AgriTech
BLUEPRINT FOR AFRICA

UNDER THE LEADERSHIP OF THE REPUBLIC OF ZIMBABWE AND SMART AFRICA
Under the leadership of the Republic of Zimbabwe and Smart Africa

SUPPORTED BY NORWEGIAN AGENCY FOR DEVELOPMENT COOPERATION (NORAD)

DRAFTED BY SCIENCE AND ADVANCED GLOBAL INNOVATION TECHNOLOGIES (SAGIT)

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This Blueprint draws extensively on existing publications and participation in workshops— available in the reference section of this document—and would not have been possible without the work of these previous authors and speakers. In particular, it builds upon information shared by the working group members.
THE WORKING GROUP

Rwanda.  Ghana  Morocco  Zimbabwe
FOREWORD

Agriculture in Africa plays a pivotal role in the social and economic footprint. In Sub-Saharan Africa at least 60 percent of the population comprise of smallholder farmers, and agriculture the role agriculture plays on the African continent the full potential of agriculture remains untapped. In 2013 the Heads of State and Government committed to pursue economic growth through agriculture-led development to reduce poverty and hunger on the continent. The CAADP framework has 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. In general, most member states are not on track to meet Maputo declaration (2003) commitments.

Africa’s contribution to global trade is less than 3%, intra-Africa trade is less than 25% and is a perennial net food importer yet the continent is endowed with natural resources (youth bulge). The application of ICT innovations and interventions is the game changer needed in the sector as this, will enable member states to leapfrog and accelerate the pace of achieving these goals, more importantly, enabling increased production and productivity in agriculture.

Africa has enormous potential to feed itself and eliminate hunger and food insecurity, transforming into a major player in domestic and global food markets, fulfilling Agenda 2063 goals and Sustainable Development Goals (SDGs). Modern large-scale agriculture has to be anchored by technologies such as high-end cutting edge agriculture tools such as a global positioning system (GPS), Artificial intelligence (AI); Internet of Things (IoT); block-chain, satellite, and drone monitoring, and increasingly detailed and instantly available weather and climate information.
Through the Smart Africa flagship program lead by each member state, the Government of the Republic of Zimbabwe has been chosen to spearhead the AgriTech flagship in Africa and is going to be the center of reference for smart agriculture technologies in Africa. The Government of Zimbabwe is implementing the strategy to transform Zimbabwe through the Smart Zimbabwe Vision 2030 in line with the transform Africa Vision. Amongst the pillars of the Smart Zimbabwe, Smart Agriculture strategy will be implemented taking into consideration that agriculture forms the country’s economic backbone and thus commands the highest priority in our implementation plan. The AgriTech strategy takes advantage of Information and Communication Technologies integrated to transform the world into one global village. Internet of Things (IoTs) technology has removed the barriers to communication and accessibility by bringing everything to everyone across the globe.

The Republic of Zimbabwe takes advantage of its God-given environmental and favorable agricultural conditions and its geo-positioning in the Global world to seriously exploit Smart Technology in the implementation of Smart Agriculture in Zimbabwe and envision becoming a model country in Smart Agriculture solutions in Africa. Zimbabwe has taken leadership in the development of the AgriTech Blueprint for Africa which provides best practices and examples of AgriTech in practice and will guide countries in development of their own country strategies and Development of National and cross border pilots.

**The President of the Republic of Zimbabwe**  
**His Excellency Cde Emmerson Dambudzo Mnangagwa**
Zimbabwe is aware that the continent is facing an enormous future of possibilities in our rapidly evolving digital world. New innovations and facilities emerge across the horizon with each passing year. Governments, companies, and individuals must adjust to this new reality as emerging 21st century technologies become the foundation of our everyday activities. Agriculture sector has not been left out as ICT innovations and interventions, will enable member states to leapfrog and accelerate the pace of achieving the Malabo goals, more importantly, enabling increased production and productivity in agriculture and agro-based industries. Zimbabwe has embarked on its digital transformation journey in order to ensure that the AgriTech benefits become a reality, and we hope that the rest of Africa will walk this journey too.

The Republic of Zimbabwe has already taken the lead driving the digital transformation agenda, by coming up with an implementation strategy to transform Zimbabwe through the Smart Zimbabwe Vision 2030 handshaking 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 Smart Agriculture which forms the country’s economic backbone and thus commands the highest priority in our implementation strategic plan. In the field of AgriTech there are a number of applications that are already in place inclusive of Eco-farmer, Kurima-mari, e-mukambo, VAYA tractor and Community information centers which are already operational. The adoption of such innovations are facilitating production and access to information on markets by both farmers and consumers. This will in turn translates to improved production, productivity and efficiency in the agriculture sector.
Under the leadership of the Republic of Zimbabwe and Smart Africa

In the same token the Government of Zimbabwe has deliberately adopted technology that enhances massive productivity and efficiency in the agriculture sector if implemented well. Technology has the potential to assist in the management of distribution and utilization of resources given to farmers and to estimate expected yields.

Zimbabwe, however, has much more to offer and gain from the application of ICTs in the agriculture sector. To harness these benefits, we have to develop technological innovations and apply tools that accelerate agriculture productivity and efficiency nationally, regionally and globally. Towards this end, Zimbabwe has developed the AgriTech blueprint for Africa as a proposed framework to guide countries on the continent and probably beyond with the development of AgriTech strategies and overally AgriTech Pilots in African countries. The implementation of the national e-Agriculture Strategy will contribute towards food security and self-sufficiency starting at housed level.

Minister of Lands, Agriculture, Fisheries, Water and Rural Resettlement
Dr. Anxious J. Masuka
Worldwide, digital technologies are quickly changing the way we conduct business, a situation we could not foresee only a generation ago. In tandem with the implementation of our Smart Zimbabwe strategy by 2030 which is being accelerated and in line with the Smart Africa vision to transform Africa into a Single digital market, we must seize the significant socio-economic opportunities that digital technologies bring.

The Smart Zimbabwe 2030 Strategy is anchored on various pillars which include Smart Government, Smart Education and Smart Agriculture which has now been further enhanced by the AgriTech blueprint. Zimbabwe, with its high literacy level has the necessary skills and competencies to develop ICT applications capable of addressing the needs of the agricultural sector. To harness these benefits, we have to develop technological innovations and apply tools that accelerate agriculture productivity and efficiency nationally, regionally and globally. Towards this end, Zimbabwe has developed the AgriTech blueprint for Africa as a proposed framework to guide countries with the development of AgriTech strategies and overall AgriTech Pilots on the African continent.

The AgriTech Blueprint for Africa presents a framework to guide countries on how to improve productivity in agriculture sector using ICT through concrete national and regional cross-border projects. The Blueprint will also guide Member States to develop and implement Agritech national strategies. This Blueprint also sets out the opportunities and challenges in maximizing the benefits on offer from application of ICTs in agriculture. It highlights the significant work already happening across Government, private sector, civil society, businesses, and academia among others, and identifies further action required to ensure Zimbabwean farmers and residents can thrive in a global digital economy.
The working group, which comprises of countries, international partners and private sector partners, drive digital transformation agenda through AgriTech to accelerate agriculture production and productivity on the African continent through the use of ICTs. The Blueprint also highlights the cross cutting issues that need to be considered for the success of a AgriTech in Africa.

This AgriTech Blueprint for Africa serves as Zimbabwe’s contributions in championing the acceleration of agriculture productivity and sustainable development through the use of technology for all of Smart Africa Alliance members. It is our hope and wish that all the member states shall peruse this Blueprint and find value in adapting it within their own ecosystems to realize the potential of digital transformation that will accelerate agriculture productivity and efficiency in Africa.

**Minister of ICT, Postal and Courier Services**

**Dr. Jenfan Muswere**
ACKNOWLEDGMENTS

Since the endorsement of the Smart Africa Manifesto by Seven (7) Heads of State on 29 October 2013, the Smart Africa Alliance has since grown in size and in strength and includes 31 African Member States that represent over 800 million people (As of December 2020). The same Manifesto was also endorsed by all Heads of State and Government of the African Union at the 22nd Ordinary Session of the Assembly of the African Union in Addis Ababa. This development placed the Manifesto at the heart of the ICT agenda for Africa.

Chaired by His Excellency President Paul Kagame, President of Rwanda, the Smart Africa Board brings together the 31 Heads of States and Government along with the International Telecommunication Union, the African Union Commission as well as Smart Africa’s Platinum members, with one common goal: To transform Africa into a single digital market.

By creating this platform, our leaders are aiming to bring about sustainable development, enable a cashless economy, increase citizen participation, increase production, productivity and efficiency, increase transparency, trust and accountability, increased evidence-based decision making and last but not least, create jobs, especially for the youth. Agriculture plays a pivotal role on the continent and application of innovative technologies would improve productivity and efficiency in the sector, in this regard the Smart Africa Member States recognizes the importance of AgriTech to accelerate productivity, inclusion of women and youth, accelerate Agricultural structural and digital transformation and economic development.

To operationalize the Smart Africa Manifesto, the Smart Africa Alliance identified flagship projects led by Member States. One of these flagship projects is “AgriTech” led by the government of Zimbabwe. In close collaboration with a range of key public and private sector stakeholders and partners, the Republic of Zimbabwe with close technical support of the Smart Africa Secretariat embarked into the development of
the “AgriTech Blueprint for Africa” aiming at improving the lives of the smallholder farmers within rural and peri-urban communities through better utilization Information Communication Technologies (ICTs) in the agricultural value Chain. The aim is achieved through harmonization of regulatory and policy framework and proffering strategic recommendations for African Member States to create national and cross-border pilots in AgriTech in Africa.

Our sincere appreciation goes to the Norwegian Agency for Development Cooperation (NORAD), which provided the financial support that enabled us to recruit the expertise of “Science and Advanced Global Innovation Technologies (SAGIT)”, our lead consultant for the development of this blueprint. We would like also to acknowledge and thank our key stakeholders and partners, ranging from Smart Africa Member States, private sector organizations, Academia & Research centers, other organizations outside the Smart Africa Alliance, for their invaluable inputs and insights during the development of this blueprint.

Our deep gratitude goes to our partners The Republic of Rwanda, the Republic of Ghana, the kingdom of Morocco, the Republic of Zimbabwe, GIZ, Intel, Microsoft, Syniverse, Field cloud, Soft Bank, Rohde & Schwarz, Inmarsat and non-partners SAGIT and FAO for availing their expertise that helped materialize this Blueprint.

MR. LACINA KONÉ
DIRECTOR GENERAL, SMART AFRICA SECRETARIAT
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EXECUTIVE SUMMARY

As the most important sector of the African economy, agriculture has potential to reduce poverty on the continent, increase food security and improve nutrition. The Malabo Declaration outlines that Africa shall be food secure by 2025, in the process decisively eliminating hunger and poverty, tripling intra-regional agricultural trade and significantly improving community and household-level resilience. While Africa’s agricultural potential is significant, unlocking it requires practical, on-the-ground effort and innovation. Africa therefore requires consistent sustainable strategic initiatives and coordinated frameworks that increase utilization of land, use of technology to boost productivity and measures to improve global trade competence starting with initiatives towards import substitution.

In this context, Smart Africa’s bold and innovative commitment to accelerate sustainable socio-economic development on the continent has given rise to the development of the Continental AgriTech Blueprint. The blueprint is meant to assist African countries to accelerate agricultural productivity using Information and Communications Technology (ICT). Led by the Zimbabwe Government, the blueprint was developed by Smart Africa with technical assistance from a consultancy firm, Science and Advanced Global Innovation Technologies (SAGIT).

