underestimated importance as sources of food and income, low priority given in research and development, lack of management skills and veterinary inputs, as well as limited scope for improving backyard production systems. Therefore, there is a need to design innovative research approaches for improving production, consumption and marketing of non-conventional livestock species to enhance food and nutritional security as well as income.

The research priorities under this thematic area are:

a) Phenotypic/Genetic Characterization of the animal species
b) Characterization of the production system
c) Marketing systems
d) Ethical issues
e) Enhancing their reproductive efficiencies for increased multiplication
4.1.7 Thematic area VII: Cross cutting issues
Some of Cross-cutting issues addressed in livestock research agenda include livestock related policies and registration, gender issues, environment and climate change, HIV/AIDS, private sector engagement, and animal welfare. Policies and legislation have profound effect on research and development investment. These equally affect the overall social and economic development of a society and the country at large. Informed decisions based on research before or during implementation of the policies and legislation need to be over emphasized in research agenda.

Other areas that require more emphasis include; Gender balance, including access to education at all levels; the proportion of women, physically challenged individuals, youth in decision-making and representation in the National Parliament. Furthermore, although the National Development Vision (NDV) 2025 aims to attain gender equity and empowerment of women in all socio-economic and political relations. Still, there is wide disparities within the population in terms of research opportunity, access to research resources, and the benefit of research findings.
Furthermore, there is high interest by international investors as indicated by their presence and contribution to the Tanzania livestock sector, which could be instrumental for unlocking the high potential of private investments in Tanzania’s livestock sector. Since, public funds are scarce and will never be enough to address the vast needs of sector development. Therefore, research may transform the traditional livestock sector to a modern one by focusing its efforts to enacting a regulatory framework that facilitates rapid private investment in the sector for the benefits of stakeholders. The cross-cutting issues of significant importance that have to be addressed in livestock research agenda shall include:

a) Livestock related policies and legislations  
b) Impacts of Livestock on Environment and climate change  
c) Quantification of Greenhouse Gas emissions from livestock  
d) Wildlife/livestock Interactions  
e) Private sector engagement  
f) Biotechnology, Nanotechnology, Bio security and Bio safety  
g) Gender issues
h) Human Immuno-Deficiency Virus / Acquired Immuno Deficiency Syndrome (HIV/AIDS)

i) Animal and human welfare

j) Continuously correlation of curricula and employment status
CHAPTER FIVE

IMPLEMENTATION STRATEGY

This chapter focuses on implementation of the research strategy and results sharing. It envisions a strategy that is fully integrated and coordinated, that evolves as recommended technological packages disseminated to intended users. Formulation and implementation of research programmes, projects and activities will be the responsibility of the research Institutions mandated for undertaking livestock research.

5.1 Livestock Research Coordination

The Ministry of Livestock and Fisheries-MLF (Livestock sector) through the Directorate for Research, Training and Extension (DRTE) shall promote, and facilitate research and its application in livestock production and allied sciences at National level. TALIRI shall CO-ORDINATE RESEARCH and its application in livestock production and allied sciences as per TALIRI ACT no. 4 of 2012. Meanwhile, the Tanzania Commission for Science and Technology (COSTECH) coordinates the preparation of the National Research Agenda.
(NRA) 2015-2020, in order to facilitate the use of the Research and Development for solving societal and developmental problems. In addition, to educate, fuel inventions and discoveries leading to development of commercially viable technologies that will stimulate economic growth. The Ministry of Livestock and Fisheries takes the responsibility of livestock related issues where research is an important component.

While COSTECH is the National Coordinator for National Research System, TALIRI is mandated to conduct and coordinate livestock research. On the other side, TVLA is mandated to conduct animal disease research. Higher learning instructions such as SUA, UDSM, UDOM and NM-AIST are conducting research as partial fulfillment for academic qualifications and addressing livestock development issues. International organizations such as ILRI, CIAT, FAO and NGOs may also conduct livestock research after obtaining permission from COSTECH.
5.2 Result sharing and dissemination

This research agenda covers the year 2020 – 2025. However, the Ministry in consultation with stakeholders may review the research priorities annually. Ministry shall set national priorities and harmonize livestock research activities of the public livestock research institutes, civil society organizations, private sectors and farmer’s organizations.

