

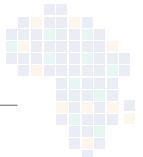


ZIMBABWE
Agritech
STRATEGY

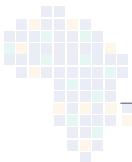
ZIMBABWE AgriTech STRATEGY 2021–2025
Ministry Of Lands, Agriculture, Fisheries, Water And Rural Resettlement
15 March 2021

TABLE OF CONTENTS

FOREWORD	7
PREAMBLE	9
ACKNOWLEDGEMENTS	11
GLOSSARY OF TERMS	12
EXECUTIVE SUMMARY	14
2.1.The State of Zimbabwe's Agricultural Sector	15
2.2.Agro-ecological Potential and Why ICTs are Key for Zimbabwe's Agriculture	17
1. INTRODUCTION	18
1.1.The need for a national smart AgriTech strategy for Zimbabwe	18
1.2.Comprehensive Africa Agriculture Development Programme (CAADP)	20
1.3.Current Development Frameworks - SDGs, Agenda 2063, Vision 2030 (NDS1, NDS2)	21
1.3.1. Sustainable Development Goals (SDGs)	21
1.3.2. Africa Agenda 2063	22
1.3.3. Vision 2030 (National Development Strategy (NDS) 1 & 2)	22
2. CONTEXT OF AGRICULTURE IN ZIMBABWE	23
2.1.The State of Zimbabwe's Agricultural Sector	23
2.2.Natural Agriculture Potential	24
2.3.Challenges faced by Small scale Commercial, Old Resettlement Scheme and Communal Lands Farmers	26
2.4.Leveraging on ICTs to Accelerate Smallholder Farmers' Development and Participation in the Agro-industry	26
2.5.Climate Change and Rainfall Patterns	27
2.6.Low Production and Productivity in Priority Crop and Livestock Value Chains	27



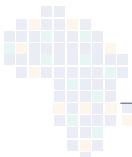
2.7.High Cost of Production and Limited Access to Input and Output Markets	31
2.8.Automated Irrigation and Agriculture Machinery	31
2.8.1.Irrigation systems	32
2.8.2.Mechanisation development	33
2.8.3.Agriculture Extension and Advisory Services	34
2.8.4.Crop Protection and Post-Harvest Handling Infrastructure	34
3. CONTEXT OF AGRITECH IN ZIMBABWE	35
3.1.Status of ICT Infrastructure	35
3.2.Services and Adoption	37
3.3.Role of ICT in AgriTech and potential benefits of AgriTech	37
3.4.Agricultural Information Management System (AIMS)	40
3.5.Adoption of Digital Technologies in Agriculture	41
4. THE METHODOLOGY USED FOR DEVELOPING A NATIONAL ZIMBABWE AgriTech STRATEGY	43
4.1.The need for a national approach	44
4.2.Determining the appropriate AgriTech Strategy approach	45
4.3. Governance Structure and Mechanisms for Implementation	45
4.3.1.Multi-stakeholder and partnerships and Institutional arrangements/ Stakeholder engagement and consultation	46
4.3.2.AgriTech Committees	46
4.3.2.1.Leadership and Advisory Committee (as members in the supreme body governing smart-agriculture activities)	46
4.3.2.2.Steering Committee	46
4.3.3.Subject matter Experts	47
4.3.4.AgriTech Task Force	47
5. AGRITECH STRATEGY PLAN	48
5.1.Vision	48



5.2.Goals	48
5.3.Strategic Thrusts for AgriTech in Zimbabwe	48
5.4.Specific Objectives	48
5.5.Medium Term Plan (2021-2025)	49
5.6.AgroTech programmatic areas	50
6. IMPLEMENTATION OF AGRITECH	52
6.1. Determining the appropriate Smart-agriculture approach	52
6.2. Governance structure and mechanisms	52
6.3. Stakeholder engagement and consultation	52
6.4. Governance functions, responsibilities and composition	54
6.5 AgriTech Management Structure	55
6.6.Proposed National AgriTech Committees	56
6.6.1.Leadership and Advisory Committee (as members in the supreme body governing smart-agriculture activities)	56
6.6.2.Steering Committee	57
6.6.3.Subject matter Experts	57
6.6.4.AgroTech Task Force	57
6.6.5.Agriculture leadership and support	57
6.6.6.AgroTech Strategic team composition	58
6.6.7.AgroTech expected outcomes	59
6.6.8.Manage the Vision development process	59
6.6.9.Outputs	60
6.6.10.Timeline and milestones	60
7. STRATEGIC RECOMMENDATIONS	61
8. NATIONAL AGRITECH ACTION PLAN AND ICT SOLUTIONS	65
8.1.AgroTech use Cases in Zimbabwe	71
9. REFERENCES	

LIST OF FIGURES AND TABLES

Figure 1.1: Agricultural life cycle, associated challenges, activities and key technologies	20
Figure 1.2: E-Agriculture led Social and Economic Transformation	21
Table 2.1: Agro-Ecological Zones	24
Table 2.2: Irrigation systems in Zimbabwe	33
Table 3.1: Overall ICT global benchmarks for Zimbabwe	36
Figure 3.1: Role of ICTs in Agriculture (Source: FAO, ITU)	37
Figure 3.2: The GSMA AgriTech Toolkit for the Digitisation of Agricultural Value Chains (Source: GSMA AgriTech, 2020)	39
Figure 3.3: Agricultural Information Management System (AIMS)	41
Figure 4.1: AgriTech Blueprint (Source: Smart Africa Continental AgriTech)	44
Figure 6.1: Smart-Agriculture governance structure	53
Table 6.1: Various groups and their responsibilities and composition	54
Table 8.1: Action plan and ICT solutions	65
Table 8.2: AgriTech Action Plan Priorities for the Period 2021–2025	69
Table 8.3: Project preparation & planning, development & testing and implementation	75
Table 8.3: Project Cost Summary	76



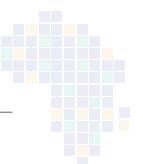
FOREWORD



The Government of the Republic of Zimbabwe has joined other African Countries in the Smart Africa alliance. This is an African initiative and vision of transforming Africa from its current position and operation into a Smart Africa by embracing Information Communication Technologies (ICTs) in all sectors of the economy in line with the transform Africa agenda. ICTs integrated with various technologies have taken the world by storm and has transformed it into 'single' global village. Likewise, technologies such as Internet of Things (IoTs), mobile technology, Voice-over-Internet Protocol (VoIP), Cloud computing and many more have removed the barriers to communication and accessibility of information and services.

The Government of the Republic of Zimbabwe has been chosen to spearhead AgriTech flagship in Africa and is going to be the centre of reference for AgriTech innovations in Africa. This is such a great honour to be accorded flagship status. The Government of the Republic of Zimbabwe, after consultations with various stakeholders and experts, came up with an implementation strategy to transform Zimbabwe into Smart Zimbabwe Vision 2030 in line with the transform Africa Vision. There are several pillars which Zimbabwe is going to work on in achieving its national vision of Smart Zimbabwe 2030, among the pillars is the Smart Cities, which has already started its implementation in Harare, Smart Parliament which has been commissioned and functional among many others including the AgriTech which forms the country's economic backbone and thus commands the highest priority in our implementation strategic plan.

The SMART Zimbabwe 2030 Master Plan seeks to transform the country through use of ICTs so that Zimbabwe attains its Vision of becoming an Upper Middle-income economy by 2030. This Vision is predicated on, among others, building on the achievements of the Zimbabwe National Policy on ICTs of 2016 to 2020 which further strengthens Zimbabwe's economic base and improves its economic environment for



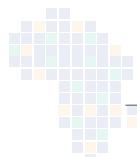
accelerated growth towards achieving a predominantly information and knowledge-based economy by 2030. The current National ICT Policy now requires a review and re-orientation for it to be aligned to the new initiatives of Smart ICT as defined by the SMART Africa Manifesto of the Transform Africa Summit. Zimbabwe has just become the 26th Member of Smart Africa Alliance where it adopted AgriTech as its flagship focus area thus opening doors for its contribution to the Africa Preferential Trade initiative. Such efforts will result in the formulation of a new National ICT Strategy, the Smart Zimbabwe 2030 Master Plan, which will guide Zimbabwe as it streamlines and accelerates the adoption of digital technologies.

The Republic of Zimbabwe takes advantage of its God-given Agricultural conditions and its geo-positioning in the Global world to seriously consider Smart Technology in the implementation of AgriTech in Zimbabwe and envision becoming a model country in AgriTech solutions in Africa. The leadership of the Government of Zimbabwe, inclusive of its ministries and various stakeholders came up with an implementation roadmap where all Smart technologies blueprints and implementation strategies have been put under the authority and supervision of the Ministry of ICT, Post and Courier Services and Cyber Crime.

The Ministry in consultation with the line ministries is responsible for the Development and Implementation of Smart Technologies in consultation with various key stakeholder ministries and departments. Emphasis is on developing home-grown solutions using available human expertise in the country to produce tailor-made smart solutions that specifically address a Zimbabwean situation taking into consideration the ever-changing climatic conditions.

Zimbabwe is proudly showcasing its home-grown Internet of Things based **AgriTech Management Application**.

**The President of the Republic of Zimbabwe
His Excellency Cde Emmerson Dambudzo Mnangagwa**



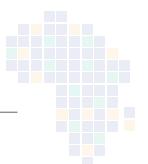
PREAMBLE



Agriculture depends on various factors which include climate, rainfall patterns, soil, inputs and markets. These factors are threatening the Agricultural productivity. Due to changes in climate, weather patterns have become unpredictable and unstable such that farmers can no longer rely on their seasonal routines, stimulus and intuition to make farming-related decisions. Furthermore, land degradation, for example, the loss of fertile soils, as well as the cost of inputs, has become difficult to imagine of agricultural productivity for food security for a growing

population in Africa which is expected to reach 2.4 billion people by the year 2050. Given the aforementioned confounding challenges, effective implementation of ICTs in Agriculture now referred to as AgriTech is the possible solution. AgriTech offers strong potential for driving economic growth and rising incomes through increased efficiency of agricultural productivity, improved livelihoods and value chain development. It can also play an important role in addressing some of agriculture's most pressing challenges, which include climate change, loss of biodiversity, drought, desertification, high individual risk and inefficient supply chains.

Put simply, AgriTech involves designing, developing and applying innovative ways to use information and communication technologies (ICTs) with a primary focus on agriculture. The aim is to boost agricultural and rural development by improving access to valuable information that can help agricultural stakeholders to make the best possible decisions and use the resources available most productively and sustainably. ICTs that can be harnessed for AgriTech may include devices, networks, services and applications. These can range from cutting edge Internet-based technologies and sensing tools to other technologies that have been around for much longer, such as radio, fixed telephones, televisions, mobile phones and satellites. In a sector that is becoming increasingly knowledge-intensive, having access to the right information, at the right time, in the right format, and through the right channel can make a crucial difference to the livelihoods of stakeholders involved in agriculture and related fields; this can accelerate our march towards Vision 2030.



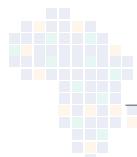
Setting in place a national AgriTech strategic blueprint is an essential first step for any country planning to use ICTs for agriculture (ICT4Ag). Experience shows that committing piecemeal resources to ICT4Ag on an ad hoc basis results in higher costs and lower impacts. Any effective roadmap for AgriTech will require a holistic, multi-stakeholder approach as ICTs are also driving other sectors which are critical for agriculture, namely banking, weather monitoring, insurance, logistics and e-governance.

Aside from the development and application of ICT tools and infrastructures, key components of an AgriTech strategy must include the provision of standards, norms and methodologies, as well as the development of individual and institutional capacities. Enabling policies will be crucial if AgriTech is to flourish, with cross-cutting support spanning across various government ministries, including those dealing with ICTs, food production and processing, rural development, irrigation and water management, disaster management, telecommunication, governance, transportation, Finance and Commerce, amongst others.

While the need for AgriTech strategies is acknowledged by many stakeholders, most countries have yet to adopt a strategic approach in making the best use of ICT developments in agriculture. AgriTech strategies will help to rationalise both financial and human resources and address holistically the ICT opportunities and challenges of the agricultural sector while generating new revenues and improving the lives of people in rural communities. It will also help ensure that the goals of national agricultural plans are achieved.

This blueprint includes an AgriTech vision, an action plan, and a framework by which results can be monitored and evaluated. Like all strategies and plans, the outcomes of these processes are not static and changes in our country's strategic context will require a dynamic approach to updating the strategy so that it remains relevant.

**Honourable Dr. Anxious Jongwe Masuka
Minister of Lands Agriculture Water and Rural Resettlement**



ACKNOWLEDGEMENTS



The Ministry of Information Communication Technology, Postal and Courier Services want to thank the head of state **the President of the Republic of Zimbabwe, His Excellency Cde Emmerson Dambudzo Mnangagwa**, an established Farmer par excellence, for his vision to transform Zimbabwe into an upper middle-income economy by 2030. He has placed agriculture at the centre of national development thrust and spearheaded command agriculture to ensure food self-sufficiency and sustained life. He has repeatedly articulated that "No one should go hungry

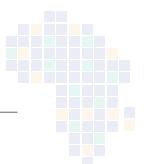
in Zimbabwe" and has therefore directed financial and other resources towards agriculture.

Comprehensive national stakeholder consultations were undertaken in preparing and finalising the Blueprint. The team conveys its gratitude to our colleagues from the Ministry of Agriculture for developing an appropriate national Agriculture policy and implementation strategy and for mobilising resources and taking the lead in ensuring that the President's vision in terms of food security and beneficiation is attained by 2030.

The Ministry of ICT, Postal and Courier Services wants to acknowledge the Government of Zimbabwe and all its institutions for the support and coordination in the entire process. The Ministry wants to thank them in advance for the perceived continual support in making the national vision 2030 come to fruition.

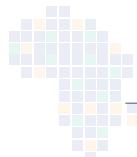
This National AgriTech Blueprint has been made possible by multiple stakeholders who worked together with the team leadership of the Ministry of Information Communications and Technology, Postal and courier services.

**Honorable Dr. Jenfan Muswere
Minister of ICT, Postal and Courier Services**

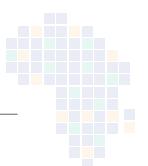


GLOSSARY OF TERMS

Term	Definition Guide
Agricultural transformation	the process by which an agri-food system transforms over time from being subsistence-oriented and farm-centred into one that is more commercialised, productive, and industry centred
AgriTech	AgriTech is the use of technology for farming that is developed to improve efficiency and profitability. While most commonly used in horticulture and agriculture, agri-tech is also found in forestry, aquaculture and viticulture.
Blueprint	A Smart Africa blueprint helps establish best practices, building blocks, enablers, policy/regulatory recommendations, strategic actions and roadmap, through inputs taken from a cross section of stakeholders and partners.
Biotechnology	Is the use of living organisms or biological processes for the purpose of developing useful agricultural, industrial, or medical products, especially by means of techniques, such as genetic engineering, that involve the modification of genes.
Duality	A dual economy is the existence of two separate economic sectors within one country, divided by different levels of development, technology, and different patterns of demand.
e-Agriculture	Involves designing, developing and applying innovative ways to use information and communication technologies (ICTs) with a primary focus on agriculture.
Food security	Exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life". World Food Summit, 1996)
GMO:	Genetically Modified Organism. An organism whose DNA has been genetically engineered for select characteristics deemed favourable.



Industrialization	When used in agriculture, this term generally refers to the consolidation of farms into very large production units that are more vertically coordinated with suppliers or markets or both.
Innovation	The practical identification and implementation of ideas that result in the introduction of new goods or services or improvement in offering goods or services.
ICT in Agriculture	Information and communication technology in agriculture (ICT in agriculture), also known as e-agriculture, focuses on the enhancement of agricultural and rural development through improved information and communication processes.
Productivity	Productivity measures the quantity of output produced with a given quantity of inputs. Long term productivity growth reflects improvements in farmers' production efficiency and technological progress.
Smallholder farmers	Defined as those farmers owning small-based plots of land on which they grow subsistence crops and one or two cash crops relying almost exclusively on family labour.



EXECUTIVE SUMMARY

1. INTRODUCTION AND PRESENTATION OF THE METHODOLOGY

The importance of Agriculture in Africa and the world cannot be overemphasized, however major policy questions relating to enhancing productivity, sustainably tackling food insecurity and bridging the digital divide have remained partly addressed over the years. Whilst other sectors such as health and education have made tremendous strides in leveraging technology to improve resource efficiencies and outcomes, the Agricultural sector has lagged behind especially smallholder farmers who are the critical mass in the food production system. Zimbabwe boasts vast tracts of arable land, conducive climate, human resources and pro-agricultural policies as well as a well-documented track record of being formerly the breadbasket of Africa. On this background the country has been deservedly selected by Smart Africa Alliance as the flagship nation for the development of the Continental AgriTech **Blueprint**. This has necessitated swift collaboration in development of this National AgriTech Strategy by the Ministry of Lands, Agriculture, Fisheries, Water and Rural Resettlement and Ministry of ICT, Postal and Courier Services with support from SAGIT consultants. The following phases summarises the methodology:

Summary of methodology



This national AgriTech strategy is greatly informed by the 2021 AgriTech Continental Blueprint, National Development Strategy 1, Vision 2030, Africa Agenda 2063 and CAADP framework. In tandem with the need to ensure Agric-led economic transformation, this AgriTech blueprint brings to the fore strategies to digitally transform agriculture, measures to close the gender and digital divide and help contribute towards making Zimbabwe an upper middle income economy by 2030. Disruptive and innovative locally engineered AgriTech practical use cases are presented herein to ensure that recommendations proffered can be applied to scale up already working examples.

Going forward, the bold call to action encompasses the following;



Context of Zimbabwe's AgriTech Landscape

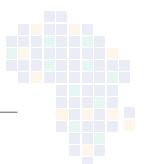
2. CONTEXT OF AGRICULTURE IN ZIMBABWE

Agriculture is the most important economic activity in Zimbabwe with all the provinces involved in either crop production and/or animal husbandry.

2.1. THE STATE OF ZIMBABWE'S AGRICULTURAL SECTOR

The main food and cash crops in Zimbabwe include maize, wheat, small grains (millets and sorghum), tobacco, cotton, sugar, horticulture (food and non-food), and groundnuts. It has been noted that over the years, crop production in Zimbabwe is highly variable due to the heavy reliance on rain fed agriculture. It is now understood that changing climatic conditions and frequent droughts contribute heavily to the volatility in crop production.