A methodology which was derived from African Union’s Comprehensive Africa Agriculture Development Programme (CAADP), was followed for this project. The developmental phases and iterative stages are:

Development Phases

1. Situational Analysis (Africa)
2. Benchmarking to Best Practices (Global)
3. Adoptable Continental AgriTech Blueprint – National Strategy and Transnational pilot projects

Iterative Development Process/stages

1. Literature review
2. Bench-marking on Global best practices
3. Guided Outcomes by Working group and Smart Africa Secretariat
4. Validation workshops
5. Progressive evaluation (relevance check to the AgriTech blueprint)

Throughout the project execution process, a co-construction approach with Smart Africa, SAGIT and the key partners was adopted. Thus, the involvement of partners was
ensured through a full consultative cycle with stakeholders. The stakeholder workshops served at the level of both data collection and validation.

**Context of AgriTech in Africa**

**AgriTech** is the fusion of agriculture and technological innovations with the purpose of increasing agricultural yield, efficiency, and profitability.

At a time when food security is a serious issue worldwide, AgriTech in Africa holds the promise of a better future. AgriTech in Africa is not a new phenomenon as competition in AgriTech start-ups started as far back as 2010. In sub-Saharan Africa, Kenya and Nigeria grab the lion's share in the AgriTech market, with Ghana being number three. In fact, Kenya was the pioneer of AgriTech on the continent and apparently continues to host a vibrant community of start-ups in this space. Nigeria's Fresh Direct Produce and Agro-Allied Services social AgriTech enterprise, Kenya's iProcure supply chain platform, Ghana's AgroCenta, South Africa's Yellow Beast precision irrigation product and South Africa's H2O Catchers fog farming project, are a few examples of successful AgriTech solutions in sub-Saharan Africa. Morocco and Egypt also boast of successful AgriTech revolution which started at the turn of the century.

**Global Success Case 1: Israel**

Agricultural revolution has been witnessed in many countries like the United States, China, Germany, Japan, etc, but Israel has a remarkable story in harnessing technology to transform agriculture and water management. Israel's AgriTech industry is characterised by intensive research and development of innovative systems, rooted in the need to overcome local scarcities of water and arable land. Israeli agricultural transformation is underpinned by close cooperation among stakeholders – government, research centres and the private sector. These in turn have fostered a market-oriented agribusiness that exports its AgriTech solutions worldwide. The result is modern agricultural methods, systems and products in a country where more than half the area is desert.

**Global Success Case 2: France**

France has been one of the most dominant agricultural centers of Europe for centuries. The major agricultural products that place France among the top producers in the world market are sugar beets, wine, milk, beef and veal, cereals, and oilseeds. At the core of agricultural transformation are the programmes which France’s Ministry of Agriculture and Food has instituted. France is one example that Global agriculture is undergoing a phenomenal digital transformation process. France has a vast and rich Agtech ecosystem. France has a vast array of start-ups and innovative SMEs that support agricultural transformation. There has been a huge attraction of technology companies, especially SMEs, into the agricultural sector.

**African Success Case 1: Morocco**

The African continent has hailed Morocco’s agriculture for its consistent growth. Several African countries are being inspired by “Moroccan expertise” which they are outsourcing
to enhance their own agricultural output. At the centre of Morocco's success is the technology industry which works with government to and other stakeholders in the agricultural sector to transform agriculture. Decision-making and functional information systems like SABA, irrigation warning systems, real time monitoring systems like ATTAISSIR, and many others, have revolutionised Morocco agriculture.

**African Success Case 2: Rwanda**

Rwanda launched its fourth Strategic plan for Agriculture Transformation (PSTA4), also constituting the third round of CAADP investment plan for the period of 2018-2024. Rwanda has embarked on digital agriculture in its efforts to make agriculture a central driver for its economic transformation, recognizing the central role of youth and women in its development.

**African Success Case 3: Zimbabwe**

Zimbabwe has been central to the development of the Continental AgriTech Blueprint. Government support in Zimbabwe is pivotal in the introduction of many innovative initiatives towards transforming agriculture. Some of these initiatives include high-tech Blueberry Farming, EcoFarmer technology, Smallholder Homestead Commercial Business Units model, Community Information Centers, etc.

**Technology Use Case 1: Field Cloud**

Field Cloud is a technology company which is a partner in the Continental AgriTech project. It has worked extensively with IoT applications to support agricultural transformation across Europe and recently in Africa. Field Cloud has set up robust Infrastructure which include Sensors, Actuators, Access Networks, Personal Devices, Nano Datacenters, Integration Workbench and Interconnect Networks.

**Technology Use Case 2: Intel**

Intel is also one of the technology companies in the AgriTech space which was a partner in the development of this blueprint. Intel's IoT solutions have been deployed for Digital Soil Testing for Small Holder Farmers, Tracking Freight at the Package Level, blockchain for food traceability, asset and equipment monitoring, etc.

**Technology Use Case 3: Syniverse**

Syniverse is another technology partner which has so far deployed its technology in the agricultural sector in Zimbabwe. Technologies from Syniverse include applications for precision irrigation management, mobile operator network extension, informational messaging campaigns, etc.

**Benchmarking Agriculture and ICT of member states**

Global data for benchmarking to best practices was collected for both agriculture and ICTs. In both sets, data was based on consolidated indicators set by agriculture and ICT world bodies. Countries in Africa were clustered into four categories as follows:
Fast Adopters. Countries in this quadrant have high Agriculture and high ICT capacities

ICT-Fit. Countries which have high ICT capacity but low Agriculture Capacity

Agric-Fit. Countries which have high Agriculture capacity but low ICT Capacity

Emerging Adopters. Countries with low Agriculture capacity and low ICT capacity

The Continental AgriTech Blueprint for Africa

Overview of the Blueprint

The Continental AgriTech Blueprint for Africa is developed around 8 steps as presented in the following illustration.
The blueprint serves as a guide to member countries during the design and development of their own national AgriTech strategies and plans. Smart Africa and Zimbabwe are committed to operationalizing the blueprint in several countries within the Smart Africa Alliance and also to those outside the alliance.

**Recommendations and Smart Africa Implementation Strategies**

In following the blueprint, countries are guided by recommendations which pertain to different clusters as follows:

**Fast Adopters.** To continue the on the transformation trajectory with equal attention on both ICTs and agricultural capacity

**ICT-Fit.** Keep growing ICT capacities but pay particular attention to development of national expertise in agriculture and human capacity development

**Agric-Fit.** Strengthen leadership and a public policy for agriculture transformation based on CAADP principles

**Emerging Adopters.** Strengthen leadership in both ICT and Agriculture capacity as well as focusing on public policy for agriculture transformation based on CAADP principles

**Key lessons and Call-to-action**

- At the confluence of all categories, is the need to improve on ICTs and Agriculture capacities. African countries should develop strategies that lie at the intersection of ICTs and Agriculture. Lessons learned which trigger call to action include:
  - Stakeholder involvement (Government, Private sector, Academia, Farmers, NGOs, etc), Institutional strengthening, legal framework on land, Technical cooperation and networking with external bodies, etc
  - ICT infrastructure development (bandwidth, digital skills and human capacity, data management, etc)
  - Capacity-building for sustainable agriculture and rural development
  - Involvement of youths and women
  - Support research and development, technology start-ups in the agriculture space,
# GLOSSARY OF TERMS

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<th>Definition Guide</th>
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<tr>
<td>Agricultural transformation</td>
<td>is the process by which an agri-food system transforms over time from being subsistence-oriented and farm-centred into one that is more commercialized, productive, and industry centred</td>
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<td>AgriTech</td>
<td>Agri-tech 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.</td>
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<td>Blueprint</td>
<td>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.</td>
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<td>Biotechnology</td>
<td>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.</td>
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<td>Duality</td>
<td>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.</td>
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<td>e-Agriculture</td>
<td>involves designing, developing and applying innovative ways to use information and communication technologies (ICTs) with a primary focus on agriculture.</td>
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<td>Food security</td>
<td>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)</td>
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<td>GMO:</td>
<td>Genetically Modified Organism. An organism whose DNA has been genetically engineered for select characteristics deemed favourable.</td>
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<td>Industrialization</td>
<td>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.</td>
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<td>Innovation</td>
<td>is the practical identification and implementation of ideas that result in the introduction of new goods or services or improvement in offering goods or services.</td>
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<td><strong>ICT in Agriculture</strong></td>
<td>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.</td>
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<td><strong>Productivity</strong></td>
<td>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.</td>
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<td><strong>Smallholder farmers</strong></td>
<td>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.</td>
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In 2014, the Africa Union (AU) Summit adopted the Malabo Declaration which outlines that Africa shall be food secure by 2025, in the process decisively eliminating hunger and poverty, tripling intra-regional agricultural trade and significantly improving community-level resilience. In general, most member states are not on target to meet these noble yet lofty Malabo goals by 2025. It is argued and demonstrated in this continental Smart Africa AgriTech blueprint that through ICT innovations and interventions, member states are able to accelerate the pace of production and productivity in agriculture and agro-based industries. Central to the argument posited by the blueprint, is the transformative potential of digital technologies across all sectors of African economies with a special focus on agricultural technologies. It is today self-evident that Africa has enormous potential to feed itself and eliminate hunger and food insecurity, transforming into a major player in domestic and global food markets, fulfilling Agenda 2063 goals and SDGs. Recognizing this opportunity, the African Union (AU) back in 2001 established NEPAD, with agriculture as one of the pillars of the New Partnership for African Development. In 2003 the AU Summit adopted the Maputo Declaration on the Comprehensive Africa Agriculture Development Programme (CAADP). CAADP envisions an agriculture-led social and economic transformation of the continent contributing to the Agenda 2063 goals of continental prosperity, integration, people centered development, with Africa as a significant global player. The Malabo Declaration (2014) alluded to above was an extension and renewal of CAADP a decade after the Maputo Declaration (2003). This Agri-tech continental blueprint is therefore conceptualized and crafted through the broader Smart Africa vision of growing the digital marketplace in Africa, catalyzing innovation in various sectors and in this case agriculture, towards Africa’s aspirations and desired future.

1.1. Background To Agriculture Challenges And Opportunity For Africa in the use of ICT

Africa is still largely an agrarian society with agriculture still forming a significant portion of the economies of all African countries. As such agriculture is expected to play the primary role of driving the economies into social and economic prosperity and contributing to an expanding food system for both rural and urban-industrial communities, as well as exports. Agriculture plays the role of supplying 60% of raw materials to a growing manufacturing sector as well as creating a rural middle class that forms an effective domestic demand for industrial products and services. Moreover, the sustainable growth in integration of agricultural and non-agricultural activity drives industrialization and economic diversification, sustainable resource and environmental management, and creating jobs, human security and shared prosperity. The African reality is of urbanization that is not hinged on a sustainable agriculture revolution. This at best has inadvertently worsened the dual-economy syndrome that has virtually locked
every African country in either a Low-Income or Middle-Income Trap (MIT). Massive increases are urgent in terms of proportion of rural populations enjoying improved production and productivity, participating in the mainstream markets and value-chains leading into mass production, mass processing and mass consumption locally and domestically. This is arguably the transformative pathway to inclusive prosperity that offers opportunities for ICT innovation.

Moreover, in countries where there has been significant industrialization triggered by a sustainable agriculture revolution, this has largely excluded most of the rural population especially smallholder farmers. However, the African reality is that 80% of productive land is in the hands of subsistence farmers who face a plethora of challenges as shown in Table 1. While ICTs have catalysed significant agricultural transformation globally as in the cases of Israel, Netherlands, Singapore, the African reality is characterized by low ICT uptake in all sectors of the economy as depicted in Table 1.