The validation of the research findings will be done by TALIRI in collaboration with other research Institutions. The MLF through its Directorate of Research, Training and Extension (DRTE) will gather and review recommended technological packages and repackage for use by intended stakeholders in the country. In addition, dissemination of technologies may be through Agricultural and National Trade shows, World Food day, livestock researcher’s stakeholders’ forum, mass media such as radio and television programmes, magazines and newsletters. Furthermore, DRTE may design and implement modalities for collection of livestock research findings from various research institutions, so that the findings will be easily available for packaging and dissemination to all stakeholders.
5.3 Effectiveness of research agenda 2020 - 2025

Linkages with other relevant institutions at national, regional and international levels are important in the implementation of the Livestock Research Agenda. Furthermore, involvement of communities through Local Government Authorities is of utmost importance. In order to implement National research priorities, the Ministry will plan to increase effectiveness of research better than before by setting up the following strategies:

i) The Ministry of Livestock and Fisheries-MLF (Livestock sector) in collaboration with stakeholders will outline and prioritize research areas and possibly titles yearly, which will be released to be undertaken by research officers, Masters and PhD. Students;

ii) The MLF (Livestock sector) will allocate funds for prioritized research areas annually for Masters and PhD. programs by providing a competitive package of grants at research stage;

iii) Follow-ups of livestock research findings released by Postgraduate students and
Research officers to be used by beneficiaries

iv) The MLF (Livestock sector) will set regulation in order to smoothening operationalization of the research agenda

5.4 Funding Sources

Reliable and adequate funding is crucial in the implementation of the research agenda. Research institutions in the country will solicit research funds from; Government approved budget, donors, grants and gift, loans, as well as internal revenue. This may include collaborative funds from various institutions within and outside the country, including supports from development partners and foundations.

5.5 Research programmes

All livestock research programmes and projects will develop research activities in line with the National Livestock Research Agenda, purposefully designed to address the key thematic areas.
5.6 Research Conferences

The DRTE may assist in organizing and facilitating regular research conferences. The conferences will provide a forum for researcher’s, trainers, farmers, processors and other stakeholders to receive and deliberate on the research activities done by scientists and stakeholders institutions; and provide strategic feedback on the management of livestock research in the country in line with the research agenda.

5.7 Review and Approval of the Agenda

The reviewed research agenda will be valid for the period of 2020-2025 with midterm and end of term reviews. The review process will be carried out by the Ministry responsible for livestock, in collaboration with key stakeholders.
CHAPTER SIX

CONCLUSION

Involvement of key research stakeholders and partners in the formulation of the NLRA 2020-2025 calls for an equally multi-stakeholder involvement in the implementation of the researchable themes and priority areas focused in the NLRA. Obviously, public research institution such as TALIRI and TVLA, higher learning institutions, regional and international research institutions are expected to involve farming communities, NGOs, private institutions and individuals through Local Government Authorities (LGAs) in implementation of the Government priorities, as key stakeholders for attaining the overall Tanzania Development Vision 2025 and TLMP 2019. For effective implementation of the research priorities, capacity building of institutions through infrastructure development by acquiring state of the art laboratories, digital data capture and other ICT equipment is highly needed. Furthermore, building of the human resource capacity through short and long-term training and sustainable mechanism for research funding are extremely necessary for effective implementation of this
Research Agenda. Livestock Research Agenda is expected to contribute significantly towards transforming the livestock sector and increasing its contribution to the GDP. In addition, the outcomes of the research priorities are expected to contribute to transforming the country towards becoming an industrialized economy, as well as shifting from subsistence economy to achieving middle-income status nation.
REFERENCES