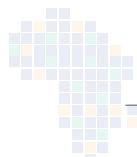
The survey¹ noted that small scale farmers lack the necessary resources, infrastructure and proper agronomic practices to boost their yields. A robust production and productivity enhancement programme driven by governments targeting low yielding smallholder farmers will go a long way in securing the nation's food security while at the same time increasing smallholder farmer earnings since they will be able to produce a surplus.



The livestock sub-sector is an important and integral part of the agricultural sector with beef, dairy, small ruminants, pigs, poultry, apiculture, aquaculture and other small and emerging stock making up the industry. The sub-sector contributes about 19 percent to the agricultural GDP (Ministry of Agriculture, 2018). The FTLR (Fast Track Land Reform Programme), combined with significant fluctuations in macroeconomic conditions, and a transformed agricultural sector post 2000 influenced major changes within the livestock sector. The land redistribution exercise has increased participation to more than 300,000 newly resettled farmers with varied skills and resources in livestock farming. This transformation of the sector has led to substantial shifts in ownership, use, and livestock management; and associated effects on animal disease management, production and marketing. Challenges faced in the sector due to the transformation were identified as diseases, lack of access to affordable funding, expensive inputs compared to the region and depressed cereal production.

Against this background, there is to find ways and means to include technologies which will help improve production and productivity on the crops and on the livestock will improve the capacity for farmers to run cattle and animal rearing as a serious business. In addition, technology helps to create strong value chains linkages between farmers, the Cold Storage Company, meat processors and abattoirs.

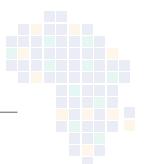
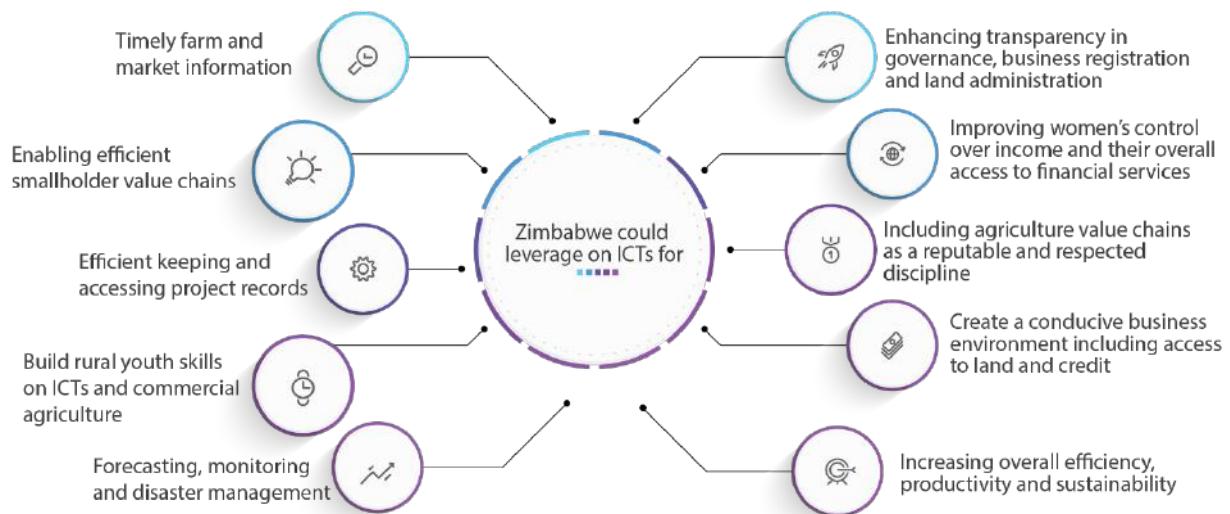
Evidence derived from this survey¹ shows that 85% of the outputs from the agricultural sector are channelled towards the local market while 15% is exported. The study noted that 25% of the produce is sold at farm gate while 75% of the output is marketed via various wholesale and retail markets. Farmers bemoan postharvest losses at the farm and loss of margins as a result of middlemen. It is often observed that farmers, in many cases, fail to meet the market needs in time. One way to improve access to markets for grains is to establish the commodity exchange. Further, enactment of the backward integrated policy in line with local content policy as noted in Nigeria by the World Bank (2017) was seen as an effective tool of creating market linkages. An integrated value chain consisting of active out grower schemes and synergies with retailers and processing companies guarantees a market to farmers, reducing post-harvest losses.



2.2. AGRO-ECOLOGICAL POTENTIAL AND WHY ICTS ARE KEY FOR ZIMBABWE'S AGRICULTURE

Zimbabwe has 5 natural farming regions and a tropical climate which enable the country to produce up to 23 crop enterprises and a wide range of livestock enterprises. The farming regions are demarcated on basis of the rainfall regime, soil quality, agricultural activity and vegetation among other factors Table 1.1. The quality of the land resource declines from Natural Region (NR) I through to NR V and Table 1.1 also includes the provinces in the countries. Endowed with such natural capabilities, the catalyst to transforming agriculture in Zimbabwe is investment in AgriTech interventions.

In Zimbabwe, ICTs are envisioned to enhance agriculture especially smallholder farmers' agricultural productivity in a sustainable manner. Hence the strong case to leverage on ICTs for:



1. INTRODUCTION

Agriculture is a sector that holds great promise for pro-poor economic growth (Ayana et al., 2021; Stienen et al., 2007). Economic growth is a key success factor for reducing undernourishment, but it has to be inclusive and provide opportunities for improving the livelihoods of the poor. Enhancing the productivity and incomes of smallholder family farmers is the key to progress. In fact, agriculture is about four times more effective at raising incomes among the poor than other sectors. It has been amply demonstrated that enhancing the ability of farming communities to connect with knowledge banks, networks and institutions via ICTs has improved their productivity, profitability, food security and employment opportunities substantially. Agriculture also has significant linkages in its operations with other related sectors such as rural development, natural resource management, banking, insurance, media, governance, transportation and logistics management. Individuals, public enterprises and the private sector all have important roles to play in the agriculture sector. Agriculture in this document is used in a broader sense and covers crop cultivation, animal husbandry, dairying, fisheries, poultry and other associated activities.

This section teases out the challenges being faced in the agriculture sector and provides a justification to why Zimbabwe needs to have the national AgriTech Strategy. It also provides an overview of the frameworks that are available globally and on the African continent and how they will contribute to the success of AgriTech in the agriculture sector.

1.1. The need for a national smart AgriTech strategy for Zimbabwe

Agriculture is the mainstay of Zimbabwe's economy as a major source of livelihoods and epicentre of other related rural economic activities. About 60-70 per cent of the population is employed in the agricultural sector and the majority are women. The sector supplies 60 per cent of the raw materials required by the industrial sector and contributes 40 per cent of total export earnings (FAO, 2020). Agriculture's contributory share of the national GDP is approximately 17 per cent. In recognition of the strategic role of agriculture in economic development, the African Union Commission, through the Maputo Declaration of 2003, encourages member states to spend at least 10% of their National budget towards the agriculture sector.

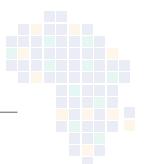
The diverse agro-climatic conditions make it easier for Zimbabwe to grow a large variety of food and cash crops. At least 23 types of food and cash crops are grown in the country. The major food crops include maize, sorghum, pearl millet, finger millet, groundnuts, wheat, cowpeas, Bambara nuts and sweet potatoes. White maize is the main staple food in Zimbabwe. Cash crops include tobacco, cotton, tea, coffee, sugarcane, soya bean, sunflower and horticultural products. Characterised by a viable livestock sector, Zimbabwe is able to cater to the needs of both domestic and export markets. The livestock sector includes beef, dairy, poultry, pigs, goats and sheep. The performance of the agricultural sector determines the overall level of people's living

standards and economic development of the country. As the main source of livelihood for the majority of the population, the performance of agriculture is a key determinant of rural livelihood resilience and poverty levels (Ayana et al., 2021; Rapsomanikis, 2015).

According to the FAO (2021), a plethora of limitations affect small scale farmers such as low and erratic rainfall, low and declining soil fertility, low investment, shortages of farm power - labour and draft animals, poor physical and institutional infrastructure, poverty and recurring food insecurity. Agricultural production is therefore very volatile. Despite these challenges smallholder farmers still contribute about 70% of total staple foods (maize, millets, and groundnuts) and yet have less than 5 percent of national irrigation facilities and still suffer significant digital exclusion. The need for a comprehensive AgriTech Strategy can therefore not be overemphasised. Thus, given the aforementioned confounding challenges, effective implementation of ICTs in Agriculture is the possible solution.

The AgriTech Strategy seeks to promote the adoption and use of technology in agriculture, water resources development and land administration. The strategy focuses on such technologies as automated irrigation and agriculture machinery, and digital technologies which include agriculture drones and various ICTs such Voice-over-Internet Protocol (VoIP), Mobile technology, Blockchain technology, Robotics, Machine Learning, Artificial Intelligence, Cloud computing, Internet of things and Big Data. According to Okediran and Ganiyu (2019), these technologies occupy an important space in the development of AgriTech. The use of technology in agriculture is a necessary and near sufficient condition for the successful implementation of the Agriculture and Food Systems Transformation Strategy (AFSTS), in addition to the agriculture policy and investment conditions. Ultimately, this will improve crop and livestock production, productivity, efficiency and profitability as well tools for measuring progress towards food security, import substitution, foreign currency generation, value addition and beneficiation, employment creation and improved incomes and livelihoods of the Zimbabwean populace.

The realisation of vision 2030 therefore lies on leveraging agriculture technologies in future farming to increase production and productivity, improve efficiency and reduce cost of production; reduce post-harvest losses and improve access to food and financial inclusion. The figure below presents a synthesis of agricultural challenges; value chain and associated key activities; and key ICT solutions/technologies.



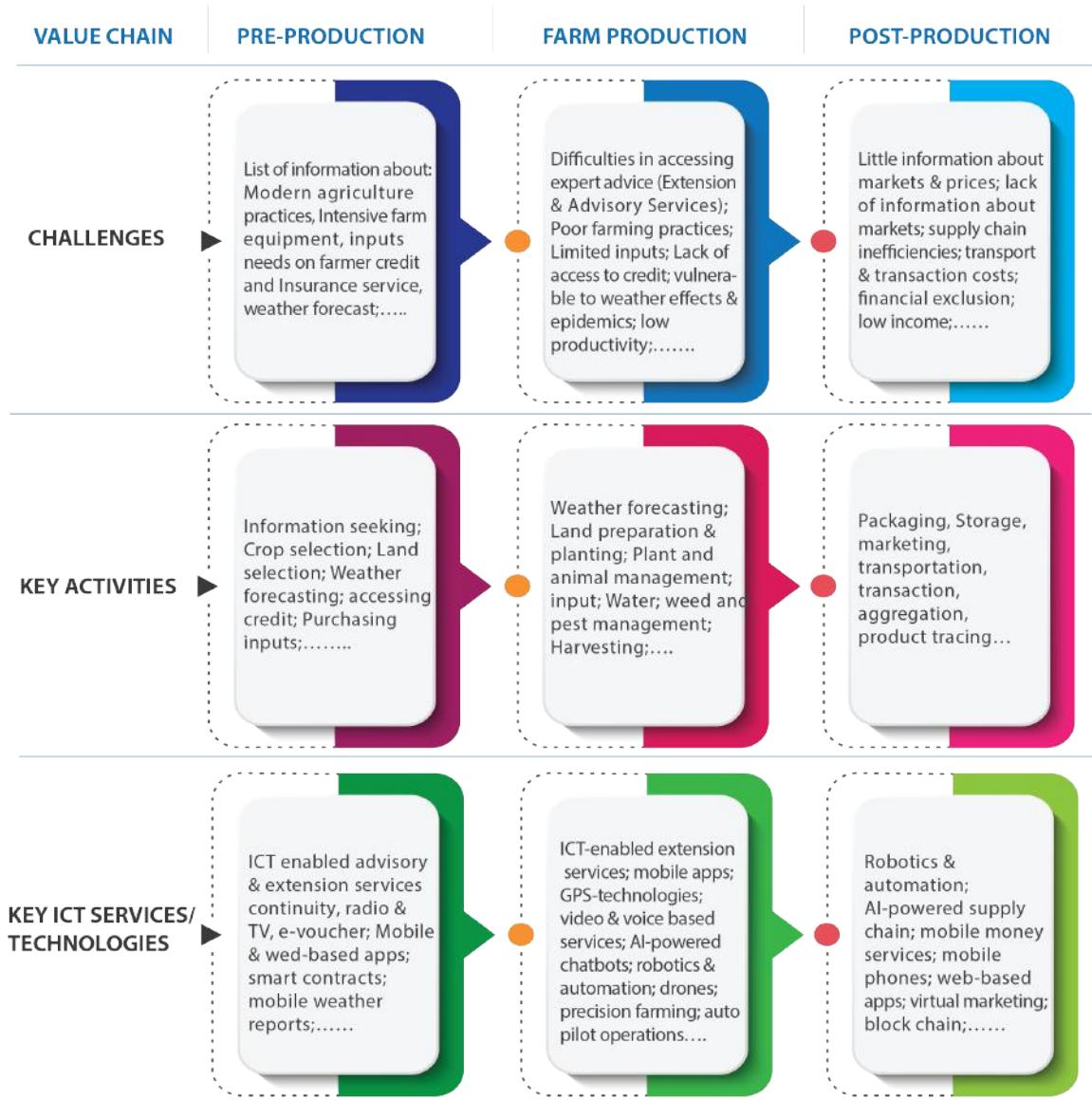


Figure 1.1: Agricultural life cycle, associated challenges, activities and key technologies

1.2. Comprehensive Africa Agriculture Development Programme (CAADP)

The CAADP is a commitment by African countries to pursue economic growth through agriculture-led development to reduce poverty and hunger on the continent. It stems from the failure of previous interventions on the continent largely attributed to their weak ownership. CAADP serves as a framework that adds value to national and regional strategies for the development of agriculture. Some of its key principles that are expected to add value are the building of partnerships; dialogue; peer review; and mutual accountability at all levels as well as exploitation of regional complementarities. CAADP countries are expected to achieve 6 percent growth in the agricultural sector and allocate at least 10 percent of the national budget to agriculture.

The Comprehensive Africa Agriculture Development Programme (CAADP) shown in Figure 1.2 is one of the popular frameworks which have stimulated African agricultural research institutions, farmers' associations, African governments and the private

sector who believe that agriculture has a pivotal role in development. CAADP is also about boosting investment to stimulate growth in the agricultural sector through bringing together the public and private sectors and civil society across the continent to promote agro-centric investment, improve coordination and collaboration. It has also been ratified by the AU and identified as the framework that engenders inclusive growth in agricultural transformation. However, ICT innovations needed special attention in CAADP. It lacks emphasis on how ICTs should be deployed and institutionalised to revolutionize the agricultural sector. Hence this national AgriTech Strategy is to a larger extent informed by the Continental AgriTech Blueprint.

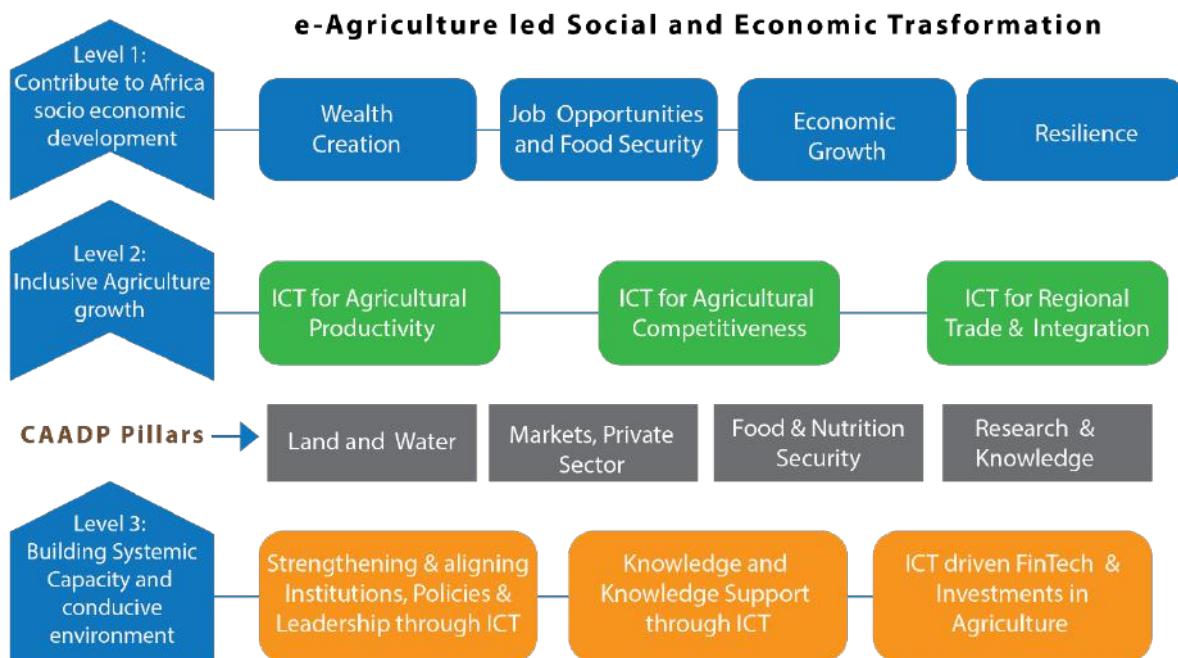


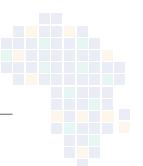
Figure 1.2: E-Agriculture led Social and Economic Transformation

1.3. Current Development Frameworks - SDGs, Agenda 2063, Vision 2030 (NDS1, NDS2)

Basically, the proposed AgriTech strategy for Zimbabwe is expected to enhance the following developmental frameworks: SDGs, Agenda 2063, Vision 2030 (NDS1, NDS2); hence this section provides an overview of these frameworks.

1.3.1. SUSTAINABLE DEVELOPMENT GOALS (SDGS)

Zimbabwe continues to commit herself to SDGs, with special emphasis on SDGs 2 – 9, 13 and 17. The prioritisation exercise is mainly guided by the country's Vision 2030 as well as by the need to focus on enabling Goals, resource availability and the country's unfinished business from the Millennium Development Goals (MDGs). Sustainable development is a fundamental constitutional imperative and an overall strategic objective for the country. In line with SDG1, the government of Zimbabwe has prioritised ending poverty as informed by and reflected in the country's Vision



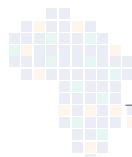
2030 policy framework. In line with SDG2, the country also prioritizes ending hunger and ensuring food security and nutrition within its overall development agenda as informed and reflected in the country's recently launched "zero-hunger strategy". As such, through SDG5 the government of Zimbabwe remains committed to the achievement of gender equality and women's empowerment. ICTs can be a leading vehicle for women and youth inclusion in agriculture (Bhattacharjee & Raj, 2018; Braimok, 2017; FAO, 2014; Joan, 2014).