**Table 1: A Snapshot of realities of Agriculture and ICTs in Africa**

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<td>Small-holder farming relies on family resources</td>
<td>Limited adoption of ICTs in Agriculture</td>
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<td>33 million farms of less than 2 hectares account for 80% of all farms</td>
<td>Internet penetration on the continent is about 39%</td>
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<td>Low productivity per unit area: Less than 1 tonne per hectare for maize</td>
<td>Youths make 60% of internet users. Millions of youths are unemployed though they are tech-savvy</td>
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<tr>
<td>Defragmented small-holder farmers: more than 33 million</td>
<td>Low digital literacy in women compared to men. 19% or women have access to internet compared to 24% of men</td>
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<td>Limited mechanisation in rural agriculture</td>
<td>Gender and rural-urban gaps in mobile internet use are at 37% and 60% respectively</td>
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<tr>
<td>60% of rural small-holder farmers are women</td>
<td>Where broadband is available, it is typically very expensive; that is, far beyond the financial means of the majority of Africans</td>
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According to FAO (2020), agricultural productivity in Africa still lag behind in comparison to other regions despite vast potential which Africa has in terms of agro-ecological condition and human capital endowment. Though moderate improvement was noted between 1961 and 2012, there are significant variations in the rate of growth in land, labour and total factor productivities depending on country and region. Adoption of better farming methods especially soil and water conservation technologies as well as continued access to input and output market are key determinants of better productivity amongst smallholder farmers. Table 2 presents 2019 data on selected
variables relating to agricultural productivity in African countries including percentage contribution of agriculture to GDP. A few countries were excluded because they did not have much data on the selected variables. General trend noted is countries with higher share of Agriculture contribution to GDP rank low in terms productivity measures and such countries typically have higher percentage of imports.

Table 2: Agriculture Productivity Data in 2019

<table>
<thead>
<tr>
<th>Country (Indicators)</th>
<th>Agriculture GDP (% of total GDP)</th>
<th>Food Production Index</th>
<th>Livestock Production Index</th>
<th>Food Exports</th>
<th>Food Imports</th>
<th>% Agric Raw Materials imports</th>
<th>% of water withdrawal</th>
<th>% Employment in Agriculture</th>
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1.2. Implications of Agriculture and ICT Realities: The Problem Space

By juxtaposing realities of African agriculture and realities of ICTs in Africa, the problem situation which this blueprint seeks to address is then formulated. This problem domain is presented as follows:
Any increases in production and productivity in agriculture and agro-based industries are a result of improved returns to the combination and innovation in utilization of 5 factors: land, labour, capital, technology and connections. Agricultural transformation requires a significant increase in the supply of these basic prime movers and the ability to organize them, if at all society is to transform into an agro-industrial society. Agricultural transformation does not happen in isolation, but as part of a broader process of structural transformation shaped by the inter-linkages between agriculture, the rural non-farm economy, manufacturing and services. Scope for ICT innovation is needed across the 5 factors and across structural transformation processes which invariably see the evolution of all key societal institutions, triggering a rise agricultural productivity, commercialization and diversification of production patterns and livelihoods within the agricultural sector and the rural non-farm sector. ICT therefore has potential applications in various aspects from micro to macro settings, from farm to folk, and so on to include the following areas: regulatory and policy practice; agricultural advisory and extension services; agricultural education; production systems and automation on-farm and
off-farm; land governance, administration and management; financial intermediation, inclusion, insurance and risk management; capacity building and empowerment; and agricultural market information services including provision of aggregation and agro-logistical services for various categories of farmers large and small.

Moreover this agenda does not only require a vibrant business sector, in fact, all this requires putting in place and guaranteeing the role played by strong leadership and a techno-savvy and capable public administration at all levels of government, reforming an promulgating enabling policy and legislation, ensuring coordination and mutual accountability mechanisms across government, creating a macro-economic policy environment that is conducive to extending structural transformation through an agrarian transformation agenda, underwritten by appropriate reforms in public budget architecture towards agrarian transformation. Before delving into the technicalities of applying ICT in agriculture, therefore, is important to enjoy an enabling environment; for society to experience an improved access to information and ICT driven knowledge and learning capabilities; as well as social marketing of rural life, changing the status of agriculture and rural life in politics, the media, schools and society as a whole, which requires the dissemination of positive messages and the enhancement of the rural side of a nation. Africa's population is still predominantly rural and is expected to tip over into predominantly urban population around 2035. Despite rapid urbanisation, the population in rural areas is expected to continue to increase in absolute terms well into the second half of the 21st Century. The youth bulge will continue to be with us, also a blessing if opportunities grow. By 2025, for instance, it is estimated that 330 million young Africans will have entered the labour market, with limited opportunities for finding jobs in cities.

There are a number of paradoxes that offer even more scope for ICT intervention and innovation. To start with, agricultural production in Africa has actually increased steadily for 2 decades, and aggregate value has almost tripled (+160%), and is almost identical to that of South America, and below but comparable to growth in Asia. The challenge is that almost all agricultural growth in Africa is through increases in land under cultivation, with limited improvement in productivity of land and labour. On average, cereal yields are less than half those obtained in Asia. The second paradox is in the unorthodox structural transformation process. Unlike orthodox structural transformation that experiences rapid urbanisation driven by manufacturing industries and services, Africa's rapid urbanisation is happening with limited manufacturing and limited urban jobs. Rural Africans are basically driven out by poverty and seeking better services in urban areas – including improving ICT facilities! Instead of structural transformation that sees prosperity in both rural and urban areas due to economic convergence of rural and urban, Africa is experiencing negative effects in both rural and urban. Rural communities are losing capacity while urban centres are ill-prepared for increasing numbers with insufficient jobs, housing and social services. Both urban and rural communities are therefore experiencing unacceptable hunger and nutritional deficiencies. Cereal production has been unable to keep pace and for urban population the gap is growing in supply of processed products and meats. Africa has become a net importer of food and imports products that compete with its own: meat, dairy products,
cereals and oils. Imports account for 1.7 times the value of exports. As a result, African agricultural exports have fallen by half since the mid-1990s.

1.4. Direct ROI of Agricultural Science and Technology Innovation

Extension, Research and Education: One of the leading benefits of ICT to farmers relates to its potential to bring about transformation in agriculture through the enhancement of education and research though platforms such as the Agricultural Science and Technology Innovation (ASTI) System (the African Economic Research Consortium (AERC) (2007: 15). These ICTs include; mobile telephony, innovative community radio and television programs, mobile phones in combination with radio, video shows, information kiosks, web portals, rural tele-centres, farmer call centres, video-conference, offline multimedia CDs and open distance learning (UNDP, 2012). ICTs assist researchers and extension workers to adopt enhanced agricultural practices and disseminate them to farmers quickly and efficiently. These researchers and extension workers provide farmers with relevant agricultural information such as agricultural methods, latest innovations in agriculture and weather patterns.

Through ICT, farmers can be updated with the recent information about agriculture, weather, new varieties of crops and new ways to increase production and quality control (Singh, 2017). Information pertaining to good agricultural practices is made readily available not only to through extension workers and researchers but also direct to the farmers (Chavula, 2014). ICTs help in capturing real time weather parameters through remote sensors and acquire updated research findings regarding crops through the web-based platforms (Amarnath et al, 2018).

The information, thus, collected is stored in a database and triggered automatically to disseminate localised and personalised information on weather, commodity prices and crop cultivation to registered farmers through Short Messaging Service (SMS) and Interactive Voice response (IVR) over the mobile communication channel (Naveen, 2018). This updated information empowers farmers as they are better informed and prepared themselves to utilise their resources profitably. This has had direct and indirect impact on production and productivity.

Market Information: The agriculture market size and its reach have increased manifold over the years due to linkages with distant and overseas markets. Farmers are using various ICT platforms viz. mobiles, web-portals, information kiosks and e-markets among others for marketing their produce (Naveen, 2018). ICT platform adds market knowledge and gives farmers greater confidence in understanding the demand and enhances ability to control production and manage supply chains.

The use of ICTs is playing a critical role in providing farmers with market information. The availability of markets and market information such as market prices gives farmers the potential to bargain and improve their incomes, to seize market opportunities through the adjustment of production plans and better allocation of production factors and also to use the information to make choices about marketing (UNDP, 2012). More so, ICT has
the great potential to widen the marketing horizon of farmers directly to the customers or other appropriate users for maximum benefit. Farmers may connect directly with many users and may get information about current prices for their commodities. They can get access to the market sitting at home.

Further, ICT will curtail the middle profit also which will be beneficial for the farmers (Singh, 2017). Through ICT farmers can deal directly with large wholesalers or traders or directly with the processors rather than small-scale intermediaries. ICT platforms thus assist in developing a broader network of contacts which helps in making better decisions regarding the markets. This can improve a farmer’s source of revenue; empower farmers for making good decisions about appropriate future crops and commodities and marketing channels to sell their produce as well as to get inputs.

**Financial services:** Availability and access to adequate, timely and low-cost credit from banks is of great importance for sustainable and profitable farming. The challenges to bring all farmers within the banking reach at affordable cost have been fulfilled through remote bank transactions assisted by hand-held biometric transaction devices (Naveen, 2018).

The Banks facilitate financial services such as savings, credit, insurance and remittance with the help of these devices accessed through smart cards. Smart cards hold farmers’ information regarding the land details, crop history and financial transactions, which help banks to process and sanction crop loans faster (Naveen, 2018). Thus, the farmer needs to initiate the loan procedure through the hand-held device available at the village and visit the bank to collect the loan amount upon confirmation on loan sanction. This saves the farmer valuable time and energy to obtain institutional loans.

**Risk transfer:** Volatility in commodity price and the threat of climate change have increased interest in risk transfer instruments such as insurance and price hedging more relevant and affordable for farmers (Naveen, 2018). The ability of mobile platforms to facilitate financial transactions, capturing real-time data about crop loss and automatically perform damage assessment can definitely help in scaling up risk transfer instruments for farmers.

**Networking and Collaboration:** ICT technologies can help for strengthening farming communities through wide networking and collaborations with various institutes, NGOs and private sectors. Nowadays, development partners in agriculture such as FAO can interact with farmers through ICTs rather than face-to-face. During the time of Covid-19 induced lockdowns and restrictions to movement, ICT helped farmers to continue networking with farmers unions, development partners, government institutions and NGOs.
1.5. Context of AgriTech

Agricultural technology has been a primary factor contributing to increases in farm productivity in developed countries over the past decades. Africa has not been an exception as articulated in the popular quote below:

“Unless Africa uses modern technologies, our farmers’ output will remain low and we will remain dependent on others to feed us.” – Akinkunmi Adesina, 2017 World Food Prize Winner.

The above famous quote by Adesina largely refers to AgriTech as being the way to go if agricultural transformation and food security are anything to go by in Africa. Indeed, the digital economy is continuously gaining substantial importance within the global economy as a driver of innovation and competitiveness. At a time when food security is a serious issue worldwide, AgriTech in Africa holds the promise of a better future. FAO (2020) projects that the world population will reach 9.1 billion by 2050, and to adequately feed that number of people; global food production will need to grow by 70%. By then, Africa is projected to be home to approximately 2 billion people. This implies that farm productivity must accelerate at a faster rate than the global average in order to avoid continued mass hunger. AgriTech is a small and yet phenomenally growing “technological wave in agriculture” whose aim is to improve the global food and agriculture industry.

In its simplest form, AgriTech is the use of technology in agriculture with the aim of improving sustainability, efficiency, and profitability. AgTech (2020) noted that the AgriTech industry is a $7.8 trillion industry with investments reaching $2.6 billion. Since 2016, over $19 million has been invested in the AgriTech sector in Africa alone, with the number of startups operating in the market increasing by 110% during the same period (Disrupt Africa, 2020). Characterized by leveraging on artificial intelligence to assist farmers better manage potential risks and disasters such as droughts and disease outbreaks, the AgriTech sector in Africa is plenary with tremendous potential. In fact, AgriTech has the potential not just to support agricultural transformation in Africa but to do so sustainably and inclusively for the whole world. Kenya and Nigeria grab the lion’s share in the AgriTech market at the moment, with Ghana being number three. In fact,
Kenya was the pioneer of AgriTech on the continent and apparently continues to host a vibrant community of startups in this space.

This, according to Krishnan et al. (2020); can happen through any of the following AgriTech disruption typologies listed below:

![AgriTech disruption typologies](image)

*Figure 2: AgriTech disruption typologies*

However, according to Krishnan et al (2020), AgriTech in Africa receives limited funding, owing to constraints relating to the business ecosystem (investment, doing business environment, financial systems), data infrastructure (digital payments, digital ID, digital literacy, digital policies), human capital and connectivity, cloud services and network access.

1.6. Methodology of the development of the Smart Africa AgriTech blueprint

The approach to developing the Smart Africa AgriTech blueprint is based on a number of requirements to have a final product that is user-friendly in supporting member states to leverage and align ICT innovations and capabilities with the country's agricultural transformation strategies and interventions. The Blueprint has to be relevant and usable to the different situations and capabilities across African countries with respect to agricultural strategies and ICT infrastructure and capabilities. Our methodology framework for the development of a continental AgriTech blueprint employed a multi pipeline approach customizable to define a roadmap of inclusive transformation concepts that can be embedded in local contexts to advise on diverse national strategies. The methodology was underpinned by the CAADP Framework which has inspired and energised African agricultural research institutions, farmers' associations, African governments and the private sector towards agricultural transformation. Drawing from the CAADP Framework, an iterative approach (Figure 1) was developed to pursue an outcome that delivered on Smart Africa objectives.
The Iterative Process was deemed to be capable of informing decisions from the local to the global scales and over short and long-term horizons, to derive locally-acceptable sustainable solutions.

Figure 3: Iteration Process in the development of the methodology.

The methodology follow a 5-phased approach that primarily builds the development of the blueprint in the context of the ongoing transformation of Africa. Situational analysis of the agriculture and ICTs of the member states was carried out through literature review, followed by benchmarking on best global practices. Continental AgriTech blueprint was the outcome of the first three phases, which pointed to the development of adoptable national development strategies of individual member states and cross-border collaborative pilots.

Development Phases
1. Situational Analysis (Africa)
2. Benchmarking to Best Practices (Global)
3. Adoptable Continental e-Agriculture Blueprint (National Strategy)

Iterative Development Process/stages
1. Literature review
2. Bench-marking on Global best practices
3. Guided Outcomes by Working group and Smart Africa Secretariat
4. Validation workshops
5. Progressive evaluation (relevance check to the AgriTech blueprint)
PART II

THEORY OF CHANGE AND BENCHMARKING AGRICULTURE AND ICT IN AFRICA

2.1. INTRODUCTION

Digital transformation represents an opportunity for improving productivity growth by enabling innovation and reducing the costs of a range of business processes (OECD, 2019). Technology and innovation have become the hallmark of productivity in the digital economy. Yet despite the rapid advance of digital technologies, aggregate productivity growth has slowed over the past decade or so, raising the question of how digital technologies can boost productivity. Today, as in the 1980s, when Nobel-prize winner Robert Solow famously quipped: “we see computers everywhere but in the productivity statistics” there is again a paradox of rapid technological change and slow productivity growth. Technology, innovation and productivity play an important role in the efforts of emerging and middle-income economies to move up global value chains, escape the “middle-income trap” and move towards knowledge-based economies.

2.2. THE DIGITAL ECONOMY: AN OVERVIEW

A digital economy is characterized by a society’s outcomes like innovation and agility. The most defining characteristic of the digital revolution is a phenomenal decline in the cost of information and the consequent massive increase in access to the information that is embedded in ideas, images, values, and goods and services. ICTs are at the heart of significant rapidly occurring changes in the history of humanity. Evidence is clear that ICTs are transforming how we learn, work, interact and move from one point to another. The internet, for example, is now built into a vast array of products and services. This environment of online coordination, delivery and accessibility, coupled with new radical business models, are all products of digital transformation. Digital transformation of the Fourth Industrial Revolution is transforming homes, health, governments, agriculture, sports, communications, etc. This monumental revolution is responsible for a significant transformation of the human experience and a massive shift in society’s standards of living. Many of society’s activities are now being facilitated by ICTs with greater velocity, scope and impact. As prosperity spreads, expanded technology-facilitated innovation also spreads. In the new digital economy, humans are changing the world through digitalization, but their lives are also being changed as behaviours are being modified by ICTs. Society’s expectations of what is possible are being changed as several new innovations open up new sets of possibilities in every economic sector.

A digital economy has potential to enhance productivity and gains in multiple ways. A digital economy can change the way economies of scale are achieved, particularly with online service delivery, as the incremental cost of offering an additional product or service may become negligible. The development of a digital economy will create new
technological platforms and industries on one hand, while enhancing the efficiency and productivity of existing industries on the other. The Figure 2 provides an ecosystem of digital economy.

![Figure 2: Ecosystem of a digital economy (Source: Smart Africa Digital Economy Report, 2019)](image)

For a successful and inclusive Digital Economy, African countries would require building key foundational elements of a digital economy (The World Bank Group, 2019). The five foundational elements of the digital economy are the following:

- **Digital Infrastructure:** Digital infrastructure provides the way for people, businesses, and governments to get online and link with local and global digital services, thus connecting them to the global digital economy. For a digital economy, good and affordable Internet connectivity is a critical foundation.

- **Digital Platforms:** Digital platforms offer products and services, accessible through digital channels, such as mobile devices, computers, and Internet, for all aspects of life. Digital platforms enable producers and users to create value by interacting with each other.

- **Digital Financial Services:** Digital financial services enable individuals and businesses to conduct transactions electronically or online and open a pathway to a range of digital financial services in addition to digital payments, including credit, savings, and insurance. Access to affordable and appropriate digital financial services is critical for the participation of individuals and businesses in the digital economy.
- **Digital Entrepreneurship**: Digital entrepreneurship and innovation create an ecosystem to bring the digital economy to life with new, growth-oriented ventures and the transformation of existing businesses, which contribute to net employment growth and help enhance competitiveness and productivity of the economy.

- **Digital Skills**: Economies require a digitally savvy workforce in order to build robust digital economies and competitive markets. Digital skills constitute technology skills, together with business skills for building or running a start-up or enterprise. Greater digital literacy further enhances adoption and use of digital products and services among the larger population.

### 2.3. THEORY OF CHANGE

The theory of change engenders innovation as the primary driver of the change. It is a comprehensive description and illustration of how and why a desired change is expected to happen in a particular context. Figure 3 depicts the AgriTech Blueprint presenting a theory technology as a change agent through ICT integration into the agro-economy to transition into the agro-industry economy.

![Figure 5: Conceptual Theory of Change](image)

Figure 4 shows a detailed conceptual view of the theory of change within the agricultural economy in Africa. Current realities have been clustered into dual economy, climate change and the growing population. These realities present both challenges and opportunities, the intervention mechanism of which is through AgriTech. The outputs and outcomes are then realized towards the long term impact of meeting the Africa Agenda 2063 and the Sustainable Development Goals.
2.3.1. IMPROVED INTEGRATION OF ICTS IN AGRICULTURE

Digital transformation literature has documented significant benefits of integrating ICTs in agriculture. Figure 5 presents a summary of the role of ICTs in catalyzing the agricultural revolution.
2.3.2. TRANSFORMING SMALL-SCALE AGRICULTURE THROUGH ICTS

Small-scale farmers are the backbone and cornerstone of agricultural and food supply chains in most developing countries (FAO, 2015). Yet, the agricultural practices of these farmers are at times not economically viable and struggle to be sustainable. As a consequence, small-scale farmers produce low yields which adversely affect their economic conditions. Critical information is inaccessible: information on production practices, information on impending extreme weather or epidemics, or information that could enable farmers to transport crops more effectively to markets and sell them at better prices. Lack of information about critical inputs and inadequate knowledge about modern and efficient agricultural practices are also some of the factors that contribute to low yields (World Bank, 2017). Small-scale farmers continue to struggle to receive quality advisory services (including weather information for a timely decision on when, how and what to plant, etc.) to optimize crop yield. Particularly for small-scale farmers, it is a challenge to get reliable weather and market information in real-time that can help with agricultural decision-making. But almost every farmer has a phone in their back pocket.

Increasing the efficiency, productivity and sustainability of small-scale farms is an area where ICT can make a significant contribution. ICT can play a crucial role in benefiting the resource-constrained farmers with up-to-date knowledge and information on agricultural technologies, best practices, markets, price trends, and weather conditions. Small-scale farmers can use ICT to match cropping practices to climatic trends, use inputs and resources environmentally and sustainably, and cope with productivity threats. There is a generally optimistic understanding that technology can empower small-holder farmers to have a larger footprint in the value chain by addressing key challenges and unlocking untapped opportunities, like making rural farmers visible to providers, customers, distributors or even making them visible to financial service providers (Research ICT Africa, 2020). With the growing mobile, wireless, and Internet technologies, ICT has found a position even in poor small-scale farmers and in their farming activities. Thus, the strategic application of ICTs to Africa's agricultural sector offers the best opportunity for high productivity in small-scale farming (Chavula, 2014).

Given the above, there is no doubt that ICT has the potential of transforming small-scale agriculture. According to CTA (2019), digitalisation for agriculture has the potential not just to support agricultural transformation in Africa but to do so sustainably and inclusively for Africa's 250 million smallholder farmers and pastoralists. ICT has come to be a major solution to the problems of small-scale farmers in rural areas. The use of ICT can radically change the costs and delivery models used for a broad range of products and services to small scale farmers and other actors along agricultural value chains (Feed Africa: Strategy for Agricultural Transformation in Africa, 2016). The Nigerian example of using an e-Wallet system for the distribution of input subsidies created both a far more efficient platform for driving input use versus the pre-existing public distribution system where only 11 percent of subsidies by value were reaching small-scale farmers, as well as creating a platform to engage with and understand farmers.
Digital technologies overcome information problems that hinder market access for many small-scale farmers, increase knowledge through new ways of providing extension services, and they provide novel ways for improving agricultural supply chain management (Deichmann, Goyal & Mishrac, 2016). Access to market information is considered a key agricultural factor that affects the participation of small-scale in markets. Small-scale farmers have little information about markets and prices. Mobile phones, in addition to other types of ICTs, can overcome this problem by informing both producers and consumers of the prices offered for agricultural products in various locations. For instance, the Esoko system, a technology that uses mobile phones, internet and information systems to provide live market feeds, direct SMS marketing, scout polling and online profiling and marketing (a customizable web space that can advertise goods and services) is used in countries such as Benin, Ghana, Malawi, Rwanda. Thus, the use of ICTs is considered paramount for providing small-scale farmers with required market information, and also reducing market asymmetries.

In addition, ICT-based agricultural extension also brings incredible opportunities and has the potential of enabling the empowerment of farming communities (Kante, 2019; Saravanan, 2010). New forms of farmer extension using text or voice-over mobile, and video, are reducing the cost and increasing the quality of training of farmers. Benefits to small-scale and rural farmers, when observed, have instead been found to derive from more rudimentary ICT applications like agricultural extension and market information systems accessible through mobile devices (Emeana, 2020). Thus, the use and adoption of ICTs for small-scale farming remain a priority in advisory and extension services.

Also, Ghana-based Farmerline and AgroCenta deploy mobile and web technologies that bring farming advice, weather forecasts, market information, and financial tips to farmers, who are traditionally out of reach, due to barriers in connectivity, literacy, or language.

Furthermore, rural communities' benefit from better access to credit and rural banking facilities. Recent mobile banking initiatives offer further scope to reduce costs and stimulate local trade. Mobile banking (m-banking) has had a tremendous impact on the socio-economic status of small-scale farmers. Through innovative schemes such as M-PESA in Kenya, farmers can send and receive money using their mobile phones (Kirui, 2013). DrumNet in Kenya helps link financial institutions, small-scale farmers, retail providers and agricultural product buyers through a cashless microcredit programme. Another example is the smart-card-based MAKWACHA system in Malawi, which allows rural farmers to receive payments and purchase farm inputs electronically. In Egypt, the e-Finance platform established by the Ministry of Agriculture connects farmers, banks and agro-input dealers for delivering subsidized inputs to farmers.