1.3.2. AFRICA AGENDA 2063

Over the period 1963 – 2013, Africa focused its collective on the decolonisation, the struggle against apartheid and the attainment of political independence for the continent. On the occasion of the golden jubilee (May 2013), of the Organisation of African Unity (OAU)/ African Union (AU) which spearheaded the decolonisation process, the continent re-directed herself to the attainment of the Pan African Vision of "An integrated, prosperous and peaceful Africa, driven by its citizens, representing a dynamic force in the international arena. To achieve this vision, Agenda 2063 became a reality (The African Union Commission, 2016). Agenda 2063 is the continent's blueprint and master plan for transforming Africa into a global powerhouse of the future and provides a 50-year development plan that is broken down into five (5) Ten-Year Implementation Plans. The First Ten-Year Implementation Plan of Agenda 2063, spanning from 2014 to 2023, outlines a set of goals, priority areas and targets that the continent seeks to achieve at national, regional and continental levels (AUDA-NEPAD, 2020). Goals 5-7 of the First Ten-Year Implementation Plan of Agenda 2063, essentially seek to transform agriculture through ICTs to improve agriculture production and productivity as well as promote environmentally sustainable climate-resilient communities.

1.3.3. VISION 2030 (NATIONAL DEVELOPMENT STRATEGY (NDS) 1 & 2)

Vision 2030 is Zimbabwe's current main aspiration to become an upper-middle-income society by 2030. To achieve this vision, the government came up with NDS1 (January 2021 – December 2025) as well as NDS2 (January 2026 – December 2030). NDS1 is the first 5-year Medium Term Plan aimed at realizing the country's Vision 2030, while simultaneously addressing the global aspirations of the SDGs and Agenda 2063 (Government of Zimbabwe, 2020). NDS1 is envisioned to stimulate the economy onto a sustainable growth path to realize an average of 5% GDP growth rate per annum over the strategy period. In agriculture, fundamental to the projected economic growth is resolving the security of land tenure and the adoption of climate-AgriTech practices such as Pfumvudza/Intwasa. NDS1 seeks to upscale innovation and modernization of agriculture, including ICT-based advisory services, automation of mechanization and irrigation, and precision farming such as drip irrigation, fertigation and smart greenhouses as well as the use of satellite technology to provide real-time agricultural information, especially for smallholder farmers.



2. CONTEXT OF AGRICULTURE IN ZIMBABWE

Agriculture is the most important economic activity in Zimbabwe with all the provinces involved in either crop production and/or animal husbandry.

2.1. THE STATE OF ZIMBABWE'S AGRICULTURAL SECTOR

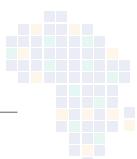
The main food and cash crops in Zimbabwe include maize, wheat, small grains (millets and sorghum), tobacco, cotton, sugar, horticulture (food and non-food), and groundnuts. It has been noted that over the years, crop production in Zimbabwe is highly variable due to the heavy reliance on rain fed agriculture. It is now understood that changing climatic conditions and frequent droughts contribute heavily to the volatility in crop production.

The survey¹ noted that small scale farmers lack the necessary resources, infrastructure and proper agronomic practices to boost their yields. A robust production and productivity enhancement programme driven by governments targeting low yielding smallholder farmers will go a long way in securing the nation's food security while at the same time increasing smallholder farmer earnings since they will be able to produce a surplus.

The livestock sub-sector is an important and integral part of the agricultural sector with beef, dairy, small ruminants, pigs, poultry, apiculture, aquaculture and other small and emerging stock making up the industry. The sub-sector contributes about 19 percent to the agricultural GDP (Ministry of Agriculture, 2018). The FTLR (Fast Track Land Reform Programme), combined with significant fluctuations in macroeconomic conditions, and a transformed agricultural sector post 2000 influenced major changes within the livestock sector. The land redistribution exercise has increased participation to more than 300,000 newly resettled farmers with varied skills and resources in livestock farming. This transformation of the sector has led to substantial shifts in ownership, use, and livestock management; and associated effects on animal disease management, production and marketing. Challenges faced in the sector due to the transformation were identified as diseases, lack of access to affordable funding, expensive inputs compared to the region and depressed cereal production.

Against this background, there is to find ways and means to include technologies which will help improve production and productivity on the crops and on the livestock will improve the capacity for farmers to run cattle and animal rearing as a serious business. In addition, technology helps to create strong value chains linkages between farmers, the Cold Storage Company, meat processors and abattoirs.

Evidence derived from this survey¹ shows that 85% of the outputs from the agricultural sector are channelled towards the local market while 15% is exported. The study noted that 25% of the produce is sold at farm gate while 75% of the output is marketed via various wholesale and retail markets. Farmers bemoan postharvest losses at the



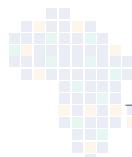
farm and loss of margins as a result of middlemen. It is often observed that farmers, in many cases, fail to meet the market needs in time. One way to improve access to markets for grains is to establish the commodity exchange. Further, enactment of the backward integrated policy in line with local content policy as noted in Nigeria by the World Bank (2017) was seen as an effective tool of creating market linkages. An integrated value chain consisting of active out grower schemes and synergies with retailers and processing companies guarantees a market to farmers, reducing post-harvest losses.

2.2. NATURAL AGRICULTURE POTENTIAL

Zimbabwe has 5 natural farming regions and a tropical climate which enable the country to produce up to 23 crop enterprises and a wide range of livestock enterprises. The farming regions are demarcated on basis of the rainfall regime, soil quality, agricultural activity and vegetation among other factors as shown in Table 2.1. The quality of the land resource declines from Natural Region (NR) I through to NR V and Table 2.1 also includes the provinces in the countries.

Table 2.1: Agro-Ecological Zones

Natural Region	Province Spread	Ave. Rainfall (mm)	% Total Land	Characteristics	Agricultural Activity
I	Manicaland	> 1050	2	High rainfall, specialized and diversified	Forestry, tea, coffee, fruit, intensive livestock
II	Mashonaland Central, Mashonaland East, Mashonaland West, Manicaland, Harare	750 – 1000	15	High rainfall	Maize, flue-cured tobacco, cotton, sugar beans, horticulture, intensive animal husbandry, coffee, irrigated wheat and barley, sorghum, groundnuts
III	Manicaland, Midlands	680 – 800	19	Periodic droughts, unreliable start to rain season, mid-term dry spells	Semi-intensive farming, extensive beef ranching, marginal maize, millet, sorghum



IV	Masvingo, Matabeleland South, Matabeleland North, Manicaland, Midlands, Bulawayo	450 – 650	37	Too dry for successful crop production without irrigation, prolonged mid - term dry spells	Marginal millet, sorghum, extensive beef ranching, game ranching
V	Masvingo, Matabeleland South, Manicaland, Bulawayo	< 450	27	Too dry for successful crop production without irrigation, prolonged mid- term dry spells	Marginal millet, sorghum, extensive beef ranching, game ranching

Source: Adapted from Moyo, 2000; Vincent and Thomas, 1961

This agriculture potential remains to be fully exploited. The AgriTech Strategy will seek to promote the exploitation and realisation of the full potential of these natural resources. Fig 2.1 below shows the types of farmers in Zimbabwe:

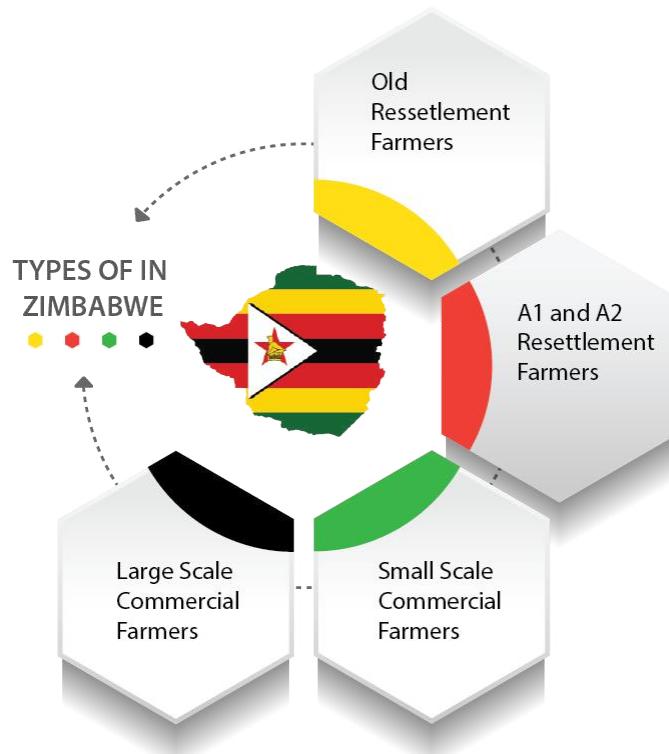
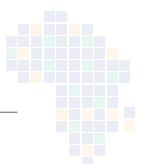


Figure 2.1: Types of Farmers in Zimbabwe



2.3. CHALLENGES FACED BY SMALL SCALE COMMERCIAL, OLD RESETTLEMENT SCHEME AND COMMUNAL LANDS FARMERS

Given that large scale farmers in Zimbabwe are basically well resourced as compared to other farming groups, there is a need to focus on the most struggling farmer groups, that is, smallholder farmers, especially. The problems below militate against efficient agricultural productivity by smallholder farmers in the country:



2.4. LEVERAGING ON ICTS TO ACCELERATE SMALLHOLDER FARMERS' DEVELOPMENT AND PARTICIPATION IN THE AGRO-INDUSTRY

ICTs are an important contributor to modern economies (Carrigan, 2020). Therefore, ICTs are considered as cross-cutting drivers of change for agricultural development in the sense that they improve agricultural productivity (Richardson, 1997). Conventional wisdom indicates that ICTs have a transformative impact on sustainable agricultural development in countries where the government and policy makers are committed to developing comprehensive AgriTech strategies (Dentoni et al., 2012; Waddock et al., 2015) biased towards smallholder agriculture. After all, most agriculture in Africa is carried out by smallholder households.

Various technologies have great potential to transform small-scale and commercial agriculture in Zimbabwe. Supporting the current practices of traditional agriculture with emerging technologies can improve the performance, quality and volume of production. This section provides an overview role of ICT in AgriTech and potential benefits of AgriTech; status of ICT Infrastructure, services and Adoption; uptake and use of ICTs and Regional and Global Benchmarks; and the adoption of digital technologies in AgriTech. There is need to deploy ICTs and agriculture technologies in order to speed up the development and participation of smallholder farmers in the agro-industry in Zimbabwe.

In Zimbabwe, ICTs are envisioned to enhance smallholder farmers' agricultural productivity in a sustainable manner. Hence the need to leverage on ICTs for:

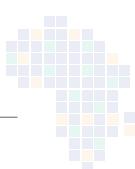
- ✖ Timely market information
- ✖ Financial services
- ✖ Weather forecasts
- ✖ Enabling efficient smallholder value chains
- ✖ Keeping and accessing project records
- ✖ Getting mentorship for farmers
- ✖ Diagnosing crop and animal diseases
- ✖ Reducing transaction and information costs
- ✖ Enhancing transparency in governance, business registration and land administration
- ✖ Improving women's control over income and their overall access to financial services
- ✖ Smart packaging of products for appeal, labelling and traceability.
- ✖ Encourage and advocate for the adoption of AgriTech
- ✖ Build rural youth skills on ICTs
- ✖ Training of rural youths in commercial agriculture
- ✖ Including rural youth in agriculture value chains
- ✖ Present agriculture as a reputable and respected discipline in order to attract youths to also engage in smallholder farming as a business
- ✖ Create a conducive business environment
- ✖ Facilitate access to land and credit
- ✖ Increasing overall efficiency, productivity and sustainability
- ✖ Open-up new business opportunities by allowing easier contact with friends, colleagues and relatives.

2.5. CLIMATE CHANGE AND RAINFALL PATTERNS

Agriculture can be affected by various factors such as climate and rainfall patterns (Ojo & Ilunga, 2017). These factors are threatening Agricultural productivity. Due to climate changes, weather patterns have become unpredictable and unstable such that farmers can no longer rely on their seasonal routines, stimulus and intuition to make farming-related decisions.

2.6. LOW PRODUCTION AND PRODUCTIVITY IN PRIORITY CROP AND LIVESTOCK VALUE CHAINS

The production and productivity of the priority agriculture value chain have generally been on a declining trend. Below is a figure showing crop productivity (proxied by crop



yield in terms of tonnes (t) per hectare (ha)) for five major crops in Zimbabwe; that is, maize, soya bean, cotton, wheat [1980–2020] and tobacco [1994–2020].

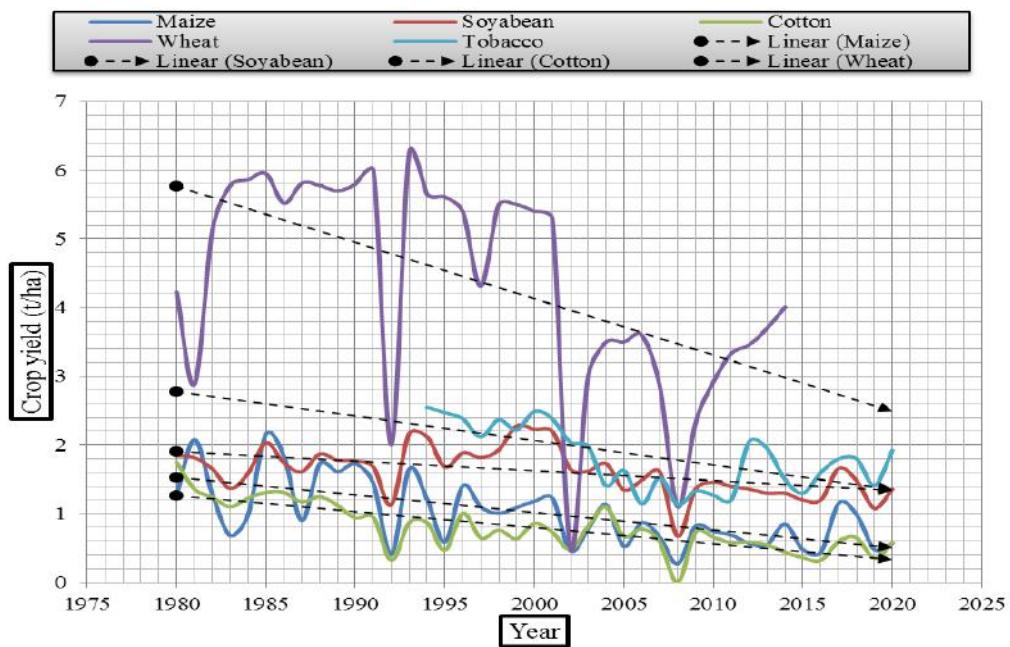


Figure 2.2: Crop productivity

In the Figure 2.2 shown, crop productivity is measured in terms of tonnes per hectare. Worthy to note is the fact that over the period 1980 – 2020, productivity has been generally following a downwards trajectory. This has also been confirmed by several researchers such as Tibugari et al. (2019) who particularly noted that maize productivity remained poor in the country over the past two decades. Wheat and tobacco are the crops that relatively performed better in terms of productivity over the past four decades. Additionally, we use the crop production index to analyze overall crop production trends in the country. The World Bank (2021) noted that the crop production index shows agricultural production and includes all crops except fodder crops.

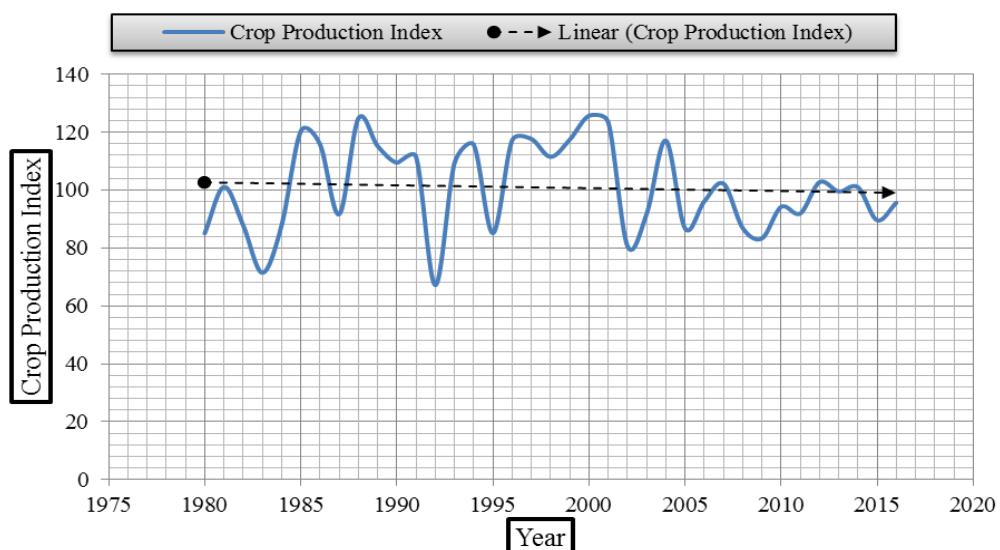


Figure 2.3: Crop production index

As shown in the figure 2.3 above, the crop production index points have been slightly declining over the period 1980 to 2016. This also explains why there is a marked decline in crop productivity as shown in Figure 2.2 above. In a desirable scenario, we would expect to see the crop production index points generally increasing. The continuous decline in crop productivity is happening against a population that is expected to reach 19 million by 2030 causing a further increase in the demand for food against a background of the negative impact of change climate, manifesting as increased temperatures, changes in rainfall patterns, more frequent droughts and extreme weather events including droughts, emergency of new pest and diseases resulting in reductions in water availability. This means that Zimbabwe is expected to produce more, with less rainfall, and increased pressure of pests and diseases all exacerbated by the Covid-19 pandemic containment measures.