A significant share of mobile and ICT-based service innovation, especially for the agriculture sector for small-scale farmers, is being driven within Africa, a potentially important source of comparative advantage versus other regions. Nevertheless, for
effective agricultural transformation to take place, ICTs serving small-scale farmers should have the following characteristics: Affordable, Scalable, Self-sustaining, Sensible, Participatory, and Appropriate.

Matsenjwa (2019) summarised the areas of importance of ICTs for small-scale farmers as follows: easy access to agricultural information; provision of information on weather, soils, crop, and animal disease outbreaks; provision of information about new farming techniques and new food storage and processing technologies; and quick access to information on market prices of crops and livestock and farm inputs such as fertilizer, agro-chemicals. Other areas of importance include ensuring effective communication with other farmers; availability of information on sources of credit, subsidies, and loans for farming; and ensuring effective communication with extension agencies and NGOs.

2.3.3. TRANSFORMING COMMERCIAL AGRICULTURE WITH DIGITAL INNOVATIONS

Various technologies have great potential to transform commercial agriculture in Africa. In fact, according to Maddikunta (2020), as depicted in Figure 6, modern large-scale agriculture is becoming unthinkable without such precision agriculture tools as a global positioning system (GPS), Artificial intelligence; Internet of Things (IoTs); Blockchains; satellite, and drone monitoring, and increasingly detailed and instantly available weather and climate information. Many of these digital technologies, particularly the on-site technical infrastructures related to data collection and processing, the IoT and AI, can likely only be adopted in large-scale commercial farming operations, primarily because of the cost involved in the technology adoption (Saiz-Rubio, 2020). This section provides an overview of modern technologies underpinning the transformation of commercial agriculture.

Figure 8: Transforming Commercial Agriculture with Digital Innovations
Artificial Intelligence (AI): AI is critical in large-scale farming. The predominant areas of application of AI in agriculture include the following: (a) smart agriculture; (b) robotics; (c) agricultural optimisation management; (d) automation; (e) agricultural expert systems; (f) agricultural knowledge-based systems; and (g) decision support systems. The technology will be helpful to yield healthier crops, provide information of prevailing weather conditions such as temperature, rain, weed speed, weed direction and solar radiation; control pests; monitor soil and growing conditions; organize data for farmers; help with the workload, and improve the food supply chain.

Supporting decision-making
Farming is increasingly affected by variability in rainfall conditions and changes in land-use patterns. Under such socio-ecological conditions, little is known about farmers’ decision-making in response to uncertainties in uncertain rainfall conditions. At a farm level, AI software will be able to analyse data to direct robotic systems to undertake specific tasks, including spraying or harvesting. At a farm and industry level, AI will predict harvest periods, packing needs and logistics requirements. Ultimately, AI will direct machinery to undertake tasks based on the interpretation of data.

Crop health monitoring
Assessment of the health of a crop, as well as early detection of crop infestations, is critical in ensuring good agricultural productivity. AI can detect early enough plant stress associated with climate change, nutrient deficiencies, weed, insect and fungal infestations must be detected early enough to provide an opportunity for the farmers to mitigate.

Assessing cattle condition for market
AI has the potential to be better than humans at determining if individual animals meet market specifications. The analysis may assist other decisions on farms, such as allowing a farmer to select animals with superior measured traits for breeding the next generation. Thus, the ability to accurately predict an individual animal’s yield potential at any instance will transform livestock production and marketing.

Autonomous and Robotic Labour
Most aspects of commercial farming are exceptionally labour-intensive, with much of that labour comprising repetitive and standardised tasks. This includes applications such as harvesting; picking, seeding, spraying, pruning, sorting and packing etc. Eventually, this new wave of smart equipment will make it possible to produce more and higher quality food with less manpower.

Supply chain connectivity
AI will provide the capability needed to recommend adjustments in what is produced (e.g. planted, slaughtered) and to what criteria (e.g. carcass weights, milk composition), to best meet demand and minimise wastage.
**Internet of Things (IoTs):** The application of IoTs in agriculture is about empowering farmers with the decision tools and automation technologies that seamlessly integrate products, knowledge and services for better productivity, quality, and profit. Major applications of IoTs in Agriculture include the following:

**Precision crop farming**

Precision farming is an umbrella notion for IoTs-based approaches that make farming more controlled and accurate. Figure 7 depicts some key IOT components of precision farming. In simple words, plants get precisely the treatment they need, determined with great accuracy.

**Figure 9: Some Key components of Precision Farming**

Precision crop farming enables farmers to increase crop yields and reduce fertiliser and pesticides costs while protecting the environment. Two examples of precision agriculture application in Africa are presented; FruitLook which is used by farmers in the Western Cape in South Africa as a state-of-the-art information technology that helps deciduous fruit and grape farmers to be water efficient and climate-smart. The Chameleon and Wetting Front Detector Sensors have enabled small scale farmers in Mozambique, Tanzania, and Zimbabwe to cut down irrigation frequency fifty times and double productivity.
**Precision Livestock Farming**

Precision livestock farming draws the farmer’s attention to those animals that require special care. IoTs enable farmers to better monitor the needs of individual animals and location. This helps them in identifying the condition of their livestock; preventing the spread of disease and attending those that are about to give birth.

**Smart Irrigation**

Smart Irrigation is a method of improving the efficiency of irrigation processes and reducing water losses while conserving existing water resources using IoTs-based smart irrigation systems. Smart irrigation makes it possible for farmers to monitor and irrigate their fields remotely without any hassles as well as save resources such as water, electricity or diesel which are slowly becoming scarce in African countries. Smart irrigation systems can save up to 45 percent water during the dry season, and around 80 per cent of water in the rainy season compared to manually operating watering systems.

**Smart Greenhouse**

The smart greenhouse allows farmers to cultivate crops with minimal human intervention. The technological development in Wireless Sensor Networks has made it possible to use in monitoring and control of greenhouse parameters in precision agriculture. This design provides optimal and cost-effective solutions for farmers with minimal and almost no manual intervention.

**Agriculture Drones (unmanned aerial vehicles):** Drones have a huge potential in agriculture transformation by supporting evidence-based planning and in spatial data collection. Drones can scan a vast area of the field and work with different sensors to gather a wide range of information at ease. Drones can also perform crop spraying tasks more efficiently, and with greater accuracy and less waste. Thus, for the most part, drones make sense where they can replace labour-intensive and potentially harmful use of backpack sprayers. In Africa, countries like Tanzania, Mozambique, Morocco and South Africa just to mention a few have made significant progress in the use of drones. Figure 8 shows some important uses of drones in agriculture.
Figure 10: Some important uses of drones

**Global Positioning System (GPS):** One main area where GPS has found importance is in the field of precision farming. Linking to a system of satellites, a farmer uses a receiver to pinpoint his or her position to within inches. GPS can be used for Soil sampling; Weed location; Accurate planting; Harvesting; Identification of irrigated crops; Autopilot operations; and Crop inventory.

**Blockchain:** During recent years, Blockchain has attracted significant increasing attention in the agricultural sector and the FAO also recommended that the development of AgriTech should incorporate the application of Blockchain technology. The Blockchain application in agriculture includes food safety through traceability of provenance, information system, agro-trade, finance, crop certification and insurance etc. As a trusted way of storing data, Blockchain facilitates the use of data-driven technologies to make farming smarter. In addition, jointly used with smart contracts, it allows timely payments between stakeholders (farmers, buyers and Agro-dealers) that can be triggered by data changes appearing in the Blockchain. The opportunity to utilise blockchain in traceability is reflected in initiatives such as IBM and Wal-Mart’s Blockchain for Food Safety Alliance in China that is seeking to develop a standardized method on food origin, safety, and authenticity on a blockchain platform.

### 2.3.4. RECOGNITION OF WOMEN’S ROLE IN AGRICULTURE AND ICT

As the backbone of the sector women represent 60% of the total population in the agricultural sector and are responsible for approximately 50% of the agricultural labour on farms in Sub-Saharan Africa (SSA). They also produce 60% to 80% of the continent’s food. Therefore, Women have to be onboarded on programmes and activities on new knowledge necessary for agricultural transformation. A critical success factor, among
others, is the adoption of new innovative approaches for continental and national response founded on gender-equality, inclusivity, sustainability and good governance. A fundamental rethink of what transformational change in agriculture means for African women and a full examination of how they can be supported, given the global factors impacting the sector.

According to FAO, women tend to experience constraints in accessing agricultural productive resources and these limitations involve several dimensions as depicted in Figure 11. The constraints range from limited ownership of land, lack of skills in managing agricultural resources, lack of financial resources, limited access to education, knowledge and skills as well as limited participation in agricultural labour activities.

### Figure 11: Challenges facing women in agriculture

Women tend to be disadvantaged in regard to all these dimensions (FAO, 2011). Targeted investments in women farmers and instituting policies that close gender gaps in African agriculture could yield enormous benefits for women and their families, communities and countries.

#### 2.3.5. ATTRACTING AFRICAN YOUTHS INTO AGRICULTURE

Babbi (2016) reported that most young people in Africa find agriculture unattractive. Given the fact that agriculture is central to rural livelihoods, its role in solving the African equation cannot be undermined. The growing disinterest of youth in agriculture is not welcome and paradoxical. Most young people, approximately 85%, live in developing countries, mostly in Africa, where agriculture provides the main source of income. Therefore, it is vital that young people are connected with farming, particularly...
commercial farming. Furthermore, Africa has the youngest population in the world. In fact, 60% of the population is under the age of 24, and approximately 12 million youths join the workforce every year. Indeed, the future of African youths lies in agriculture. It is possible to realize this future if we can make agriculture a profitable career for youths. There is a need shift the perception of agriculture as a way of life for most Africans to a serious profitable business. Commercial agriculture should not be seen through the lens of subsistence farming. There are many micro-enterprises within agriculture that youths can engage. There is a world of opportunities in processing and adding value to harvests. Commercial agriculture offers many opportunities for youths to find gainful employment along the value chain.

While most of African countries are largely rural, we cannot undermine the fact that urbanization is rapidly increasing across Africa. This means that the number of youths engaged in farming in Africa is also set to decline rapidly. Now, there is the question: how do we attract youths onto commercial farming or agricultural projects when the trend is to live in urban and not rural areas? This is the question that we will address as policy makers. Figure 10 presents some of the most important ways of luring (attracting) youths onto commercial agriculture.

Investing in ICTs to digitise agriculture can be an attraction to the youths because agriculture then becomes a modernised activity. Investing in training and research and development, investment in agriculture and rural economy, supportive land tenure systems as well as access to finance are some of the factors that could attract the youths into agriculture.

**Figure 12: Attracting Youth into Agriculture**

Investing in ICTs to digitise agriculture can be an attraction to the youths because agriculture then becomes a modernised activity. Investing in training and research and development, investment in agriculture and rural economy, supportive land tenure systems as well as access to finance are some of the factors that could attract the youths into agriculture.

### 2.3.6. AGRICULTURAL TRANSFORMATION GLOBAL SUCCESS CASE 1: ISRAEL

ICTs have disrupted different sectors in many ways and the recent COVID-19 pandemic has accelerated the drive towards digital economies especially in developing countries. The critical role of Agriculture as a driver for economic growth and source of livelihoods makes it imperative to take a closer look at outstanding cases of ICT integration in Agriculture.
• Israel manages to produce 95% of its own food requirements and success of the advanced agricultural sector is attributed to the close cooperation between farmers, Israel’s agro industry, and technological research (R&D is about 17 percent of Israel’s budget allocation for agriculture).

• Exports of agricultural inputs including chemicals and fertilizers almost double those of exports of agricultural produce.

Israel's agriculture is characterised by high technological level, pressure irrigation systems, automatic and controlled mechanisation and high quality seeds and plants. Israel's AgriTech industry is characterised by intensive research and development of innovative systems, rooted in the need to overcome local scarcities of water and arable land. Israeli agricultural transformation is underpinned by close cooperation among stakeholders – government, research centres and the private sector. These in turn have fostered a market-oriented agribusiness that exports its AgriTech solutions worldwide. The result is modern agricultural methods, systems and products in a country where more than half the area is desert. Figure 8 shows the private sector investment and the entrepreneurial world of Israeli Agrotech.

Figure 13: Private Sector Investment and the Entrepreneurial World of Israeli Agrotech (Source: Tal, 2019)
Israel has used ICTs in agriculture in the following key areas:

- **Water and irrigation:** Israel pioneered innovative irrigation technologies, systems and accessories, such as drip irrigation, automatic valves and controllers, media and automatic filtration, low discharge sprayers, mini-sprinklers and compensated drippers. In addition, the computer-controlled drip irrigation system saves huge quantities of water and also provides for the ability to supply fertilisers with the water (“fertigation”).

- **Post-Harvest:** Modified atmosphere (MA) and controlled atmosphere (CA) cooling systems together with advanced product-specific packaging are used to preserve and protect the produce.

- **Greenhouses:** The need to overcome the natural restrictions of soil, water and a harsh climate has led Israel to develop sophisticated greenhouse technologies. Greenhouse systems, including spectrum-optimised plastic films and heating, ventilation and structural systems, enable Israeli farmers to grow more than three million roses per hectare per season, and an average of 300 tons of tomatoes per hectare per season – four times the yield of those grown in open fields.

- **Dairy Farming:** Israel’s dairy industry has developed and employs advanced technologies that have transformed the industry to produce an average of 1200 liters of milk per cow annually from an average 4000. Exports include frozen semen, embryos for transplant, heifers, advanced milking and computerised feeding systems, consulting services and joint international project development.

- **Poultry Farming:** Israel has developed innovations that contribute to higher production and making the work of poultry farmers more efficient. Israel exports automatic egg collectors, poultry drinking systems, and durable plastic-slat flooring that improve henhouse hygiene. In addition, advanced control systems developed by Israel maintain optimal conditions in the henhouse under all climatic conditions. These systems maintain desired levels of humidity, heat, lighting, feed, ventilation and cooling 24 hours a day.

- **Mechanisation:** Israel farmers use a variety of specialised agricultural equipment, including: Mobile celery packing plants; Machinery for digging silage and mixing feed uniformly; Poultry equipment (drinkers, automatic egg collectors, climate control systems, weigh scales); Air-blast sprayers that provide efficient cover of the tree for use in citrus groves and vineyards; Flower bulb transplanters; and Fruit and vegetable packing-house machinery.

- **Fertiliser application:** One of the remarkable Israeli developments is the application of fertilisers through buried drip-irrigators. These ensure that less mobile components such as phosphorus directly reach the roots. Another Israeli innovation is controlled-release fertilisers. These are coated with polymers to ensure slow, prolonged release and delivery via diffusion. Slow-release fertilisers allow better exploitation of the fertiliser and reduce groundwater pollution.
2.3.7. AGRICULTURAL TRANSFORMATION GLOBAL SUCCESS CASE 2: FRANCE

**Figure 14: Case of France**

Figure 14 provides a snapshot of the deliberate efforts which the Government of France has made towards transforming agriculture. At the core of agricultural transformation are the programmes which France’s Ministry of Agriculture and Food has instituted. France has been selected as a global success case in this blueprint owing to its global position in the agro-economy as summarised in Figure 15.

**Figure 15: Success of agricultural productivity of France**
France is one example that Global agriculture is undergoing a phenomenal digital transformation process. France has a vast and rich Agtech ecosystem. Figure 16 shows a vast array of start-ups and innovative SMEs. There has been a huge attraction of technology companies, especially SMEs, into the agricultural sector.

Figure 16: The mapping of AgriTech Startups in France (Source: XAnge, 2017)

2.3.8. AGRICULTURAL TRANSFORMATION AFRICAN SUCCESS CASE 1: MOROCCO

In the case of Morocco, ICTs enables farmers to access critical information on the go and access to market and weather information, allow farmers to transfer money and negotiate prices with traders. Moreover, the use of mobile phones is rapidly increasing.
The following Figures show use cases of digital agriculture technologies which have been deployed in Morocco:

Figure 17: SABA Decision-making and functional information system

Figure 18: Irrigation warning system
Thanks to smart cards provided free of charge to 80,000 farmers, the ATTAISSIR system enables the real time monitoring of the operations linked to the farmers’ activities in complete transparency. In this sense, it grants integrated support through:

**Figure 19: Agricultural Upstream Digitization: The Sugar Industry by COSUMAR**

- Availability of many advisors in the field;
- Eliminate vouchers to seize inputs;
- Control the sown area;
- Quick access to the farmer informations;
- Recommend farmers as inputs at any time;
- Avoid the shortage of input stocks;
- Monitor the phytosanitary state of the plots and prompt notification of incidents.

**Figure 20: ATTAISSIR system**

The contract between the farmer and COSUMAR includes a set of information, such as, the location of the plot, as well as the necessary inputs. This data is stored on the smart card, the farmer having only to present it to his agricultural advisor to collect the required inputs in appropriate quantities ensuring their efficient use.

ATTAISSIR also extends to agricultural machines, which are equipped with sensors intended to:

- determine the appropriate moment of harvest according to the product maturity.
- control the speed and the alignment to optimize the plots’ productivity.
When an anomaly is detected, an alert is automatically triggered at the control center in order to adjust the parameters and react in real time.

**ATTAISSIR** helped considerably improve extension services offered by agricultural advisers in charge of technical support to farmers

### 2.3.9. AGRICULTURAL TRANSFORMATION AFRICAN SUCCESS CASE 2: RWANDA

**Smart nkunganire system (sns)**

The Smart Nkunganire System (SNS) is a supply chain management system built by BK TechHouse Ltd in collaboration with Rwanda Agriculture and Animal Resources Development Board (RAB) to digitalize the end to end value chain of the Agro-Input Subsidy program. SNS is a critical strategic tool for all stakeholders in the Agro-Input subsidy program as it significantly increases efficiency, productivity, transparency and bridges communication gaps within the Agro-Input subsidy program. SNS will also help remarkably raise financial inclusion, cashless transactions and green economy in the agriculture sector. The platform is envisaged to be living as it will grow and evolve over time to meet the needs of the agriculture sector, continuously adding value for all stakeholders involved; while at the same time promoting cashless economy, facilitating access to finance for the farmers and turning agriculture into a more attractive investment sector for financial and insurance institutions. The comprehensive supply chain management system of the national agro-input subsidy program which:

- Enables farmers to register and access subsidized inputs
- +870000 registered farmers in season 21B
- +1000 agro dealers
- +10 seed/fertilizer suppliers
- Android app used by Agrodealers for input ordering and delivery
- Integrated with a local wallet for cashless payment between farmers, agro-dealers, and suppliers

**Impact:**

- Create database of all stakeholder in the subsidy scheme
- Monitor demand and supply at all levels
- Create transparency and efficiency
Smart Africa Agritech Blueprint For Africa

Promote green economy by promoting cashless payments

Rwanda Agriculture Outlook

Smart kungahara system (SKS)

This is a digital innovation introduced as a smart agriculture solution known as Smart Nkunganire System (SNS) focused on transforming agriculture from subsistence to commercialized farming through the application of digital solutions that support productivity. The system eases all transactions in the agro-inputs supply chain, helps farmers to specify agro-dealers' shops from where to get subsidized seeds or fertilizers and enables them identify the number of farmers connected to a particular shop and required quantity in store. The smart agriculture solutions have been broadened to reach coffee farmers from across the country to pave their way to wealth and help them shift from analog to digital transactions. The purpose of the Digital platform is to:

- To digitize the coffee value chain linking all stakeholders
- +300 coffee washing stations, +300,000 coffee farmers
- Accessible through web, smart phone app, and USSD app
- Farmers can:
  - Delivery and approve their cherry supply
  - Integrating with cashless payment methods
- Enable and standardize the produce delivery
- Empowering decision makers at all levels with real time analytics
National agriculture insurance scheme

The Ministry of Agriculture and Animal Resources (MINAGRI) launched the National Agriculture Insurance Scheme (NAIS) in Nyanza District, Southern Province of Rwanda in 2019. The Scheme will mitigate against risks and losses incurred by farmers due to unpredictable natural disasters, pests and diseases that affect their livestock and crops. The scheme is dubbed “Tekana Urishingiwe Muhinzi Mworozi” (Meaning “Smallholder farmer, feel safe, you are insured”), the scheme which is subsidized up to 40% by the Government of Rwanda, will also enable the farmers to easily access financial services and ensure flow of credit to the agriculture sector. The livestock insurance has been unveiled with an innovation of the use of microchips to avoid fraud. Rwanda joins few countries globally who have implemented a national Radio Frequency Identification (RFID) system and database for livestock. This national digital database will be a great asset in decision making both for the Government and the private sector. Some of the results are shown below

- Using RFID to register cattle and keeping track of all processes related to cattle insurance
- +20000 Registered cows
- Subsidized insurance to farmers
- Reduction of compensation time
2.3.10. AGRICULTURAL TRANSFORMATION AFRICAN SUCCESS CASE 3: ZIMBABWE

Figure 23: Insurance Scheme

BLUEBERRY FARMING IN ZIMBABWE

Figure 24: Blueberry Farming at Hilbre farm Mashonaland West Zimbabwe
Blueberry farming is a 20th century invention before the 1900s they were only found in the wild. Due to scientific work Commercial blueberry cultivation is not only being done in Zimbabwe but Hilbre Farm in Mashonaland west is Africa’s biggest producer for local and export market. The farm has the whole value chain and full processing infrastructure to enable the Farm to Market model as shown in Figure 24.

Blueberries grow in higher pH/acidic soils and they need moist and well-drained growing medium. To achieve highest production, there is need to amend the soil around the plants. A big benefit of growing them in containers is that you can easily control each of these soil conditions.

![Figure 25: Container growing, smart weather station technology for Blueberry Farming at Hilbre farm Mashonaland West Zimbabwe](image)

Hilbre Farm has some of the most advanced technologies that allow cultivation of blueberries including smartphone-based report technologies, smart weather station, satellite monitoring, watering and putting fertiliser on the farm can take a single person in front of a computer to water +50 hectares. Each plant is closely monitored from a special pot that has sensors to help keep growing conditions optimal.

**Case 2 EcoFarmer in Zimbabwe**

![Figure 26: The EcoFarmer Story in Zimbabwe](image)
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 3 Smallholder Homestead Commercial Business Units model in Zimbabwe**

Figure 27 shows a smallholder homestead which gets support from the rural ecosystem. This ecosystem comprises Community Information Centres (Economic Production Zone), other homesteads, etc. CICs provide resources and support to Business Units (local homesteads) to drive productivity on their land. The business units will be empowered with resources that primarily include installation of a 1 hectare of gravity drip irrigation system. Academia and Industry/Private Sector will run Research and Development (R&D) programs under community adoption initiative on CIC land which will be at least 10% of the total land in each community. This will allow them to drive innovation, science and technology initiatives that solve everyday community-based challenges at the same time providing industrial attachment (hands-on learning to academia)

![Figure 27: Smallholder Homestead Commercial Business Units](image-url)
Since the rural homestead is commercialised into a rural business unit, it then produces for commercial purposes as depicted in Figure 27. The modern rural productive home engages in one or more of the following farming activities: irrigation crop production, livestock production, poultry production, vegetable farming, or fish farming.

**Figure 28: Production for a commercialised rural homestead**

**Case 3 Community Information Centers in Zimbabwe**

Community Information Centres (CICs) (Figure 29) 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, bridging the digital divide and boosting the utilisation technologies 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.
2.3.11. AGRICULTURAL TRANSFORMATION TECHNOLOGY USE CASE 1: FIELD CLOUD

Field Cloud is a technology service provider which was an important resource in the development of the blueprint. The company works with countries in Europe and Africa to modernise the agricultural sector. Applications provided and supported by Field Cloud are for farm operations, farmer-to-farmer (cooperatives), farmer-to-market (distribution), farmer-to-bank (finances), community information services, Quality, Visibility and Traceability. The platforms which support these applications include Data Access (Permissions, Sovereignty), Transaction Systems (Co-monetization), Alerting & Notifications and Media (Community Radio, Edutainment). Field Cloud has set up robust Infrastructure which include Sensors, Actuators, Access Networks, Personal Devices, Nano Datacenters, Integration Workbench and Interconnect Networks.