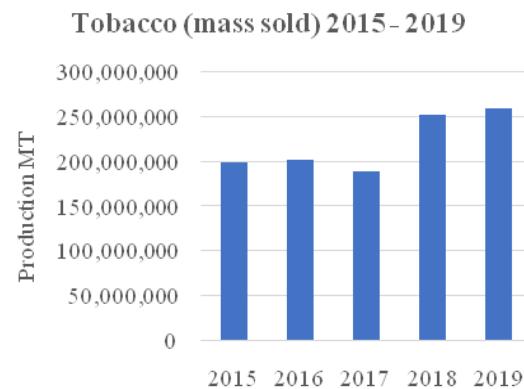
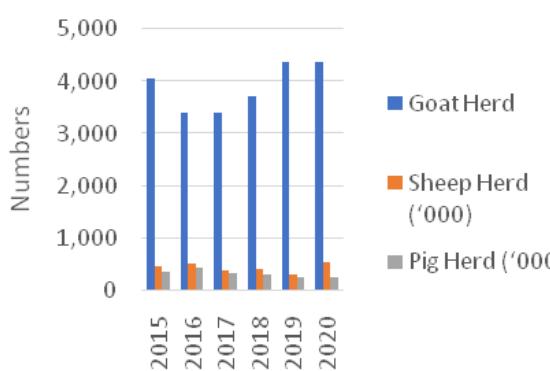
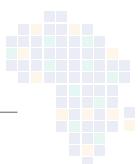


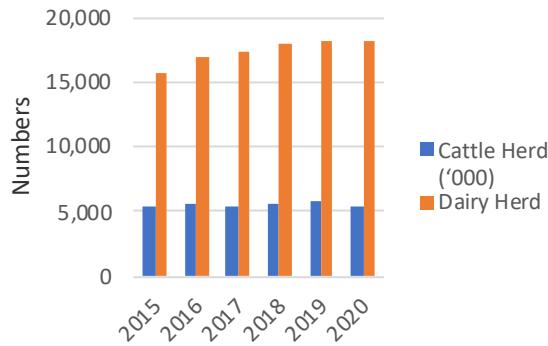
Figure 2.4: Field Crops Production: 2015 – 2019 **Figure 2.5: Tobacco Production 2015 - 2019**

Source: MLAFWRR

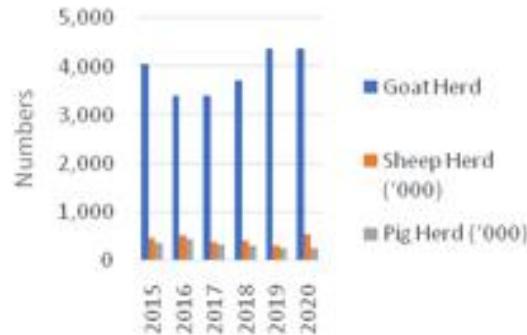
Source: MLAWRR

The livestock sub-sector is an important and integral part of the agricultural sector with beef, dairy, small ruminants, pigs, poultry, apiculture, aquaculture and other small and emerging stock making up the industry. The sub-sector contributes about 19 per cent to the agricultural GDP. The Land redistribution Programme, combined with significant fluctuations in macroeconomic conditions, and a transformed agricultural sector post-2000 influenced major changes within the livestock sector. The land redistribution exercise has increased participation to more than 300,000 newly resettled farmers with varied skills and resources in livestock farming. This transformation of the sector has led to substantial shifts in ownership, use, and livestock management; and associated effects on animal disease management, production and marketing. Challenges faced in the sector due to the transformation were identified as diseases, lack of access to affordable funding, expensive inputs compared to the region and depressed cereal production. The figures below show livestock numbers as well as the livestock production index:



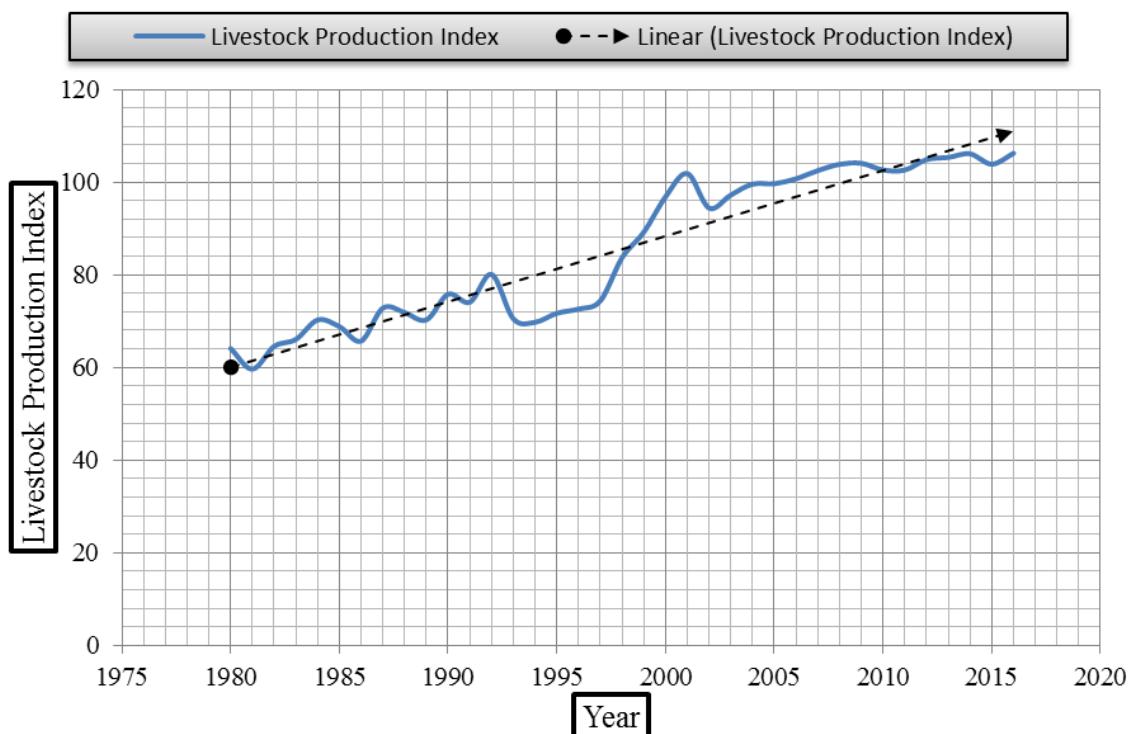
**Figure 2.6 Cattle and dairy numbers**

Source: MLAFWRR 2020

**Figure 2.7 Small stock numbers**

Source: MLAFWRR 2020

The livestock production index, according to the World Bank (2021); includes meat and milk from all sources, dairy products such as cheese, and eggs, honey, raw silk, wool, and hides and skins.

**Figure 2.8 Livestock production index**

As shown in fig 2.8 above, livestock production index points for Zimbabwe were 64.11 in 1980; and have substantially grown to approximately 106.25 index points by 2016. This indicates growth and viability in the livestock sector in Zimbabwe.

Fisheries production in Zimbabwe is an increasingly growing opportunity and is getting increasingly widespread in the country. Zimbabwe's fishery sector comprises the capture fishery, aquaculture and recreational fishery. The main fish stocks exploited

by commercial farmers in Zimbabwe are within 5 reservoirs namely Kariba, Chivero, Manyame, Mutirikwi and Mazvikadei. The largest fishery is on Lake Kariba and contributes almost 90% of the country's fish production. Post-harvesting processing for fish is limited in the country largely because the infrastructure in place is minimal. Zimbabwe has limited fisheries output even though the country has at least 136 major dams. The figure below shows total fisheries production in metric tonnes.

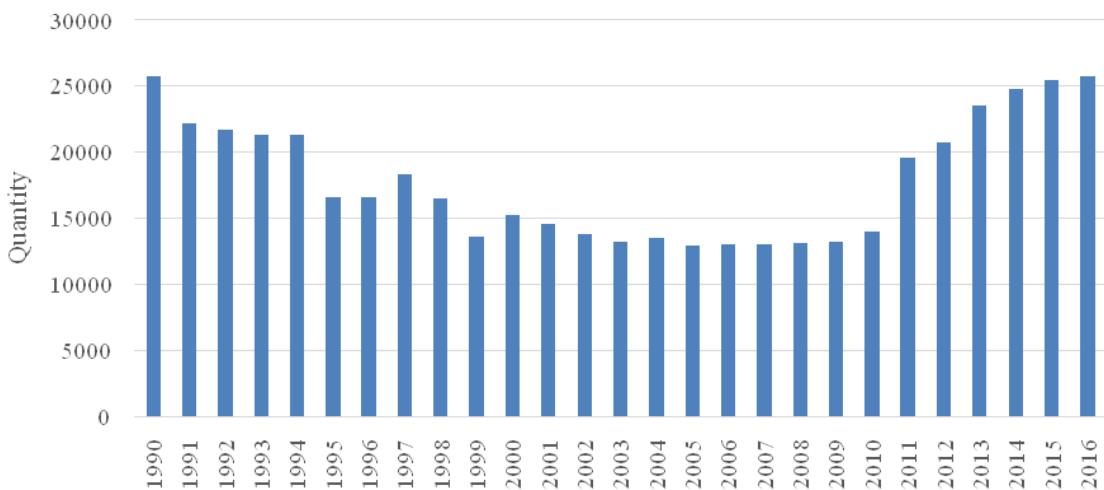


Figure 2.9: Fisheries Production (MT)

Source: World Bank (2021)

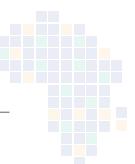
The AgriTech Strategy will provide better information for farmers to make more informed decisions to improve farm performance. Through the increasing use of digital technology, agriculture can attract and retain younger generations to live and work in regional and rural communities. Digital agriculture provides an opportunity to create stronger regional and rural communities which are connected through the use of technology.

2.7. HIGH COST OF PRODUCTION AND LIMITED ACCESS TO INPUT AND OUT PUT MARKETS

The cost of production and hence the price of agriculture inputs such as seed, fertilisers and chemicals are mostly out of reach of the predominant farming sector, the smallholder farmers (Lencucha, 2020). There is thus a high dependency on imports against a backdrop of foreign currency shortages. The result is low input use and access to mechanisation and irrigation equipment and facilities due to unaffordable prices and limited access to and costly finance for capital development. Given the factors confounding the Agriculture sector, the use of Information Communication and Technology (ICT) is vital in addressing the aforementioned challenges.

2.8. AUTOMATED IRRIGATION AND AGRICULTURE MACHINERY

There is a great need to modernise agricultural practices for better water productivity and resource conservation. Efficient water management is a major concern in precision irrigation practices. The use of automated irrigation systems can provide



water on a real-time basis at the root zone, based on the availability of soil water at the crop root zone, which also leads to the saving of water (Ojha et al., 2015). Irrigation scheduling remains a reliable technique for applying the required amount of water at the appropriate time, and automated irrigation systems based on crop water needs. Thus, automated irrigation systems (AISs) are critical for the sustainability of irrigated farming systems, considering the present water crisis in Zimbabwe caused by low rainfall.

2.8.1. IRRIGATION SYSTEMS

Zimbabwe has a semi-arid climate that negatively affects dry land agricultural production with resultant periodic severe socio-economic challenges including low farm incomes, increasing poverty, hunger and malnutrition. Climate change variability is projected to result in a drier and warmer climate in the country in the decades ahead. This will increase the frequency of droughts and dampen the prospects for successful agricultural production for national food security, import-substitution, and employment creation and value addition unless measures are taken to climate-proof agriculture. Zimbabwe's estimated 10 000 dams have the potential to irrigate over 2,000,000 hectares. A paltry 216, 000 ha have been developed. The developed area includes 55,000 – 60,000 hectares under plantations, leaving annual cropping potential at 120,000 hectares discounting the 45 000 ha which is non-functional on A1 and A2 farmers. Smallholder irrigation schemes in Communal and Old Resettlement areas are on 26, 000 ha. Additionally, about 25 percent of wetlands are found in communal areas where they are used for vegetable and field crop production. Annually, during the drier months, vegetable gardens are established along most streams and rivers in the smallholder sector.

Irrigation water management faces several challenges due to inefficient irrigation technologies and poor water management practices. About 26% of the irrigated area in the country is under centre pivot and drip irrigation systems. These systems are more efficient than surface and sprinkler irrigation. In many surface irrigation systems, up to 50% loss of water is not utilised.

The table below shows the distribution of various working irrigation types in the country.

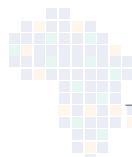


Table 2.2: Irrigation systems in Zimbabwe

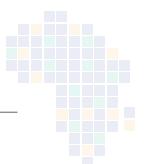
Type	Area (ha)	%
Centre pivot	57 815	33
Drip	4 599	2,6
Surface	37 098	21
Sprinklers	75 488	43
Total	175 000	100

2.8.2. MECHANISATION DEVELOPMENT

Farm power (from human, animal and engine driven sources) is a crucial input in the agricultural production process at any level of economic development. Shortages of farm power compromise the ability of families to cultivate sufficient land and are a major contributory factor to the increasing prevalence of poverty in Zimbabwe. Farm-power availability is not simply a matter of promoting a certain technology or equipment, it shows that all aspects of the livelihoods of a rural household are connected to and affected by the available farm-power base. Appropriate mechanisation optimises efficiencies, productivity and production, which in turn and ultimately increases agricultural value chain competitiveness. Tillage implements, planting units, spraying equipment, detasseling machines, harvesting equipment and drying equipment are good examples of mechanisation which need to be embraced and promoted in our farming systems.

Zimbabwe is implementing various mechanisation programmes namely the Belarus scheme, John Deere Scheme, the Brazil More Food for Africa as well as promoting the local manufacture of implements. The objective of these schemes is to bridge the divide and remove the focus from tractors and intermediate technology but rather more comprehensive mechanisation systems that focus on managing a farming system in space and time. The country currently has 15 000 tractor units, but only 6 000 units are functional while the optimum is about 45 000 – 50 000 tractor units. In irrigation, the country has 206 000 hectares of developed irrigation infrastructure out of which 153 000 is functional. This is against the potential of irrigating up to 2 million hectares using water in existing dams. Huge investments are therefore required in mechanisation and irrigation development, and smart solutions should be integrated into these investment efforts as part of a modernisation drive.

The focus of farm power and mechanisation in Zimbabwe is now to consolidate different sources of power, mechanisation, machines, equipment and tools in a much broader context of sustainable production intensification and agricultural transformation. In the Agriculture and Food Systems Transformation Strategy, intensification and transformation are based on increased labour productivity along



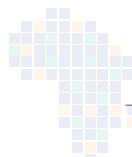
supply and output value chains, including on-farm labour productivity and employment generation which mechanization can make possible as increased volumes of output are envisaged to be handled to meet future demands for food and other biological products from agriculture.

2.8.3. AGRICULTURE EXTENSION AND ADVISORY SERVICES

Extension, communication and farmer education is key for technology adoption, innovation and modernisation to improve agricultural productivity in Zimbabwe. The farmer to extension worker ratio is high. This is further alleviated by geographical separation, making it difficult for extension workers to efficiently reach farmers. The AgriTech strategy will promote investment in interventions that address challenges facing both the extension personnel and the farmers.

2.8.4. CROP PROTECTION AND POST-HARVEST HANDLING INFRASTRUCTURE

Generally, failure to control weeds during the first five weeks of a crop cycle leads to a 50% yield reduction. The correct use of herbicide technologies (pre-emergence and post-emergence) can help keep fields weed-free. Fall Armyworm pest is proving to be a menacing pest, and a real threat to farmer productivity and food security in Zimbabwe, but the use of registered pesticides technologies can help avert yield losses from this and other pests. The same applies to fungal diseases and fungicide technologies in crop production systems. Annually, 25 to 30 % of yield is lost due to poor Post Harvest Handling (PHH) of agricultural produce. PHH technologies including metal silos, grain protect ants, grain bags, refrigerated trucks/containers, modern granaries and fumigants etc. must be promoted to avert PHLs.



3. CONTEXT OF AGRITECH IN ZIMBABWE

The status of ICT infrastructure, services and adoption underpin the success of the implementation of AgriTech.

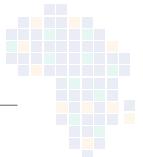
3.1. STATUS OF ICT INFRASTRUCTURE

The uptake and use of ICTs has greatly increased in recent years resulting in considerable reduction in the "digital divide" between inter-urban, rural and urban areas. The Inter-Census Demographic Survey (ICDS) conducted by the Zimbabwe National Statistics Agency (ZIMSTAT) from 18 to 23 August 2017, which was officially launched in May 2018, shows that the country's literacy rate stands at 94 percent - the highest in Africa and this, in a way, has contributed to the increased uptake of ICTs in the country. This growth is evidenced by Zimbabwe's ICT indicators where mobile penetration has reached 93.1% and internet penetration was at 62.9% as at 31 December 2018. The national 2G and 3G coverage stands at 93% and 84% respectively against the regional survey of 92% and 73%. Zimbabwe stands at 35% against a regional average of 42% in respect of LTE Population coverage.

Telecommunication services in Zimbabwe are very competitive, with eight (8) operators in the country making retail offerings. TelOne is State-Owned and offers, among others, fixed Internet through capped and uncapped ADSL, with speeds up to 4 Mbit/s, an optical fibre with speeds up to 50 Mbit/s, and via satellite. There are three mobile operators namely, Econet, NetOne and Telecel where NetOne is State-Owned and Econet is privately owned and has the largest market share. The three mobile network operators continue to invest in network upgrades to support data services and their fast-expanding m-commerce and m-banking facilities. Two other operators Powertel and Africom primarily provide CDMA based (fixed-wireless) telecommunications services. Liquid Telecom is another private sector operator that provides optic fibre networks and other services in the country and has also expanded its network to several countries in southern and East Africa regions.

The countrywide transmission backbone spans over 3000 km, using microwave radio, fibre optic and, in some cases, open-wire systems. The bulk of the network is now digital, with a few links still analogue. The country uses Access Network, a network that provides last-mile connectivity from switches and the customer premises equipment (CPE) that interfaces the user and the telecommunications network. The main technologies employed are as follows:

- ✖ Optic fibre cable
- ✖ Copper cables (underground & overhead)
- ✖ Code Division Multiple Access (CDMA) Wireless
- ✖ Point to point/multipoint radio systems



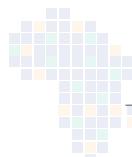
Despite its landlocked situation in Southern Africa, Zimbabwe has a vibrant backbone market, with cross-border connections to several submarine cables (ITU, 2018). The country's National Broadband Backbone (NBB) has three international connections. The transmission network has over 9,500km of fibre interconnecting major cities and towns across the country. There are several backbone operators in the market. The leading ones include TELONE, Liquid Telecom and POWERTEL, which have developed fibre-optic routes throughout the country and to the borders of neighbouring countries. Tel-One is a key player in the Zimbabwean ICT industry, whose network provides the main backbone network on which other players ride their services. The company operates an internet hub in Harare that boasts over 10 Gbps international bandwidth.

POWERTEL is notable as a subsidiary of the Zimbabwe Electricity Supply Authority, and it offers retail broadband services. The national fibre-optic backbone connections to Mozambique and South Africa enable access to the SEACOM, West African Cable System (WACS) and East Africa Submarine System (EASSy) undersea fibre-optic cables. Thus, Zimbabwe is now connected to the undersea optic fibre cable networks through SEACOM and EASSY cables in the Indian Ocean and WACS cable in the Atlantic Ocean. The efforts from the public and private sector operators in this development are commendable.

Table 3.1: Overall ICT global benchmarks for Zimbabwe

Key ICT indicators for Zimbabwe (2017)	Africa	World
Fixed-telephone sub. per 100 inhab.	0.9	13.0
Mobile-cellular sub. per 100 inhab.	74.4	103.6
Active mobile-broadband sub. per 100 inhab.	24.8	61.9
3G coverage (% of the population)	62.7	87.9
LTE/WiMAX coverage (% of population)	28.4	76.3
Individuals using the Internet (%)	22.1	48.6
Households with a computer (%)	8.9	47.1
Households with Internet access (%)	19.4	54.7
International bandwidth per Internet user (kbit/s)	11.2	76.6
Fixed-broadband sub. per 100 inhab.	0.6	13.6
Fixed-broadband sub. by speed tiers, % distribution		
-256 kbit/s to 2 Mbit/s	38.7	4.2
-2 to 10 Mbit/s	37.2	13.2

Source: ITU (as of June 2018)



3.2. SERVICES AND ADOPTION

Rapid and robust infrastructural development and rejuvenation has enabled the development and availability of a plethora of e-services, which consumers have embraced as easier means to communicate and transaction between person to person, person to business and business to business, government to government and various e-Government services to the citizenry. There has been an increase in the adoption of mobile money transfer, mobile wireless broadband, use of plastic money and various social applications such as WhatsApp, Facebook, Twitter, YouTube and Skype, to name but a few.

3.3. ROLE OF ICT IN AGRITECH AND POTENTIAL BENEFITS OF AGRITECH

AgriTech is defined as the collection of digital technologies that provide the agricultural industry with the tools, data and knowledge to make more informed and timely on-farm decisions and improve productivity and sustainability (GSMA AgriTech, 2020). FAO and the ITU communities and ecosystems have adopted an all-inclusive model that shows the Role of ICTs in Agriculture as shown in Figure 3.1 below. The centrality of ICTs cannot be disputed and its cross-cutting nature is evident in all stages of the agricultural process. Proper policies and regulatory frameworks must be developed to facilitate the smooth and effective deployment of ICTs. The technologies are enablers and crosscutting in nature and therefore contribute significantly in bridging the digital divide, financial inclusion and enhanced markets. ICTs play a significant role in weather forecasting, disaster management and early warning systems (Fergus & Chioma, 2017). Agricultural Extension and advisory services to support food security through environmentally sustainable farming are enhanced and better managed through the use of ICTs. Capacity development and continuous retraining of personnel in the agricultural ecosystem is critical to keep abreast with continuous technological developments. The role of ICTs in agriculture is summarised below in Figure 3.1.

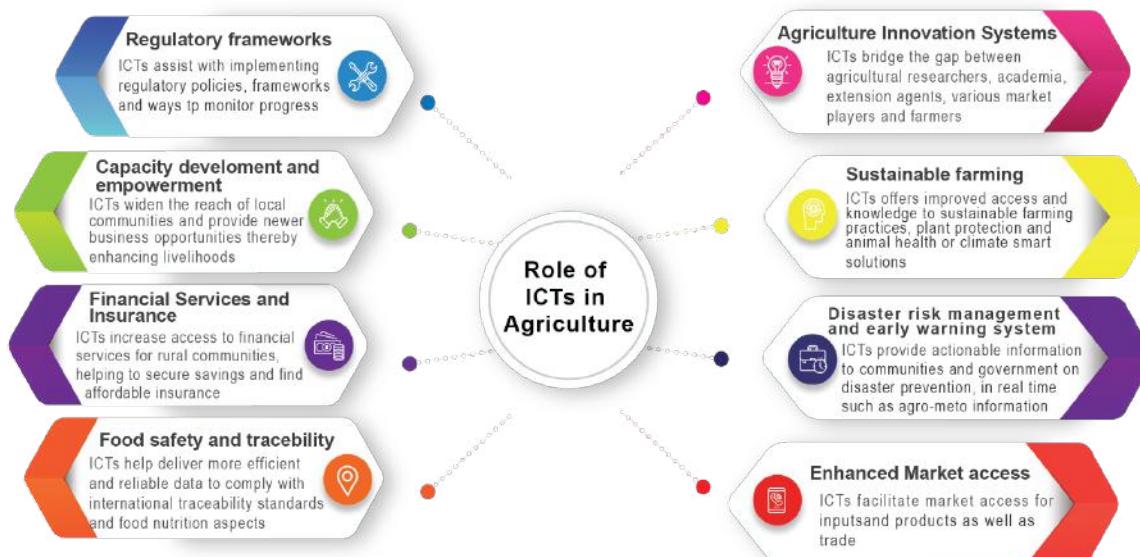
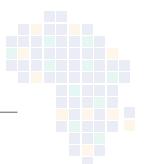


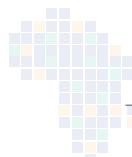
Figure 3.1: Role of ICTs in Agriculture (Source: FAO, ITU)



More specifically, Smart- Agriculture has the potential to meet the agricultural goals of Zimbabwe or any other country by contributing in the following areas:

- ✖ Improving agricultural research and national agricultural information systems.
- ✖ Facilitating international trade and domestic market access and trade.
- ✖ Improving productivity on-farm yields as well as increased asset efficiency.
- ✖ Improving agricultural extension and advisory services.
- ✖ Improving the sustainability of land and water through technologies that, for example, reduce chemical use, improve land mapping and enhance water management.
- ✖ Improving postharvest handling and logistics.
- ✖ Enhancing disaster management and early warning systems.
- ✖ Facilitating financial inclusion, credit, insurance and risk management schemes.
- ✖ Advising policies and monitoring effective implementation.
- ✖ Improving data availability and analytics for food safety and traceability.
- ✖ Enhancing linkage between government, researchers and producers which in turn facilitates effective policies.
- ✖ Improving farmers' incomes and productivity on a sustainable basis.
- ✖ Enhancing knowledge management and access to information.

Besides, the GSMA AgriTech (2020) has grouped digital agriculture solutions into three (3) categories and six (6) main uses based on the problem they solve for farmers: 1) **Access to markets** improves linkages to formal crop buyers, allowing farmers to bypass multiple intermediaries and making procurement more equitable; 2) **Access to assets**, particularly farm assets and equipment, increases productivity and farmers' incomes; and 3) **Access to services** strengthens farmers' resilience and improves access to financial services.



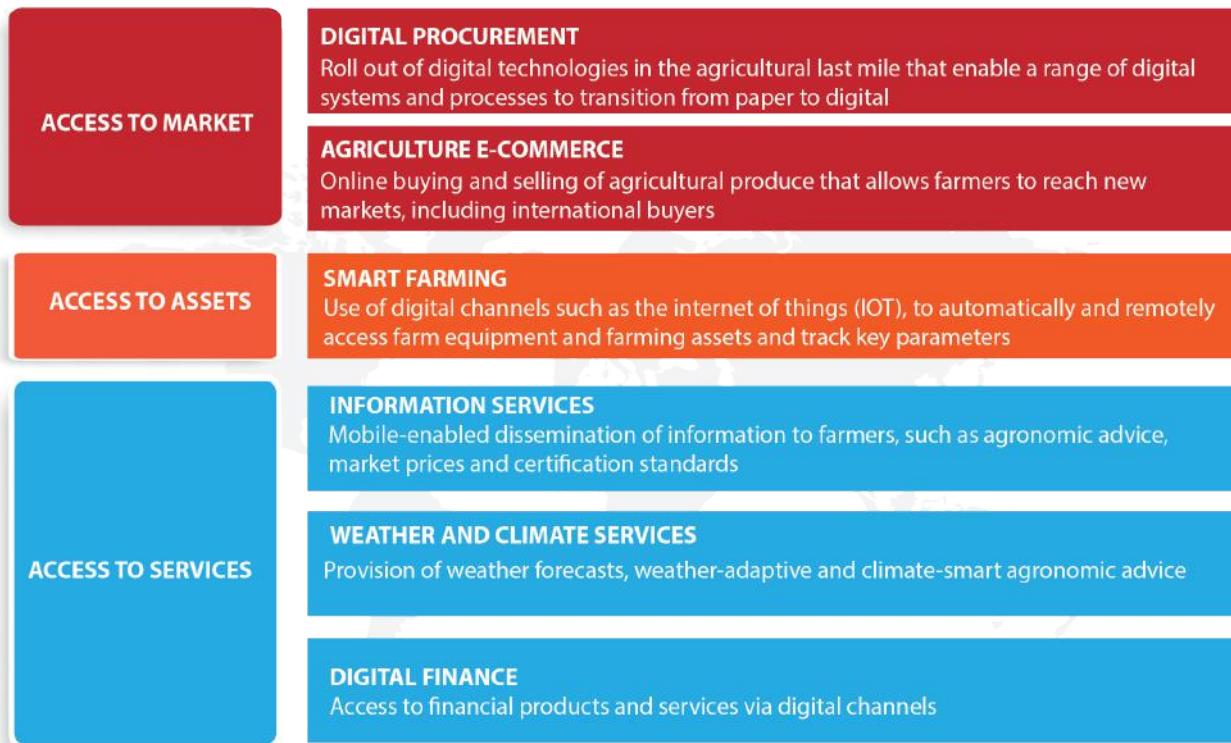
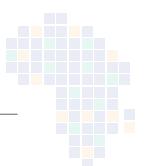


Figure 3.2: The GSMA AgriTech Toolkit for the Digitisation of Agricultural Value Chains
 (Source: GSMA AgriTech, 2020)

Furthermore, based on the Global Navigation Satellite Agency's (2015) market review report, the AgriTech application for farmers include the following:

- ✖ **Control traffic management-** uses Global Navigation Satellite Systems (GNSS) positioning to assist drivers to follow the optimal path with the use of a digital display, thereby minimising potential overlaps and input costs.
- ✖ **Automatic steering-** takes over the steering of the farm equipment from the driver allowing the operator to engage in core agricultural tasks.
- ✖ **Variable-rate application-** combines GNSS positioning with information from other sensors and digital maps to distribute the right amount of agrochemicals.
- ✖ **Crop and yield monitoring-** enables site-specific monitoring of harvest, combining the output of a yield sensor with GNSS positioning of the harvester. More specifically, optical sensors allow several parameters related to crop and vegetative health to be monitored. This can be used to direct irrigation patterns and fertiliser use.
- ✖ **Biomass, nutrient and soil condition monitoring-** GNSS positioning enables site-specific monitoring of biomass and soil quality in an agricultural field, providing up-to-date information on crop development.



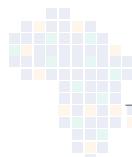
- ✖ **Livestock tracking and virtual fencing-** use GNSS-enabled portable equipment to track livestock movement and behaviour, leveraging tracking and virtual fencing.
- ✖ **Aerial spraying/mapping-** Unarmed Aerial Vehicles (UAVs) are used in precision farming support, encompassing a wide range of applications, including crop and field analysis, mid-season crop health monitoring, health assessment, planting, crop spraying and cattle herd monitoring.
- ✖ **Connecting agricultural devices:** the Internet of Things (IoTs) is the connectivity of physical devices to collect and exchange data between them. This provides farmers with an opportunity to monitor their crops and increase productivity.
- ✖ **Satellite Communications:** the concept of the 'connected farm' – where connectivity will support the integration of different agricultural activities and systems – and the productivity gains require an advanced application of satellite communications in agriculture.

3.4. AGRICULTURAL INFORMATION MANAGEMENT SYSTEM (AIMS)

According to FAO (2018), a robust agricultural information management system (AIMS) provides policy makers, planners and economic players' access to reliable and timely information that is necessary for policy development, emergency preparedness, planning and decision making in the context of programme management. It contributes directly to the main development objective of ICT driven revitalization of agricultural and natural resources growth, enhancing food security and promoting rural development.

As far back as the year 2006, the SADC regional secretariat took a stance to establish regional AIMS to spearhead the collection, analysis, dissemination, archiving of information and integration of various information systems in the region. Regular collection of data in agriculture and natural resources is mandatory to monitor progress made towards achieving targets. In Zimbabwe AIMS is a major focus area for the respective ministry to execute on.

The Integrated Agriculture Information Management System (AIMS) Implementation Plan for Zimbabwe has two focus areas: (1) Centralised and Integrated AIMS comprising Sub-Information Systems on crops, livestock, water and land systems and a Coordination Mechanism for the AIMS and the Sub-Subsystems; and (2) Establishment of a coordinated mechanism for a High Frequency Monitoring System anchored on identified and agreed indicators to activate responses and an embedded Crisis Modifiers System (CM), which are risk financing mechanisms inbuilt in existing or on-going programmes to timely avail funds for the necessary responses to preserve and conserve the initial investment and achieve intended objectives.



The Integrated AIMS will make available real-time, relevant, quality, harmonized and cost efficient agriculture statistical data and information which includes: (1) Area and yield estimation for various crops; (2) Livestock Identification and Traceability; (3) Agro ecological crop zoning; (4) Land Information Systems; (5) Information on Water and Dams; and (6) Agricultural Trade Information for sector planning and formulation, implementation, monitoring and evaluation of policies and programmes.

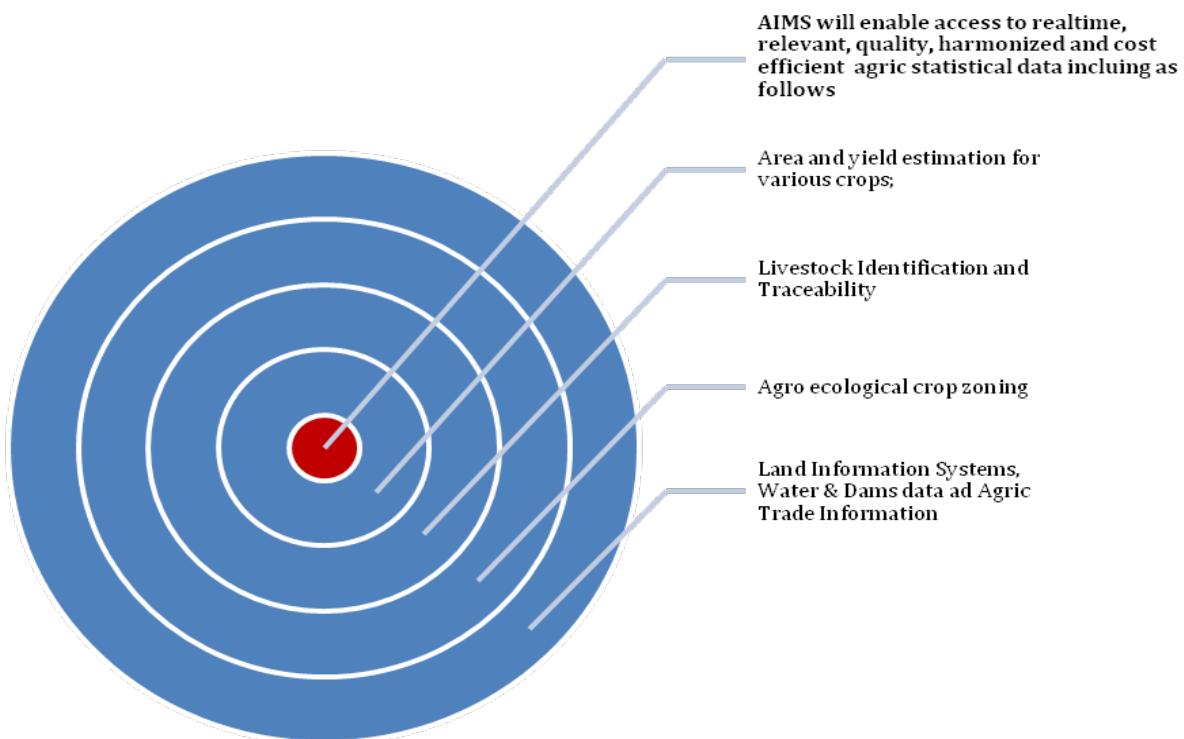
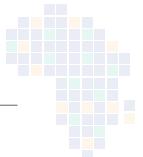


Figure 3.3: Agricultural Information Management System (AIMS)

3.5. ADOPTION OF DIGITAL TECHNOLOGIES IN AGRICULTURE

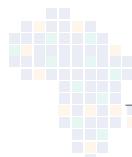
Despite the high rate of adoption and potential benefits of ICTs, agriculture is the least digitised industry in Zimbabwe, while there is no detailed study that has been conducted to assess the level of adoption of digital technologies in Zimbabwe; a rapid assessment showed that the adoption level remains low for precision farming, agriculture drones and smart greenhouses. A limited number of large-scale farmers have already made inroads into technologies that make use of integrated systems involving satellites, drones, robotics, sensors and massive data analytics. Digital sensors are already being used in automated farm machineries such as centre pivots and advanced analytics software to fine-tune precision irrigation and fertigation.

Innovative data management systems are increasingly being used to improve the efficiency and transparency of agri-food value chains. However, agriculture services that use mobile platforms and ICTs are widely being used to share production and marketing information with farmers. Examples include the Kurima Mari App, Eco farmer, eMkambo and AgriFin Mobile.



The challenges identified in the adoption of digital technologies in Agriculture are as follows:

- ✖ **Connectivity:** Appropriate connectivity is fundamental to digital agriculture with digitised farms needing widespread and reliable coverage.
- ✖ **Digital literacy:** Many farmers have not had opportunities for practical learning and exposure to technology to identify the right technology options for their farm, or how to reliably use it.
- ✖ **Cost and Investment rationale:** The value of digital agriculture has not been proven to farmers. Demonstration of return on investment is needed to boost adoption rates.
- ✖ **Data sharing:** There is a lack of confidence in data privacy and security among farmers. Agreed data sharing protocols and governance arrangements are required to encourage the sharing of data across the value chain.
- ✖ **Interoperability of datasets:** It is currently difficult for farmers to analyse data generated from multiple technologies. The ability to incorporate diverse datasets into a shared platform would allow farmers to gain greater insights and benefits from digital technologies.