Field Cloud has worked extensively with IoT applications to support agricultural transformation across Europe and recently in Africa. Figure 26 shows IoT grid as supported by Field Cloud.
Field Cloud has realised some remarkable results that exhibited themselves in vibrant local economies, capacity building (skills and competencies) as well as strengthening ownership of agricultural operations. Vibrant local economies include transactional ecosystem involving local buyers and sellers, agrifood production, increased affordability, etc. Human capacity development which was driven by Field Cloud included training local technology system integrators and solution builders as well as training installers and maintainers of the IoT devices. Ownership of local agricultural operations was demonstrated especially in Africa through establishment of farming cooperatives, employee partnerships, savings and investments as well as formation of public private partnerships.

As depicted in Figure 30, Field Cloud managed to forge collaboration within the farming community through coalescing African ingenuity with European technique. Collaboration is exhibited in Community Context Engagement, Co-Creation and Co-Execution.
Another technology company which worked with Smart Africa in developing this blueprint is Intel. The company focuses on what it terms “Data-Driven Agriculture: From Farm to Fork”. Intel’s IoT solutions are helping to address the complex challenges of modernizing agriculture and the food value chain. The following are selected cases where Intel’s IoT solutions are transforming agriculture:

**Case 1: Digital Soil Testing for Small Holder Farmers**

The Intel soil testing solution enables actionable recommendations based on data collected from the digital soil test and eAgro software suite. The soil testing platform quickly and accurately characterizes soil samples and records sample, GPS data and farm environmental information. The sample is evaluated by the eAgro software to give real-time, expert recommendations.

The hardware allows the farmer to rest the nutritive chemical makeup of the soil. Farmers must take their soil samples to a far-off testing station or ship soil to a lab. Because of lost time and related costs, this is rarely done. Now, the testing center is brought to the farm.
The solution helps small farmers make more informed decisions on key aspects including seed and fertilizer selection, harvest planning and sales management.

**Case 2: Tracking Freight at the Package Level**

The system developed by Intel responds quickly to unexpected situations, save on shipping costs through early detection of lost products, identify conditions leading to shipment damage or delays. The Intel platform is designed to help automate shipment tracking and increase shipment visibility of goods as they move across the food value chain. This product is used for tracking small assets such as pallets of food boxes and small equipment in the agriculture segment. The platform has the following features:

- Provides thorough and continuous updates about package conditions which:
  - Saves shipping costs through early detection of damage of products
  - Identifies conditions leading to shipment damage or delays
  - Monitors perishables products during shipment and transport
  - Sends automatic alerts when a package’s location or condition changes unexpectedly
  - Delivers near real-time data analytics and insights
  - Protects confidential asset information with data encryption

**Additional Use Cases**

Figure 32 gives a summary of other use cases which Intel has undertaken in Africa and other parts of the world. These include responsive retail sensors for retail analytics, blockchain to improve traceability of food production, and asset monitoring for traceability and recording of assets.

**Figure 32: Intel’s Retail Sensors, Blockchain and Asset Monitoring Systems**
2.3.13. AGRICULTURAL TRANSFORMATION TECHNOLOGY USE CASE 3: SYNIVERSE

Syniverse has mainly developed solutions to assist the Republic of Zimbabwe in their effort to transform the country into Smart Zimbabwe Vision 2030 in line with the transform Africa Vision. Syniverse develops IoT solutions and their vision, called “Connected Everything”, is summarized in Figure 33.

Figure 33: Syniverse’s Connected Everything model

Syniverse Case 1: Precision Irrigation Management

The aim of Precision Irrigation Management is to optimize conditions for crop yield and quality through sensor-based irrigation management. Following is the application of the system, its requirements and benefits:

Application:

- Sensors to monitor precipitation and humidity levels and automatically adjusts irrigation schedules
- Optimize conditions for crop yield and quality while reducing waste
- Farm equipment automation

Requirements:

- High speed mobile network with local breakout capabilities and/or secured data transit to backend applications
- Sensors and cellular-based gateways
- Sensor controlled water supply valves

Benefits:

- Optimized and remotely controlled irrigation
- Improved yields and reduced waste
Syniverse Case 2: Mobile Operator Network Extension
The Mobile Operator Network Extension uses private network to extend coverage of mobile operator services into rural areas. The application process, system requirements and benefits are as follows:

Application:
- Expand cellular coverage to remote and rural farms
- Syniverse operates as a multi operator solution or neutral host
- Provides network services for network operators into hard-to-reach locations

Requirements:
- Power and fiber network connectivity
- Can operate in deregulated shared spectrum
- Management of connection between the subscriber and the network
- Partner with local African mobile operators

Benefits:
- Delivers 4G coverage and capacity enhancements to rural farms
- Support for mobile devices entering into a location with insufficient macro network support

Syniverse Case 3: Informational Messaging Campaigns
Informational Messaging Campaigns delivers timely and important messaging to farmers.

Application process:
- Leverage existing Syniverse messaging reach to deliver messaging to farmers
- Use private network extension where operator coverage is non-existent

Requirements:
- Government application API integration
- Private wireless mobile operator network extension solution where cellular coverage does not exist

Benefits:
- Provide farmers with access to
  - Weather updates
  - Public safety and health updates
  - Access to improved crop maintenance information
  - Crop pick up and delivery notices
## 2.4. Benchmarking Agriculture and ICT of Member States

### 2.4.1. Agriculture Indicators

**Table 3: Agriculture Indices**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Food Security Index</td>
<td>The index is a dynamic quantitative and qualitative benchmarking model which examines food security comprehensively across the dimensions of affordability, availability, and quality. It also includes an adjustment factor on natural resources and resilience.</td>
</tr>
<tr>
<td>2 Easy of Doing Business in Agriculture (EBA) index</td>
<td>This measures how easy it is to do business in the agriculture sector. The index ranges from 0 – 100. Higher rankings of this index imply better, simpler regulations for businesses in agriculture as well as stronger protection of property rights (especially rights to land ownership).</td>
</tr>
<tr>
<td>3 The Africa Agriculture Transformation index – AU/NEPAD</td>
<td>It captures issues such as transformation readiness (institutional and political success factors), existence of a national agriculture plan (what to do) as well as delivery mechanism (how to transform agriculture).</td>
</tr>
</tbody>
</table>

### 2.4.2. ICTs Indicators

**Table 4: ICT Indices**

<table>
<thead>
<tr>
<th>ICTs Indicators</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 GSMA Mobile Connectivity Index</td>
<td>It is an analytical tool that measures the performance of 134 countries, representing more than 95% of the world's population, against the four key enablers of mobile internet adoption which are: Infrastructure, Affordability, Consumer readiness and Content &amp; Services.</td>
</tr>
<tr>
<td>2 ICT regulatory tracker</td>
<td>It is an evidence-based tool to help decision-makers and regulators make sense of the rapid evolution of ICT regulation. It is composed metric based on a total of 50 indicators grouped into four clusters regulatory authority, regulatory mandate, regulatory regime, competition framework</td>
</tr>
<tr>
<td>3 Africa Infrastructure Development Index (AIDI) Index</td>
<td>provides consolidated and comparative information on the status and progress of infrastructure development in African countries. These components are disaggregated into 9 indicators that have a direct or indirect impact on productivity and economic growth.</td>
</tr>
</tbody>
</table>
2.4.3. **BENCHMARK DATA PRESENTATION AND STRATEGIES**

Benchmarking data which was collected using the Agriculture capacity and ICT Capacity indices was analysed using the Quadrant Analysis Cartesian Chart. Global data for all the indices was collected. Figure 34 shows the Regional Economic bodies and country abbreviations which were used to populate the quadrant.

### Regional Economic Bodies Showing Countries and Standard Abbreviations

<table>
<thead>
<tr>
<th>Regional Economic Bodies</th>
<th>Countries and Standard Abbreviations</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAC</td>
<td>Comoros (KM), Ghana (GH), Mauritius (MU), Sierra Leone (SL)</td>
</tr>
<tr>
<td>SADC</td>
<td>Congo (CG), Guinea (GN), Morocco (MA), Somalia (SO)</td>
</tr>
<tr>
<td>AMU</td>
<td>DR Congo (CD), Guinea-Bissau (GW), Mozambique (MZ), South Africa (ZA)</td>
</tr>
<tr>
<td>ECOWAS</td>
<td>Benin (BJ), Cote d’Ivoire (CI), Kenya (KE), Namibia (NA), South Sudan (SS)</td>
</tr>
<tr>
<td>ECCAS</td>
<td>Burkina Faso (BF), Djibouti (DJ), Lesotho (LS), Niger (NE), Sudan (SD)</td>
</tr>
<tr>
<td>EAC</td>
<td>Burundi (BI), Egypt (EG), Liberia (LR), Nigeria (NG), Tanzania (T2)</td>
</tr>
<tr>
<td>SADC</td>
<td>Cameroon (CM), Equatorial Guinea (GQ), Libya (LY), Rwanda (RW), Togo (TG)</td>
</tr>
<tr>
<td>AMU</td>
<td>Cabo Verde (CV), Eritrea (ER), Madagascar (MG), Sahrawi Arab, EH, Tunisia (TN)</td>
</tr>
<tr>
<td>ECOWAS</td>
<td>CAR (CF), Ethiopia (ET), Malawi (MW), Sao Tome and Principe (ST), Uganda (UG)</td>
</tr>
<tr>
<td>ECCAS</td>
<td>Chad (TD), Gabon (GA), Mali (ML), Senegal (SN), Zambia (ZM)</td>
</tr>
<tr>
<td>EAC</td>
<td>Madagascar (MG), Gambia (GM), Mauritania (MR), Seychelles (SC), Zimbabwe (ZW)</td>
</tr>
</tbody>
</table>

**Figure 34: Regional Economic bodies and country abbreviations**

The economic zones are the East African Community (EAC), Southern African Development Community (SADC), Arab Maghreb Union (AMU) and Arab League, Economic Community of West African States (ECOWAS) and the Economic Community of Central African States (ECCAS).
Figure 35 shows the countries clustered in the quadrant. A quadrant Analysis chart combines similar data points, thereby putting them in the same quadrant.

Figure 35: Benchmarking Quadrant

Figure 36 shows a full list of countries and their location in the Quadrant Analysis Cartesian Chart. On a global scale, the Agriculture capacity median index for African member states is 40 while the median for ICT is 39.
Figure 36: Quadrant with full country names

Countries were then categorised on the Quadrant Analysis Cartesian Chart as described in Table 5:

Table 5: Quadrant Descriptions

<table>
<thead>
<tr>
<th>Quadrant</th>
<th>Quadrant Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAST ADOPTORS</td>
<td>Countries in this quadrant have high Agriculture and high ICT capacities. Although their Agriculture and ICT capacities are lower than some countries on the global scale, they fall in the top 75% when compared to other African countries. The 13 countries in Category One have scored above the median values of 40% and 39% for both agricultural capacity and ICT capacity respectively. Some countries scored close to median values while others like Morocco and South Africa scored above 60% for both agriculture and ICT. The countries in Category One still have some way to go when compared to other countries globally.</td>
</tr>
<tr>
<td>ICT-FIT</td>
<td>Category Two Quadrant contains countries which have high ICT capacity but low Agriculture capacity. It means that they have scored above the median value of 39% in ICTs but scored below the median value of 40% for Agriculture. It can therefore be observed that growth rate of ICTs in Category Two countries is faster than the growth rate for agriculture.</td>
</tr>
<tr>
<td>EMERGING ADOPTERS</td>
<td>Category Three Quadrant contains countries with low Agriculture capacity and low ICT capacity. It means that they have scored below the median value of 39% in ICTs and also below the median value of 40% for Agriculture. Countries in this category require high level intervention to accelerate growth for both Agriculture and ICTs.</td>
</tr>
<tr>
<td>AGRIC-FIT</td>
<td>Category Four Quadrant contains countries which have high Agriculture capacity but low ICT capacity. It means that they have scored above the median value of 40% in Agriculture but scored below the median value of 39% for ICTs. It can therefore be observed that growth rate of Agriculture in Category Two countries is faster than the growth rate for ICTs.</td>
</tr>
</tbody>
</table>
PART III

IMPLEMENTATION OF THE AgriTech BLUEPRINT FOR AFRICA

3.1. INTRODUCTION

In this part of the blueprint document, goals and objectives are re-defined as well as the strategies towards framing of the context to the continental blueprint. The AgriTech blueprint is then presented followed by recommendations and insights which countries can adopt and adapt to their unique contexts when developing their own strategies and pilots. Key lessons and recommendations for developing an AgriTech strategy are also presented before the section ends with outlining the need to develop an AgriTech monitoring and evaluation framework.