4. THE METHODOLOGY USED FOR DEVELOPING A NATIONAL ZIMBABWE AGRITECH STRATEGY

This National AgriTech Strategy for Zimbabwe was developed through a multi-stakeholder consultation approach comprising the following three key stages;

- i. Review of existing secondary data to scope the AgriTech Context of Zimbabwe driven by Ministry of Lands, Agriculture, Fisheries, Water and Rural Resettlement and Ministry of ICT with support from SAGIT consultants
- ii. Virtual and physical consultative iterative in-depth meetings with representatives of respective ministries to put together the document including incorporating input from respective permanent secretaries
- iii. Aligning the overall approach with the recommendations in the Smart Africa Continental AgriTech blueprint (2021)

The Smart Africa AgriTech Blueprint for Africa was developed to assist member African countries to complete their own national AgriTech strategies highlighting Zimbabwe as the flagship country on Agriculture hence the need to immediately apply the detailed framework. The Continental AgriTech Blueprint steps are shown in Figure 4.1

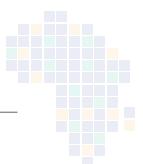


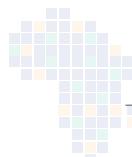


Figure 4.1: AgriTech Blueprint (Source: Smart Africa Continental AgriTech)

4.1. THE NEED FOR A NATIONAL APPROACH

According to Smart Africa's Continental AgriTech Blueprint (2021), developing a national AgriTech strategy enables respective governments to draw up a roadmap for the use of ICTs for agriculture. Zimbabwe being the flagship country, immediately operationalized the call to action to put together this AgriTech strategy which will upon implementation accrue the following benefits:

Enable the farmers to get access to all services they need such as financial services, insurance services and agricultural extension services.



Help to improve the coordinated planning and funding of e-agricultural development, making interventions more cost-effective and providing clear direction for other players, including the private sector, donors and non-government organizations (NGO).

Integrate information required by the farmers and all stakeholders in agriculture into a single access point to provide anywhere-anytime and any device information. Therefore, developing AgriTech strategy gives farmers access to the much-needed information in an integrated and comprehensive platform on pre-production; farm production; and post-production that assist to boost agricultural productivity.

Ensure collaboration among agricultural stakeholders and co-design of agricultural innovations. Transforming agriculture in Africa requires the involvement and participation of all stakeholders due to their unique interests and contributions to agriculture. This will enable the country to leverage the capacity and capability of these stakeholders as each has unique strengths.

Empower poor farmers with information and communication assets and services that will increase their productivity and income as well as ensure food security and livelihoods.

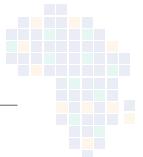
4.2. DETERMINING THE APPROPRIATE AGRITECH STRATEGY APPROACH

Given the complexity of the agriculture sector, some stakeholders may argue that the best approach to adopt is one focused on adopting an ICT strategy for a specific value chain segment/key agricultural activity. However, in order to maximize the potential from smart-agriculture at a systemic level, a holistic smart-agriculture approach is needed to clearly formulate a national vision and overall strategic objectives, to identify the e-agricultural priorities of the nation, to define the areas of intervention, as well as to define stakeholder responsibilities and necessary resources. This helps in providing a sense of common purpose and a framework for synergy amongst stakeholders at a national level.

4.3. GOVERNANCE STRUCTURE AND MECHANISMS FOR IMPLEMENTATION

The governance structure and roles should be set up early in the vision development process to gain credibility, coordinate efforts and establish the necessary expert and reference groups. A governance mechanism is a committee, council, task force or special group that has the mandate or responsibility to perform one or more of the following functions:

- i.** Oversight and steering.
- ii.** Subject-matter (expert) input across domains such as:
 - ✖ National agricultural system and services delivery, including the agricultural workforce and budget;



- ✗ National agricultural strategy and policy;
- ✗ Current ICTs and smart-agriculture environment; and
- ✗ Other aspects including national infrastructure, telecommunications, workforce development, education, finance, governance, irrigation and water management, disaster management, meteorology, etc.

4.3.1. MULTI-STAKEHOLDER AND PARTNERSHIPS AND INSTITUTIONAL ARRANGEMENTS/ STAKEHOLDER ENGAGEMENT AND CONSULTATION

The proposed Smart-agriculture governance framework should comprise a Leadership Committee, a Steering Committee and a Task Force. Working groups can be formed based on the decision of the steering committee as and when required. The joint efforts of both agriculture and ICT sectors are required for successful launching of an AgriTech Strategy vision. The compositions of the committees are suggested as under:

4.3.2. AGRITECH COMMITTEES

4.3.2.1. LEADERSHIP AND ADVISORY COMMITTEE (AS MEMBERS IN THE SUPREME BODY GOVERNING SMART-AGRICULTURE ACTIVITIES)

- ✗ Minister of Lands, Agriculture, Water and Rural Resettlement –Chairman
- ✗ Minister of ICT, Postal and Courier Services – Vice Chair
- ✗ Secretary, Ministry of Lands, Agriculture, Water and Rural Resettlement
- ✗ Secretary/Chief Director/Director-E-Government-OPC
- ✗ Secretary, Ministry of ICT, Postal and Courier Services
- ✗ Secretary/Chief Director/Director of E-Government in the OPC
- ✗ Director of Information Communication Technology – Ministry of Lands, Agriculture, Water and Rural Resettlement
- ✗ Director, Ministry of ICT, Postal and Courier Services
- ✗ Director, Economics Ministry of Lands, Agriculture, Water and Rural Resettlement,
- ✗ Director of Mechanization and Irrigation Development
- ✗ Director of Water Resources
- ✗ Director-General of POTRAZ

4.3.2.2. STEERING COMMITTEE

- ✗ Secretary, MOA(Chairman)
- ✗ Secretary, MICTPCS (Vice-Chairman)
- ✗ Secretary/Chief Director/Director E-Government
- ✗ Chief Director AGRITEX
- ✗ Director ICT-MOA

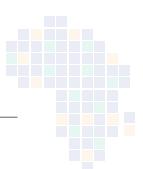
- ✖ Director Ministry of ICT, Postal and Courier Services
- ✖ Director – Irrigation
- ✖ Director Mechanization
- ✖ Director- Research
- ✖ Director of Finance
- ✖ Steering Committee reports to the Leadership and Advisory Committee)

4.3.3. SUBJECT MATTER EXPERTS

Invite experts for specific tasks to achieve well defined targets. Their terms of reference should be specific and the experts must be provided with the necessary resources. The experts should periodically report to the Steering Committee

4.3.4. AGRITECH TASK FORCE

The AgriTech Task Force should be led by a senior level officer from the ministry of agriculture and should comprise officers at director or senior management executive level from various departments of agriculture, telecom and ICTs. Working groups can be formed by the task force on specific issues involving stakeholders from other sectors as and when required.



5. AGRITECH STRATEGY PLAN

5.1. VISION

AgriTech driven transition of Zimbabwe into an upper middle-income economy by 2030 grounded on the following strategic mission:

"To take an active role in transforming the agriculture sector by providing support to 200,000 smallholder beneficiaries of the land reform program and at least another 200,000 smallholder farmers in the traditional communal areas to accelerate technical change in farming and increase production and productivity and more importantly connect them to mainstream markets and industries."

5.2. GOALS

- ✗ Leverage AgriTech innovations to Improve efficiency in light of climate change;
- ✗ To reduce Cost of Production and enhance the competitiveness of agriculture; and
- ✗ Improve production and productivity and promote the sector's contribution to the GDP.

5.3. STRATEGIC THRUSTS FOR AGRITECH IN ZIMBABWE

- ✗ Strong leadership and a techno-savvy and capable public administration at all levels of government, reforming and promulgating enabling policy and legislation, improved access to information and ICT-driven knowledge and learning capabilities for agriculture;
- ✗ Development of national expertise in ICT and human capacity development and its application to agriculture;
- ✗ Development of national backbone infrastructure, with an emphasis on rural areas;
- ✗ ICT for rural communities and vulnerable groups;
- ✗ Content development for AgriTech especially small family farmers;
- ✗ e-government; and
- ✗ Measures to reduce the cost of ICT

5.4. SPECIFIC OBJECTIVES

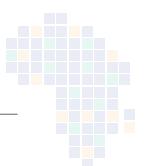
- ✗ Increase the availability and accuracy of agricultural information by creating, updating, analysing and linking critical databases;
- ✗ Accessible, affordable and secure ICT platforms, networks and devices with enhanced sensing, hosting, analytical, identification, tracking and communicating features;

- ✖ Improve the awareness, education and skills of farmers, extension workers, livestock herders and another sector end-users by creating and disseminating credible agricultural knowledge remotely;
- ✖ Reduce the demand-supply gap, and enhance outreach and profitability of Zimbabwean products and services through vibrant AgriTech market places and efficient logistics;
- ✖ Improve the research capability, quality, credibility and reach of extension advisory using ICTs;
- ✖ Increase the traceability, certification, verification and monitoring capability to improve food safety and quality, wildlife tracking and biosafety, and reducing food waste;
- ✖ Promote innovation in AgriTech services;
- ✖ Reduce the individual risks of agriculture sector stakeholders;
- ✖ Improve the financing, investing and banking outreach to the agriculture sector leveraging on electronic and mobile technologies;
- ✖ Improve the existing framework of policies, legislation, regulations and guidelines critical for e – agriculture and ensure its effective implementation.

5.5. MEDIUM TERM PLAN (2021-2025)

To achieve the above strategic thrusts and objectives, the medium-term plan is structured under the following seven-fold priority areas:

- ✖ Enabling Environment for Agricultural Transformation and Development;
- ✖ Change Management and Enhanced Capacity Building of Stakeholders in the Agricultural Sector;
- ✖ Increasing Agricultural Production and Productivity through AgriTech;
- ✖ Development of AgriTech Support Services and Establishment of Knowledge and Information Network;
- ✖ Agricultural Industrialisation, Development of Value Chain and Market Access;
- ✖ Addressing the Issues of Agricultural Land, Protecting and Developing Natural Resources, including Wildlife;
- ✖ The realisation of Food Security and Nutrition and Implementation of Quality
- ✖ Control and Safety Measures for Domestic Consumption and Export.



5.6. AGRITECH PROGRAMMATIC AREAS

5.6.1. INCREASE THE AVAILABILITY AND ACCURACY OF AGRICULTURAL INFORMATION

- ✖ Create and update various government and private sector databases for Agri-Tech
- ✖ Develop technical guidelines and requisite institutional frameworks for the security of connected databases and network infrastructure
- ✖ Develop guidelines for sharing data amongst government and private sector and academia
- ✖ Align AgriTech services with e-government services

5.6.2. ACCESSIBLE, AFFORDABLE AND SECURE AGRITECH PLATFORMS, NETWORKS AND DEVICES

Ensure universal access to affordable broadband and low-cost smartphones

- ✖ A secure Zim-Smart-AgriTech application
- ✖ Make sure information is available in real-time
- ✖ Develop effective data analytics systems in the agriculture sector

5.6.3. IMPROVE THE AWARENESS, EDUCATION AND SKILLS OF FARMERS AND OTHER RELEVANT STAKEHOLDERS

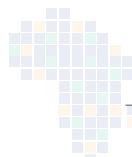
- ✖ Bridge the skills gap using ICTs
- ✖ Use of extension services through online resources
- ✖ Enhance education and better health in the agriculture sector through ICT interventions

5.6.4. REDUCE THE DEMAND-SUPPLY GAP

- ✖ Analyse and link nationwide demand and supply of agriculture produce
- ✖ Develop an AgriTech market place
- ✖ Promote e-services that can enhance the efficiency of logistics linked with transportation, storage and farm machinery as well as workforce

5.6.5. IMPROVE RESEARCH AND EXTENSION SERVICES USING ICTS

- ✖ Promote research and innovation
- ✖ Promote climate-AgriTech

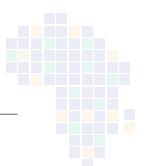


5.6.6. PROMOTE INNOVATION IN AGRITECH SERVICES

- ✖ Develop an ecosystem for innovative AgriTech services
- ✖ Encourage universities and academia to strengthen agriculture research
- ✖ Enhance efficiency and sustainability of existing AgriTech services
- ✖ Reduce the risks of agriculture stakeholders
- ✖ Create effective early warning systems and agricultural disaster alerts using mobile technologies
- ✖ Improve the efficiency of insurance and government subsidy
- ✖ Bridge information gap using ICTs

5.6.7. FINANCE, INVESTMENT AND BANKING

- ✖ Ease availability of credit and loans through ICTs
- ✖ Strengthen mobile payment and banking systems and enhance their uptake by agriculture stakeholders
- ✖ Policies, regulations and legislations
- ✖ Strengthen current policies
- ✖ Create an enabling environment by coordinating policymakers and regulators



6. IMPLEMENTATION OF AGRITECH

The implementation of this strategy will involve a series of activities, processes, and phases. The following activities and processes will be followed during implementation; determining the appropriate Smart-agriculture approach, setting up the governance structure and mechanisms, stakeholder engagement and consultation, establishing an AgriTech management structure and resource mobilisation.

6.1. DETERMINING THE APPROPRIATE SMART-AGRICULTURE APPROACH

An appropriate smart-agriculture approach will be determined as the starting point of implementation. Given the complexity of the agriculture sector, some stakeholders may argue that the best approach to adopt is one focused on adopting an ICT strategy for a specific value chain segment/key agricultural activity. However, in order to maximize the potential from smart-agriculture at a systemic level, a holistic smart-agriculture approach will be needed to clearly formulate a national vision and overall strategic objectives, to identify the e-agricultural priorities of the nation, to define the areas of intervention, as well as to define stakeholder responsibilities and necessary resources. This will help in providing a sense of common purpose and a framework for synergy amongst stakeholders at a national level.

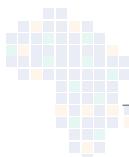
6.2. GOVERNANCE STRUCTURE AND MECHANISMS

The governance structure and roles will be set up early in the vision development process to gain credibility, coordinate efforts and establish the necessary expert and reference groups. A governance mechanism is a committee, council, task force or special group that has the mandate or responsibility to perform one or more of the following functions:

- i. Oversight and steering.
- ii. Subject-matter (expert) input across domains such as:
 - ✖ National agricultural system and services delivery, including the agricultural workforce and budget;
 - ✖ National agricultural strategy and policy;
 - ✖ Current ICTs and smart-agriculture environment; and
 - ✖ Other aspects including national infrastructure, telecommunications, workforce development, education, finance, governance, irrigation and water management, disaster management, meteorology, etc.

6.3. STAKEHOLDER ENGAGEMENT AND CONSULTATION

Stakeholder engagement and consultation will be done throughout the implementation phase. The structure, reporting or accountability mechanisms can be flexible depending on the organisational or ministerial structure, and the desired management of the process. Figure 9 provides an example of a governance structure, and a description

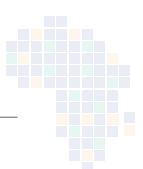


of roles is given in Table 8. The joint efforts of both agriculture and ICT sectors will be required for successful launching of a smart-agriculture vision. However, it is recommended that the key leadership and ownership should rest with the agriculture sector.



Figure 6.1: Smart-Agriculture governance structure

The various groups and their responsibilities and composition are described in Table 8 below.



6.4. GOVERNANCE FUNCTIONS, RESPONSIBILITIES AND COMPOSITION

Table 6.1: Various groups and their responsibilities and composition

GROUP 01	RESPONSIBILITY 02	COMPOSITION 03
Agriculture sector leadership in collaboration with the ICT sector	<ul style="list-style-type: none"> • Gives overall direction, oversight and mandate; • Secures spending authority and resources; • Acts as the vocal and visible champion; • Assists with resolution of major issues, problems, conflicts and other challenges; and • Approves, endorses and owns the national smart-agriculture vision 	Senior-level agricultural and ICT sector decision-makers, such as the Minister or a senior bureaucrat in the Ministry of Agriculture and Ministry of ICT and/or regulatory authority as well as the Department of E-Government in the Office of the President and Cabinet.
Steering Committee	<ul style="list-style-type: none"> • Acts individually and collectively as a vocal and visible champion through its representative organizations; • Provides direction and guidance to other groups; • Plans and manages the vision development process the national smart-agriculture vision; • Makes decisions at key stages of the process; • Organizes information gathering, analysis and drafting of the national smart-agriculture vision; • Assists in addressing risks, resolving issues and conflicts; • Oversees overall progress, and approves changes to scope or approach; and • Provides support in policy and advocacy. 	Those individuals who should be involved in making decisions in relation to development of the national smart-agriculture vision, the acceptance of the vision, and the progression of its recommendations, including representatives from ministries and sector regulators (agriculture, ICT, finance, commerce, governance, Recommendations, including representatives from ministries and sector regulators (agriculture, ICT, finance, commerce, governance, meteorology, etc.). Representatives of industry could be considered.

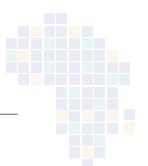


Source: Food and Agriculture Organisation: Smart-agriculture Strategy Guide Piloted in Asia-Pacific Countries in 2016.

6.5. AGRITECH MANAGEMENT STRUCTURE

An AgriTech management structure will be established. A national approach to smart-agriculture developed in an inclusive manner, involving representatives of all critical stakeholders, will ensure that adequate national awareness is raised and that the key stakeholder groups are engaged. In addition, this will also ensure that ICT challenges such as access and use (including costs, applications and quality) posing as hindrances, notably in rural areas and across sectors, are identified and tackled at a higher level in a systematic manner. This would also apply to other sectors critical to agriculture. Such strategic alignment will result in better sustainability of solutions, cost-effectiveness and their wider adoption.

A national approach help improve the coordinated planning and funding of smart-agriculture solutions/service development, avoid duplication and the waste of resources. ICT for agriculture projects should be anchored in the Ministry of Agriculture and not be duplicated in different ministries, agencies as well as service



providers targeting the same stakeholders. The Ministry of ICT should provide total ICT technical expertise, maintenance, facilitating and monitoring working closely with the Ministry of Agriculture. Systematic effort in planning and setting up a national smart-agriculture approach allows for a streamlining of government efforts, ensuring the judicious use of scarce resources while providing a clear direction to the private sector, donors and other stakeholders.

Furthermore, the process of developing a national smart-agriculture approach may reveal the need for related institutional changes or adjustments and instituting an ICT interoperability framework leading to an enabling regulatory environment for the deployment, adoption or integration of innovative technologies. The elaboration of such an approach offers the opportunity not only to raise awareness but also to clarify the main components and potential benefits of smart-agriculture for the vast majority of stakeholders and their role in realising that potential.

The proposed Smart-agriculture governance framework should comprise of a Leadership Committee, a Steering Committee and a Task Force. Working groups can be formed based on the decision of the steering committee as and when required. The compositions of the committees are suggested as under:

6.6. PROPOSED NATIONAL AGRITECH COMMITTEES

6.6.1. LEADERSHIP AND ADVISORY COMMITTEE (AS MEMBERS IN THE SUPREME BODY GOVERNING SMART-AGRICULTURE ACTIVITIES)

- ✖ Minister of Lands, Agriculture, Water and Rural Resettlement – Chairman
- ✖ Minister of ICT, Postal and Courier Services – Vice Chair
- ✖ Secretary, Ministry of Lands, Agriculture, Water and Rural Resettlement
- ✖ Secretary/Chief Director/Director-E-Government-OPC
- ✖ Secretary, Ministry of ICT, Postal and Courier Services
- ✖ Secretary/Chief Director/Director of E-Government in the OPC
- ✖ Director of Information Communication Technology – Ministry of Lands, Agriculture, Water and Rural Resettlement
- ✖ Director, Ministry of ICT, Postal and Courier Services
- ✖ Director, Economics Ministry of Lands, Agriculture, Water and Rural Resettlement,
- ✖ Director of Mechanization and Irrigation Development
- ✖ Director Water Resources
- ✖ Director General of POTRAZ

6.6.2. STEERING COMMITTEE

- ✗ Secretary, MOA (Chairman)
- ✗ Secretary, MICTPCS (Vice Chairman)
- ✗ Secretary/Chief Director/Director E-Government
- ✗ Chef Director AGRITEK
- ✗ Director ICT-MOA
- ✗ Director Ministry of ICT, Postal and Courier Services
- ✗ Director – Irrigation
- ✗ Director Mechanization
- ✗ Director- Research
- ✗ Director Finance
- ✗ *Steering Committee reports to the Leadership and Advisory Committee)*

6.6.3. SUBJECT MATTER EXPERTS

Invite experts for specific tasks to achieve well defined targets. Their terms of reference should be specific and the experts must be provided with the necessary resources. The experts should periodically report to the Steering Committee

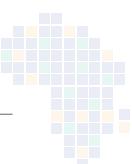
6.6.4. AGRITECH TASK FORCE

The AgriTech Task Force should be led by a senior level officer from the ministry of agriculture and should comprise officers at director or senior management executive level from various departments of agriculture, telecom and ICTs. Working groups can be formed by the task force on specific issues involving stakeholders from other sectors as and when required.

6.6.5. AGRICULTURE LEADERSHIP AND SUPPORT

Significant reform or transformation initiatives require sustained leadership and commitment from senior government officials, and agriculture and ICT sector leaders. The strategy development and implementation process will benefit from a credible and respected leader, or leadership team, which actively and visibly champions the effort. This sends a clear message that the national AgriTech vision is being driven by the agriculture sector with support from other sectors that manage critical inputs to agriculture. The leadership team will also be responsible for securing any funding and resources required to develop the smart-agriculture vision, and assisting in resolving major issues and challenges that may arise during its implementation.

Given the central role of ICT in smart-agriculture, the ministry and regulators dealing with ICT should also be co-drivers of the vision. Depending on the national conditions, inputs may also be needed from financial (banking, insurance, risk management), disaster management, governance, meteorological, media and educational sectors as appropriate. In some countries, agriculture may already be explicitly mentioned in their



national policies for ICT. Examples of this include Bangladesh's National ICT Policy, Malawi's National ICT for Development Policy and Zambia's National Information and Communication Technology Policy. Côte d'Ivoire is an example of one country that has already begun the process of developing a specific AgriTech strategy that builds off of its national ICT policy.

6.6.6. AGRITECH STRATEGIC TEAM COMPOSITION

The complexity of the nation's agricultural system and the associated stakeholder environment will determine the number of individuals required in each group. Ideally, this should range from between five and ten people. This is particularly the case for the AgriTech vision team as the effort associated with coordinating, management and consultation is directly related to the complexity and size of the stakeholder environment.

This guide takes a project-based approach to the development of a national smart-agriculture vision, which is a complex undertaking requiring knowledge and expertise across several disciplines, sectors and ministries. At a minimum, the core strategy team should have domain expertise, and can draw from other government agencies and the private sector as required. Senior agriculture and ICT sector, ministerial or government representatives should also be a part of the team.

Individuals involved in the development of an AgriTech vision should include or have access to the following skills, knowledge and expertise:

Deep understanding of national agriculture sector needs and challenges;

- ✖ Ability to research, analyse and extract lessons from international programmes and projects;
- ✖ Strategic analysis, planning skills and experience at the national level;
- ✖ Broad experience in working with stakeholders and communicating with broader constituencies.
- ✖ Knowledge of the ICT industry, AgriTech, its components and its application in the sector;
- ✖ Broad knowledge of financing (banking, insurance, risk management, investment), disaster management, local-level administration processes, irrigation and water management, meteorological and weather information applications in agriculture;
- ✖ Awareness of gender aspects and the changing role of women and youth in ensuring food security and using ICTs;
- ✖ In-depth knowledge of existing and emerging ICTs, standards and services; and
- ✖ Knowledge and experience of other e-strategies being adopted in the country (e.g., Smart Governance, Smart Education, Smart Health, etc.)

6.6.7. AGRITECH EXPECTED OUTCOMES

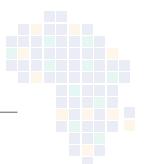
Effective deployment of ICTs in agriculture by **2030** would make a transformative impact on the sector in Zimbabwe. It is expected to deliver the following Smart-agriculture outcomes through a number of ICT solutions (or Smart-Solutions):

- ✖ Increase the availability and accuracy of agricultural information by creating, updating, analysing and linking critical databases;
- ✖ Accessible, affordable and secure ICT platforms, networks and devices with enhanced sensing, hosting, analytical, identification, tracking and communicating features;
- ✖ Improve the awareness, education and skills of farmers, extension workers, livestock herders and other sector end-users by creating and disseminating credible agricultural knowledge remotely;
- ✖ Reduce the demand -supply gap, and enhance outreach and profitability of Zimbabwean products and services through vibrant AgriTech market places and efficient logistics;
- ✖ Improve the research capability, quality, credibility and reach of extension advisory using ICTs;
- ✖ Increase the traceability, certification, verification and monitoring capability to improve food safety and quality, wildlife tracking and biosafety, and reducing food waste;
- ✖ Promote innovation in AgriTech services;
- ✖ Reduce the individual risks of agriculture sector stakeholders;
- ✖ Improve the financing, investing and banking outreach to agriculture sector leveraging on electronic and mobile technologies;
- ✖ Improve the existing framework of policies, legislations, regulations and guidelines critical for AgriTech and ensure its effective implementation.

6.6.8. MANAGE THE VISION DEVELOPMENT PROCESS

Effective leadership and governance improve transparency and credibility, facilitate guidance, provide ownership and ensure that mechanisms for approving, endorsing and owning the national AgriTech vision are in place. Effective management ensures that the process is undertaken in a structured and timely manner with the inclusion of appropriate stakeholders. The process requires establishing or ensuring:

- ✖ High-level agriculture sector leadership and support;
- ✖ High-level support from the ICT sector;
- ✖ Appropriate governance structure and mechanisms;
- ✖ A multidisciplinary project team with the requisite skills and expertise; and
- ✖ An agreed timeline and resources for completing the work.

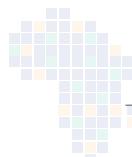


6.6.9. OUTPUTS

The output would be a governance structure with well-defined processes and protocols that supports the development of a national AgriTech vision.

6.6.10. TIMELINE AND MILESTONES

The time frame for developing a national AgriTech vision can vary significantly, based on factors such as the size, structure and diversity of the agricultural system, the level of engagement and support sought for the scope of the strategy and the resources available for the process. Developing a realistic plan and monitoring and updating it regularly are important for successful management and implementation. Taking time to develop this plan enables the team to understand the expectations of the steering committee and decision makers, and to keep them informed as the process progresses. It also helps to forge a common view across the team, facilitates coherence between different strands of the process and helps to anticipate long lead-time activities. Planning for internal (team) coordination and communication, project documentation and management should be conducted at an early stage.



7. STRATEGIC RECOMMENDATIONS

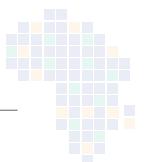
In order to meet the expected outcomes of AgriTech and realize the vision, the following strategic recommendations are important.

1. Recommendation 1: Increase the availability and accuracy of agricultural Information by creating, updating, analyzing and linking critical databases:

- ✖ Develop technical guidelines and requisite institutional framework for interoperability, privacy and security of connected databases and network infrastructure;
- ✖ Creating and updating various government and private databases is critical for AgriTech services. It is also important to have the linkage and integration of databases, wherever feasible;
- ✖ Develop guidelines for sharing of data amongst governments, private sector and academia; and
- ✖ Align the AgriTech services with the Smart Government services as far as possible including utilization of the existing service platform for government linked AgriTech services.

2. Recommendation 2: Accessible, affordable and secure ICT platforms, networks and devices with enhanced sensing, hosting, analytical, identification, tracking and communicating features:

- ✖ Ensure universal access to affordable broadband and low-cost smartphones. Although, a number of services can also be launched over feature phones, the full potential of ICTs requires capability to share multimedia;
- ✖ A secure digital application platform for AgriTech should be established (or used if existing) for delivery of services and sharing of information with government and non-government entities;
- ✖ Integration of databases with application platform and transactional capability is very important to unleash the growth of Government and third-party services;
- ✖ Make accurate information available in real time or near real time for the sector leveraging on smart sensing technologies and integration of required databases;
- ✖ Enhance the sensing capabilities of agriculture and associated services using modern technologies (e.g. satellite, drones, Internet of Things (IOTs)) and systematically integrate into database;
- ✖ Effective monitoring of agriculture sector using ICTs;
- ✖ Strengthening tracking and traceability framework nationwide;
- ✖ Need to harness the big data generated in the agriculture sector by deploying effective analytics systems and capabilities; and
- ✖ Strengthen the existing call centres capabilities in scope and quality



3. Recommendation 3: Improve the awareness, education and skills of farmers, extension workers, livestock herders and other sector end-users by creating and disseminating credible agricultural knowledge remotely:

- ✖ Bridging the skills and knowledge gap in the sector using Smart Learning and networking tools;
- ✖ Improving the confidence in use of extension and advisory services through enhanced online knowledge resources; and
- ✖ Facilitate education and better health in agriculture sector through ICT interventions;

4. Recommendation 4: Reduce the demand-supply gap, and enhance outreach and profitability of Zimbabwean products and services through vibrant Agri-Tech market places and efficient logistics:

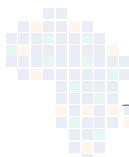
- ✖ Create tools for analyzing and linking nationwide demand and supply of agricultural produce;
- ✖ Develop a AgriTech market place for sharing information on supply and demand, promoting AgriTech product and advising on international trading norms and practices; and
- ✖ Promote Smart Services that can enhance the efficiency of logistics linked with transportation, storage, farm machinery etc. as well as workforce;

5. Recommendation 5: Improve the research capability, quality, credibility and reach of extension advisory using ICTs

- ✖ Promote research and innovation through availability of information and enhance engagement leveraging on modern communication tools;
- ✖ Improve linkage between agriculture extensions and researchers and increase responsibility of agricultural advice; and
- ✖ Increase the efficiency of production, climate AgriTech and diversity of crops

6. Recommendation 6: Promote innovation in AgriTech services:

- ✖ Given the emphasis of AgriTech in Zimbabwe, a dedicated centre for such services could be considered. This centre can be hosted by the Department of agriculture and focus on:
 - ✖ Development of applications to deliver priority AgriTech services;
 - ✖ Development of the ecosystem for innovative AgriTech services;
 - ✖ Strengthen the call centre services and extend its scope to all AgriTech services;
 - ✖ Enhance the efficiency and sustainability of existing AgriTech services;
 - ✖ Develop a framework for service delivery by private sector using digital platform;
 - ✖ Provide hosting for private sector application and services and serve as a one stop shop for AgriTech services. The detailed scope, however, would need to be developed;



- ✖ The consumer protection framework and language remain a bottleneck for developing trust around use of ICTs in agriculture. It is recommended to build a consumer protection system in consultation with public and private sector entities involved in AgriTech services; and
- ✖ Encourage universities and academia to strengthen research and capability to develop applications and services. Facilitate availability of timely data and platform for development and delivery of these services.

7. Recommendation 7: Reduce the individual risks of agriculture sector stakeholders

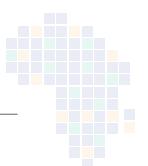
- ✖ Bridging the information gap and improving the efficiency of risk management tools and procedures using ICTs;
- ✖ Introduce new risk management services, while improving the efficiency of existing services, such as micro-insurance, government subsidy, others;
- ✖ Creating effective early warning systems and agricultural disaster alerts using mobile platforms

8. Recommendation 8: Improve the financing, investing and banking outreach to agriculture sector leveraging on electronic and mobile technologies:

- ✖ Ease availability of credit and loan through electronic and mobile credit verification systems; and
- ✖ Strengthen mobile payment and banking systems and enhance its uptake by agriculture sector stakeholders;

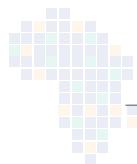
9. Recommendation 9: Improve the existing framework of policies, legislations, regulations and guidelines critical for AgriTech and ensure its effective implementation:

- ✖ Develop and strengthen the current policy, legislative and regulatory frameworks by identifying gaps, addressing them and creating guidelines;
- ✖ Proactively coordinate with policy makers and regulators of various sectors to create the appropriate enabling environment and ensure strategic alignment with other sectoral developments; Proactively coordinate with key stakeholders from Agriculture, Banking, Telecom, IT, Governance, Agromet, Insurance and donor agencies to enhance synergy; and Increase the transparency and awareness on policies and regulations;



Conclusion

The National AgriTech strategy for Zimbabwe has articulated bold recommendations to leapfrog the country's high potential agricultural sector in line with aspirations for Vision 2030. The already existing and referenced practical use cases for AgriTech in Zimbabwe provide exceptional scalable opportunities to ensure successful implementation of this strategy and roll out of transnational pilot programmes. There is therefore a need for continued political will, multi-stakeholder involvement especially private sector, fiscal support, conducive policy environment and robust resource mobilization approaches to operationalize strategies encompassed herein otherwise the desired future state of Agriculture in Zimbabwe will remain elusive. Going forward Ministries of Agriculture and ICT must take full ownership to execute, monitor and evaluate progress towards full roll out of this all encompassing AgriTech strategy which resonates with dictates of the continental AgriTech blueprint as championed by Smart Africa

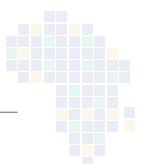


8. NATIONAL AGRITECH ACTION PLAN AND ICT SOLUTIONS

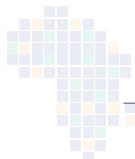
The following action plan and ICT solutions are suggested:

Table 8.1: Action plan and ICT solutions

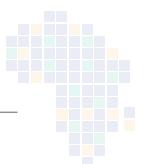
ICT Solution	Description
Social network amongst agriculture users	To create a network of agriculture sector stakeholders including (producers, marketers, extension workers, policymakers etc.) to distribute information (informal) and enhanced engagement.
Integrated natural resource management information system	An information system that includes GIS data (incl. high-resolution satellite image) and other information on land use/land cover/land degradation, Soil map/ land fertility, forest resource use, Geoportal and geomorphology, Irrigation and water management, Biodiversity, invasive alien species, Disaster management, weather forecasting, fire history and forest preservation.
Credible GAP content aggregation and packaging	Creation of agriculture content, which is packaged for various dissemination mediums (video, audio, website, text) or could be repurposed for capacity building.
AgriTech advisory services (with possible consumer protection)	Advisory services offered by extension workers, consultants, researchers in the country or abroad through electronic media (phone, Internet, email, video chat), face to face meetings or paper reports. Recognizing that the lack of credibility may deter agriculturists to deploy good agricultural practices, credible advisory services with consumer protection can be created. These can be paid or reused and would complement the availability of content in open mode. The dissemination can be through computers, telecom, and the Internet or broadcasting networks.
Capacity development and education using ICT	Use of videos, audios, texts, brochures on good agricultural practices and their dissemination through web-based, mobile-based, print or broadcasting networks. Using multimedia tools to build skills and offer distance education. It also includes vocational and skill-based courses.
Smart water management	Deployment of sensors, GIS maps to manage information around water and manage their smart utilization. Knowledge sharing, access to weather data online, geo-referenced (map) water source identification (groundwater, river, etc.) and sub-surface moisture sensors.
E-marketplace for agriculture	Creation of e/m-market place, market information and scalable payment systems for national and international trade, promotion and awareness-raising on use of e/m-services.



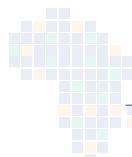
Logistics (storage and transport) information linking agriculture service providers and markets	Creation of a database of storage and transportation service providers with information management, tracking and payment capability
Certified higher-yielding seeds/ planting/ breeding materials verification and traceability	Database with a web interface (barcoded) to verify the authenticity of seeds
Online Agriculture workforce information and services	Creation of an online workforce (skilled and unskilled) requirement and availability information system.
Agromet data and services	Online availability of weather and other climate data, forecasting, and knowledge base.
Agriculture Early warning system	Early warning systems for agriculture stakeholders against disasters and hazards alert and response system, integration with disaster management
Information on climate-smart technologies and Climate resilient crops & breeds	Information, access to training on climate-smart agricultural practices, and new technologies
GIS animals' movement (e-animal surveillance), Area mapping of animals' crop damage/prone, Online system for animal conflict management, animals cyber tracking and alert	Traps, trackers, sensors with the capability to inform on animals' movement
The electronic Pest surveillance system	Pest online database with historic vectors linked with crop lifecycle, climate data, video-based verification, and remote compensation and GIS maps. Pests and pest management online database, advisories and knowledge sharing
Farm mechanization information and service	Creation of an online machine and equipment information system linked with market machine availability and rentals.
Information on enabling environment and agri-business opportunities	Information on investment opportunities for entrepreneurs and international investors, buyers and suppliers
Electronic banking and payment	Creation of banking facilities for all using electronic/mobile banking.



Credit rating and loan availability	Create a credit management system that makes credits available using the simplified procedure and online verification. A credit rating mechanism can also be developed.
Policy guidelines and support to agri-insurance providing companies	Guidelines to enable micro-insurance, field database, disaster and compensation.
Universal mobile broadband connectivity, deployment of low-cost mobile phones, tablets	4G, 5G connectivity with tablets and broadband services.
Interoperable and secure e/m-agriculture applications platform with content	An integrated application platform interoperable with e-government services for AgriTech service delivery.
Integrate AgriTech services with G2C	Service integration of e-government and AgriTech services including security, interoperability.
Remote video-based surveillance	A solution to carrying out remote video-based information capture and remote surveillance.
Climate change modelling	Estimating the impact of climatic parameters (change) on crop, fisheries and livestock productivity.
Commodity outlook modelling	Forecasting future demand and supply of specific commodities.
Data capture and analytical tool	Data capture and analytical tool to syndicate demand from farmers.
A central database of research programmers and new technologies	Repository of research findings/abstracts and information on on-going research programs to find and analyses the present and past research titles/findings toward designing appropriate research for the benefit of farmers and the country
A central database of agriculture statistics	Reliable data collection and updating mechanism with compliance to national data from census and statistic department
Database for seed and planting material	Planning seed and planting material production public and private both to meet the farmers/country needs, monitoring the progress of the production programs, forecasting the seed and planting material production, making awareness and access to the information on available seed and planting material stocks.



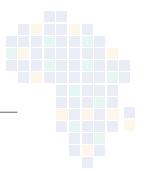
AgriTech solution	Description
An Agricultural Information Management System (AIMS)	This is a system in which agricultural information is generated, transformed, transferred, consolidated, received and fed back in such a manner that these processes function synergistically to underpin knowledge utilisation by agricultural producers.
Geographical Information System/Spatial Data Infrastructure	Geospatial information infrastructures (GIIs) provide the technological, semantic, organizational and legal structure that allow for the discovery, sharing, and use of geospatial information (GI).
Portable hyperspectral imaging spectrometer	Hyperspectral Imaging Sensors (HSI) obtains spectral information from an object, and they are used to solve problems in Remote Sensing, Food Analysis and Precision Agriculture.
Eco farmer	A mobile platform that enables smallholder farmers to have access to insurance, weather index and farming tips which include prices of inputs and market prices for their produce. The same service will allow farmers to save money, make payments for their agricultural and household needs as well as receive payments for their produce.
e-AgriTransport GO Network	This network aims to provide viable transport and improved marketing channels for farmers to transport farm produce from farms to villages and selected marketing centres, based on a database of contacts and phone numbers of individual members, farming associations, transport owners and drivers.
SmartFish	Aims to reduce post harvest fish losses for improved food security. The information collected via mobile devices will show where fish losses are occurring, how large the losses are and why they are occurring. All this information is important in planning where and how to reduce losses and therefore how best to make use of development resources.
Event Mobile Application	Enable district veterinary officers using the Smartphone app to report disease outbreaks immediately through an online system. This system will allow district veterinary officers to access disease reports submitted by their colleagues and farmers, keeping them informed of events.
e-Farm information service	A toll-free voice activated response service to provide best farming practices for maize in different farming regions.



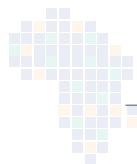
AgriTech action plan priorities for the period 2021-2025

Table 8.2: AgriTech Action Plan Priorities for the Period 2021-2025

	Name of smart-agriculture solution	Im-pact	Ex-ists	Depen-dency	Feasi-bility	MUST SHOULD WOULD COULD	2020	-	-	2030
High (H), Medium (M), Low (L)										
1	Integrated natural resource management information system	H	L	H	L	MUST				
2	Social network amongst agriculture Users	M	H	H	H	MUST				
3	Smart-agriculture advisory services (with possible consumer protection)	H	M	H	M	MUST				
4	Capacity development and education using ICT	H	L	H	M	MUST				
5	E-market place for agriculture	H	L	H	H	MUST				
6	Agromet data and services	H	M	H	M	MUST				
7	Accessible information resources on government policies and guidelines	H	H	H	H	MUST				



8	Electronic banking and payment	H	M	H	H	MUST				
9	Credit rating and loan availability	M	M	H	H	MUST				
10	Setting up / strengthening of IVR systems	H	H	M	H	MUST				
11	AgriTech extension monitoring	H	L	H	M	MUST				
12	Universal mobile broadband connectivity, deployment of low-cost mobile phones, tablets	H	M	H	M	MUST				



8.1. AGRITECH USE CASES IN ZIMBABWE

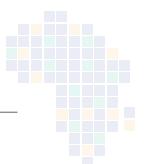
Case 1 EcoFarmer in Zimbabwe

The EcoFarmer Story in Zimbabwe

EcoFarmer is committed to the transformation of the agricultural sector and the livelihoods of farmers, farmer organisation, industry through enhancing productivity and improving access to information to drive the shared economy model.

EcoFarmer is Econet's own mobile farming platform launched in 2013 in Zimbabwe as a weather indexed insurance business. Eco-farmer is enhancing digital, financial and social inclusion through breaking information asymmetries especially amongst close to 1 million smallholder farmers in Zimbabwe. Accessible even on non-smart phone makes ecofarmer a highly accessible platform even with the cheapest device.

Source: <https://www.ecofarmer.co.zw>



Case 2 Smallholder Homestead Commercial Business Units model in Zimbabwe



Zimbabwe's integrated ICTs civic society transformation initiative is rolling out an audacious initiative to commercialise rural homesteads transforming them into formal production business units as it continues to deliver on reaching out to the country's non-serviced areas, bridging the digital divide and boosting the utilisation of ICTs through the Ministry of Information Communication Technology, Postal and Courier Services.

THE PRODUCTION PART: The Community Information Centre's will connect the rural communities to local and international markets as well as acting as convergence platforms for Industry and Academia to solve community-based challenges. Each production unit comes with a modern homestead and complete installation of the production section with a stable source of water to drive year-round crop production, poultry, fisheries which can be scaled through different phases and other business pipelines. The beneficiaries will pay from sales of the surplus produce which will be done at the CICs on their behalf.

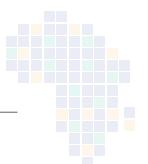
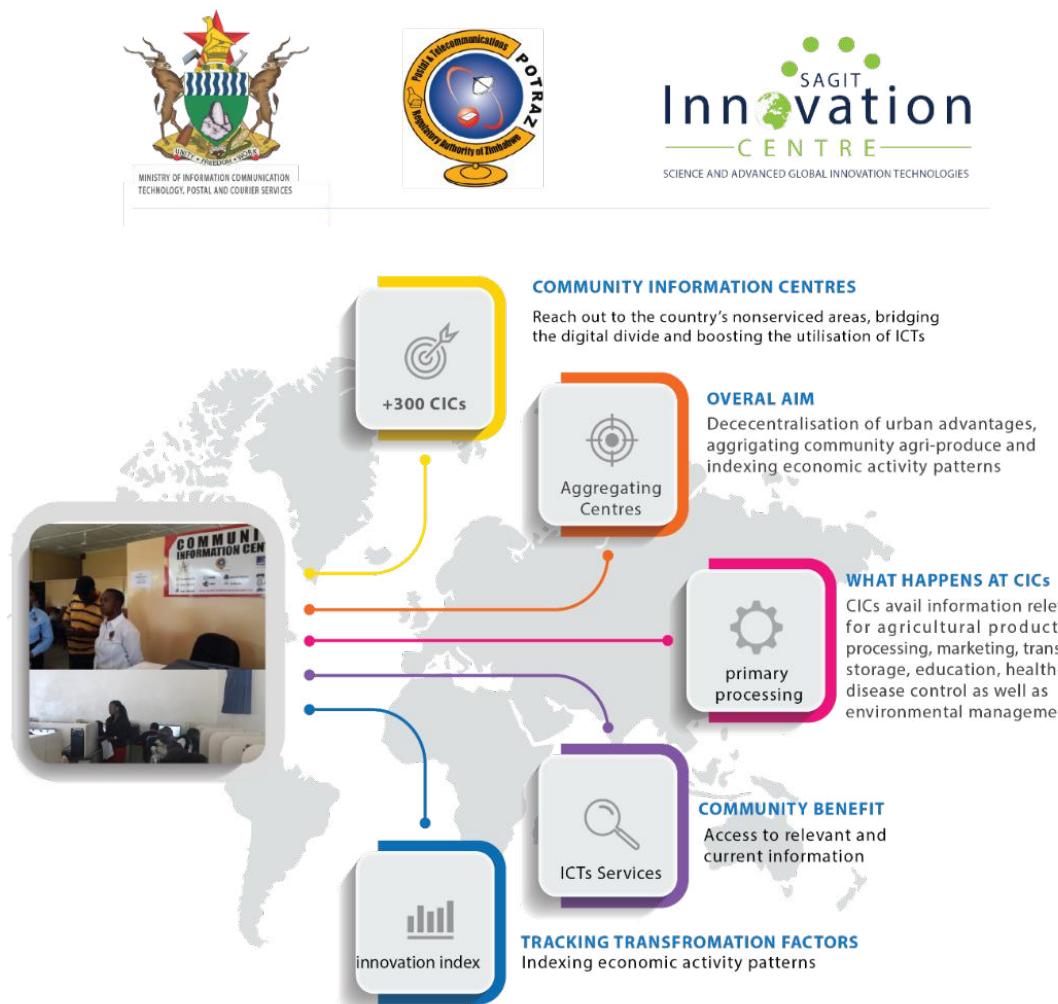
THE ULTIMATE GOAL: is to Connect small family Households with the bigger economy and the bigger market through industrial upgrading process where we are supporting the small holder farmers to improve from artisanal food to more efficient processes. Essentially, this initiative will build their competitiveness at local levels to produce

raw materials as well as process them in ways that will outcompete imports in cost and quality.

This initiative will trigger a sustainable AgriTech revolution that will enable Zimbabwe as a nation to mass produce, mass process and mass consume. The whole industrial upgrading process includes connecting smallholder farmers to the main stream economy so that they are within the same flow of capital that the whole economy is going through. This is based entirely on information flow to enable them to asynchronously trade and transact, within the larger economic ecosystem of the commercialised world.

Case 3 Community Information Centres in Zimbabwe

Community Information Centres (CICs) are a project by Postal and Telecommunications Regulatory Authority of Zimbabwe (POTRAZ) through their Universal Service Fund (USF). The CIC project is being carried out in a bid to further the knowledge and appreciation of ICT throughout the country. CICs are mainly focused on serving the 'underserved and unserved' communities as far as ICT is concerned. Smallholder farmers especially women and youths are already benefiting for the innovative initiative which is closing the digital divide.



Case 4 Smart Relay Operation Principle & High-Tech Blueberry Farming in Zimbabwe



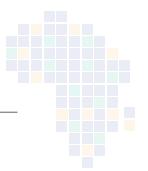
Zimbabwe boasts the largest blueberry farm in Africa located 40km out of Harare. The farm operates on a Smart Relay model. The Zone Master Smart sensor module publishes a command for a specific operation to be done by Smart Relay. Fertilisers and Pesticides are also applied per zone for precision application where they are needed. High-level AgriTech innovations enable intensive highly mechanized production of blueberries.

Table 8.3: Project preparation & planning, development & testing and implementation

	Month1	Month2	Month3	Month4	Month5	Month6
Preparation and Planning						
Develop Project Proposal						
Approve Project Proposal						
Recruit Project Team						
Development and Test						
Specify Detail Requirements						
Develop Prototype						

	Month7	Month8	Month8	Month10	Month11	Month12
Development and Test						
Approve Prototype						
Develop beta Version						
Test beta Version						
Apply Final Corrections						
Approve Final Version						

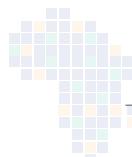
	Month13	Month14	Month15	Month16	Month17	Month18
Implementation						
Train Users						
Roll-Out Final Version						



Project Cost Summary (Stage 1-Blueprint and Prototype)

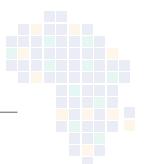
Table 8.3: Project Cost Summary

PROJECT MATERIALS	QUANTITY	COST/USD
Satellite Internet full Components and accessories set for one site	1	USD 50 000.00
Toyota/Isuzu/Ford Ranger –Twin cabs.	2	USD 100 000.00
Dell Latitude 7 400 Laptop	10	USD 17 000.00
Model Farm with Dam	1	To be allocated by Min. of Agriculture.
Azure IoT Packs with Raspberry Pi 3 or 4	10	USD 2 000.00
Groov Epic Controller Opto 22	1	USD7 000.00
Accessories and sensors		USD10 000.00
Software Development		USD 510 424.00
TOTAL		USD 696 424.00
5 % Of Total Costs (RUNNING COSTS)		USD 34 821.20
25 % Of Total Costs (Software Cost)		USD 182 811.30
ESTIMATE GRAND TOTAL		USD 914 056.50



9. REFERENCES

- Ayana, G. F., Megento, T. L., & Kussa, F. G. (2021). The extent of livelihood diversification on the determinants of livelihood diversification in Assosa Wereda, Western Ethiopia. *GeoJournal*, 5(1992). <https://doi.org/10.1007/s10708-021-10379-5>
- Bhattacharjee, S., & Raj, S. (2018). *Youth and ICTs for Agricultural Development*. October.
- Bhattacharjee, S., & Raj, S. (2018). *Youth and ICTs for Agricultural Development*. October.
- Balafoutis, A. T., Beck, B., Fountas, S., Tsiropoulos, Z., Vangeyte, J., van der Wal, T., Soto-Embodas, I., Gómez-Barbero, M., & Pedersen, S. M. (2017). *Smart Farming Technologies – Description, Taxonomy and Economic Impact* (Issue November). https://doi.org/10.1007/978-3-319-68715-5_2
- Braimok, T. (2017). *Exploring the Opportunities and Challenges of ICTs for Women Farmers in Kenya*. 1–2.
- Carswell, G. (1997). *Agricultural Intensification and Rural*. May 1997, 1–30.
- Corrigan, T. (2020). Africa's ICT Infrastructure: Its Present and Prospects, Southern African Institute of International Affairs.
- Dentoni, D., Hospes, O., & Ross, R. B. (2012). Managing Wicked Problems in Agribusiness: The Role of Multi-stakeholder Engagements in Value Creation, *International Food and Agribusiness Management Review*, 15: 1 – 17.
- FAO. (2014). Youth and Agriculture. In *The Food and Agriculture Organization of the United Nations (FAO) in collaboration with the Technical Centre for Agricultural and Rural Cooperation (CTA) and the International Fund for Agricultural Development (IFAD)* (Issue 17).
- Fergus U, O., & Chioma L, N. (2017). ICT: A Cornerstone for Effective Weather Forecasting. *International Journal of Computer Applications Technology and Research*, 6(3), 121–129. <https://doi.org/10.7753/ijcatr0603.1001>
- Jain, R., Ahuja, U. R., & Kumar, A. (2012). ICTs and farm women: Access, use and impact. *Indian Journal of Agricultural Economics*, 67(3), 385–394.



Joan, K. M. (2014). The Effect of ICT on Youth Participation in the Production of Pigeon Pea the Case of Muka Sub County,Makueni County, Kenya. *Uon Repository*.

Kirkaya, A. (2020). Smart Farming- Precision Agriculture Technologies and Practices. *Journal of Scientific Perspectives*, 4(2), 123–136. <https://doi.org/10.26900/jsp.4.010>

Ojo, O. I., & Ilunga, M. F. (2017). The Rainfall Factor of Climate Change Effects on the Agricultural Environment: A Review. *American Journal of Applied Sciences*, 14(10), 930–937. <https://doi.org/10.3844/ajassp.2017.930.937>

Okediran, O. O., & Ganiyu, R. A. (2019). E-Agriculture Reviewed: Theories, Concepts and Trends. *FUOYE Journal of Engineering and Technology*, 4(1), 125–130. <https://doi.org/10.46792/fuoyejet.v4i1.366>

Rapsomanikis, G. (2015). The economic lives of smallholder farmers. *FAO Food And Agriculture Organization of the United Nations*, 39. <http://www.macrothink.org/journal/index.php/rae/article/view/6320> http://www.upov.int/edocs/mdocs/upov/en/upov_sym_ge_11/upov_sym_ge_11_10.pdf <http://ajae.oxfordjournals.org/cgi/doi/10.2307/1241587> [http://link.springer.com/10](http://www.iosrjournals.org%0Ahttp://link.springer.com/10).

Richardson, D. (1997). The Internet and Rural Agricultural Development – an Integrated Approach, FAO, Rome.

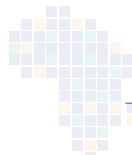
Santiteerakul, S., Sopadang, A., Tippayawong, K. Y., & Tamvimon, K. (2020). The role of smart technology in sustainable agriculture: A case study of wangree plant factory. *Sustainability (Switzerland)*, 12(11), 1–13. <https://doi.org/10.3390/su12114640>

Shenoy, S. (2019). *8 Farm Women Empowerment through ICTs Integration*. August.

Stienen, J., Bruinsma, W., & Neuman, F. (2007). How ICT can make a difference in agricultural livelihoods Information & Communication Technologies. *The Commonwealth Ministers Reference Book*, 2–4.

Tibugari, H., Chikasha, T., Manyeruke, N., Mathema, N., Musara, J., & Dlamini, D. (2019). Poor Maize Productivity in Zimbabwe: Can Collusion in Pricing By Seed Houses be the Cause? *Cogent – Food & Agriculture*, 5 (1): 1 – 9.

Thornton, P. K., Loboguerrero, A. M., Campbell, B. M., Mercado, L., Shackleton, S., & Kavikumar, K. S. (2019). *Rural Livelihoods, food security and rural transformation under climate change*. 48. <http://www.indiaenvironmentportal.org.in/files/file/RuralLivelihoodsFoodSecurityRuralTransformation.pdf>



Waddock, S., Meszoely, G. M., Waddell, S., & Dentoni, D. (2015). The Complexity of Wicked Problems in Large Scale Change, Journal of Organizational Change Management, 28 (6): 993 – 1012.

World Bank (2017), ICT in agriculture: Connecting Smallholders to Knowledge, Networks, and Institutions)

ZimStats (2019). Zimbabwe Smallholder Agricultural Productivity Survey – 2017 Report, ZimStats, Harare.