3.2. GOAL AND OBJECTIVES OF THE BLUEPRINT

The AgriTech Blueprint is set to achieve the following:

- The Blueprint will assist every African country to complete it’s AgriTech strategy. Only a handful of countries have launched initiatives to develop AgriTech strategies. These include Ghana, Ivory Coast, Rwanda, Mali, Burkina Faso, Kenya and Sudan among a few countries.
- To help countries mainstream ICTs into agriculture and develop or revitalize AgriTech schemes in line with agricultural goals and priorities.
- AgriTech strategies will help countries to decide on pilot projects, giving preference to projects with low-hanging fruits and higher priority within the strategy.
- At a continental level, AgriTech strategies will enhance exchange and collaboration that would allow learning from neighbouring countries’ experiences; hence avoiding repetition of mistakes and eventually enabling faster agricultural development.

3.3. STRATEGIC OBJECTIVES

The following are the strategic objectives of the AgriTech Blueprint:

- Improve Agriculture Capacities is terms of
  - Agrarian transformational capabilities
  - Food security
  - Easy of doing agri-business
- Improvement is ICT capabilities in terms of
  - Infrastructure:
  - Affordability:
- Consumer readiness
- Content and Services
- Massive increases of proportion of rural populations enjoying the transformation
- Increased returns to: land, labour, capital, technology and connections
- Enhanced inter-linkages between agriculture, the rural non-farm economy, manufacturing and services.
- Improve innovation and entrepreneurial ecosystem of rural communities
- To provide timely information, increase choice, reduce transaction costs, and contribute to improving the efficiency of decision making to raise agricultural productivity.

3.4. THE AgriTech STRATEGY

3.4.1. STRATEGIC THRUSTS FOR AgriTech
- 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 cost of ICT at last mile point

3.4.2. OVERALL CONTINENTAL STRATEGY
- The state of the AgriTech ecosystem in Africa varies from country to country and is fragmented within the countries as well. This calls for a comprehensive strategic approach that would prioritize actions to maximize the benefits for the stakeholders involved in agriculture.
- Two decades or so of telecommunications sector reforms have resulted in notable improvements in Africa’s ICT sector. Many countries have created a relatively competitive environment for telecommunication services by issuing multiple licenses and allowing operators to compete with one another. This has triggered large-scale investment in telecommunications networks, mainly from the private sector. This has to be encouraged and supported at regional and continental levels
- Taking a national approach to AgriTech will help to target areas where capacity development is required, while at the same time identifying the need for awareness-raising, effective engagement of key stakeholders and action
to resolve issues of ICT access, especially in rural areas. Once the picture becomes clearer, specific policy measures and an enabling regulatory environment can be put in place, so that agricultural stakeholders can benefit from the potential of AgriTech at an affordable price.

- The strategy will integrate standalone ICT experiments under a collaborative and inclusive framework while prioritizing solutions that can be scaled-up and supported through the required ecosystem. Prevent AgriTech projects from being implemented in isolation; thereby avoiding duplication of efforts and resources while developing efficiency gains from intra-sector and cross-sector synergies.

3.4.3. COUNTRY SUPPORT STRATEGIES BY SMART AFRICA

- Regional Networking
- Capacity building
- Regional and continental policy engagement

3.4.4. OVERARCHING NATIONAL STRATEGIES

- Developing a national AgriTech strategy will enable the government to draw up a roadmap for the use of ICTs for agriculture.
- To 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).
- Therefore, AgriTech strategies will 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.
- To 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.
- To 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.
- To avoid falling behind the technology curve
3.5. PROBLEM AND OPPORTUNITY TO BE ADDRESSED BY AgriTech STRATEGY

3.8.1. OPPORTUNITY
- Agriculture still back-bone of African economies with best chance of lifting massive numbers into the modern economy
- Covid-19 has demonstrated the limitations of relying on global markets and need to enhance domestic and regional food sovereignty
- The Africa Union commitment to agriculture through CAADP provide Smart Africa enormous opportunities for regional synergies
- The political will of many African countries to develop/promote South–South cooperation
- Ride on expanding digital marketplace
- decline in the cost of information, increase in access to the information
- transforming how we learn, work, interact and move coupled with new radical business models, are all products of digital transformation.
- youth and women inclusion in agriculture

3.8.2. CHALLENGES
- Smallholder family farm, especially women led are still largely disconnected from mainstream economy and enjoying low levels of productivity
- Public sector investment is agriculture still below levels needed for accelerated growth
- Difficulties inherent in interactions among people in dispersed locations, knowledge sharing and multi-stakeholder engagement
- Disconnected small family farms from mainstream economy
- Lack of an appropriate regulatory framework to support cross-border Agri-Tech pilots;
- Lack of an efficient governance model especially towards cross-border Agri-Tech initiatives
- Lack of expertise and skills in the field of AgriTech
- Lack of policies to enhance ict development in rural areas;
- Lack of awareness of opportunities and benefits in using icts for agriculture purposes;
- Absence or limited digital literacy in rural areas
- High costs of ICTs.
- Weak telecommunications infrastructure to support the rapid development of ICT in the continent.
- Weak and non-existent regional links to help create economies of scale and drive cost of capital equipment down.
- Lack of other related resources such as electricity, finance, human resource
Africa’s connectivity gap: Thus, nearly 250,000 new 4G base stations and at least 250,000 kilometers of new fiber across the region would be required to achieve universal access to broadband connectivity in Africa by 2030.

3.6. FORCE FIELD ANALYSIS TO BE COMPLETED BY EACH COUNTRY AS PART OF IMPLEMENTATION PLANNING

Figure 37: Force Field Analysis

Figure 30, which is explained in Table 6, shows touch points which should be considered as part of the AgriTech implementation strategy

Table 6: Force Field Analysis for AgriTech in a Country

<table>
<thead>
<tr>
<th>FORCE FIELD ANALYSIS FOR AgriTech IN A COUNTRY</th>
<th>Forces towards desired AgriTech future</th>
<th>Forces against desired AgriTech future</th>
<th>Gap to be addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Policy, regulatory enabling environment;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Agricultural innovation system (education, advisory and extension services; farmer training, capacity building and empowerment)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Production systems and automation on-farm and off-farm;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Land governance, administration and management;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Financial intermediation, inclusion, insurance and risk management;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Agricultural market information</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Provision of aggregation and agrologistical services and supply chain connectivity for various categories of farmers large and small.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Promote environmentally sustainable farming practices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Food safety and traceability</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.7. THE AgriTech BLUEPRINT: RECOMMENDED PATHWAY

Having iteratively conducted literature review, benchmarking of agriculture and ICT progress evaluations, working group workshops and validation sessions, the continental AgriTech Blueprint was developed. The rigour in the development process of the blueprint has led to a persuasive argument that it forms the guide for success of an agricultural transformation agenda for African countries. The blueprint (Figure 31), is presented as a series of logically connected steps to guiding the development of country AgriTech strategies and plans. However, designers of country AgriTech strategies may opt to expand, collapse or omit some steps depending on their peculiar contexts.

Figure 38: The AgriTech Blueprint recommended pathway
As depicted in Figure 31, the phases in the blueprint include:

1. **Establishing institutional arrangements and governance structure.** This is setting the stage for developing the strategy. Critical activities include stakeholder mapping and collaboratively develop a common vision.

2. **Agree on collaborative approach.** Identified stakeholder should co-develop partnership and collaborative strategies regarding working together. Roles and responsibilities defined in Stage 1 can be further refined.

3. **Establish status of agriculture and its capabilities.** Establish and agree on standard measuring regime and indicators. This is where country agriculture data is collected and analysed.

4. **Establish status of ICTs and their capabilities.** ICT data is collected using agreed indices and indicators. Data is analysed and presented in formats that are easy to understand.

5. **Establish current levels of AgriTech uptake.** Collect data on the status of ICT use in agriculture. Use agreed measurement regime and present results that guide in decision making towards stepping up agricultural transformation using modern technologies.

6. **Manage the vision develop process.** Agree on timeframe of developing and implementing the strategy and plans.

7. **Develop national AgriTech action plan.** Develop a common goal which is specific, measurable, achievable, realistic and time-bound (SMART). Operational plans should have details of budgets, responsibilities, specific tasks with clear milestones and deadlines.

8. **Develop an AgriTech Results Framework.** Provide clear details on monitoring and evaluation. As implementation progresses, checks and balances should be instituted in the form of an unambiguous results framework.

9. **AgriTech Pilot Project.** Implementation of the AgriTech pilot upon agreement with government personnel.

### 3.8. PRECONDITIONS TO SUPPORT IMPLEMENTATION OF AgriTech STRATEGIES

#### 3.8.1. **FUNDING MODELS FOR AgriTech STRATEGY**

Emphasis is placed on innovative partnerships that bring together smallholder farmers, farmers unions, business, government, universities, development partners, NGOs and civil society should be promoted as a mechanism to drive inclusive growth and transform the agricultural sector. Alternative sources of funding into the agricultural sector could be harnessed by these innovative partnerships. Figure 32 presents some of the identified funding options.
The broadband network value chain comprises four broad segments: first mile, middle mile, last mile, and invisible mile. All elements of the value chain need to be built incrementally. This section looks at the broad infrastructure value chain in Africa:

**First mile:** The first mile is where the internet enters a country. Many countries in Africa have access to submarine cable systems, either directly through local landing points or through terrestrial connections, particularly for smaller and landlocked countries. Most countries are now connected with an abundance of cable connectivity in North Africa. In September 2018 only three countries were not connected by fibre to submarine cables: the Central African Republic, Eritrea, and South Sudan. Every seaboard country except Eritrea and Guinea-Bissau had at least one submarine cable landing. The rapid expansion of the submarine cable network circumventing the continent in the past decade has increased Africa's international submarine fibre capacity nearly tenfold since 2010, crossing the 100 Tbps mark in 2018.

**Middle mile:** The middle mile is where the internet passes through a country. The network components are the national backbone and intercity networks, including the fibre optic cables or copper wires, microwave, satellite links, internet exchange points (IXPs), local hosting of content, and so on. African countries have rolled out over 1,389,000 kilometers of terrestrial fibre links, of which about 936,000 kilometers were operational in 2018. Fiber backbone is an unfinished agenda for both Sub-Saharan Africa (SSA) and North Africa. There are about 44 active IXPs located across 32 countries in Africa. This means that most of their domestic internet traffic is exchanged through points outside their respective country, usually through satellite or submarine fiber across multiple international hubs to reach their destination.

**Last mile:** The last mile is where the internet reaches the end-user and includes the local access network, including the local loop, central office, exchanges and wireless masts. The access network reaches end-user devices, typically basic and smartphones, laptops, tablets, computers and other
Internet-enabled devices. Once high-speed internet arrives at a population center, via the first and middle miles, telecommunications operators provide internet services (such as mobile or fixed internet services) to people, businesses, and governments. In June 2018, 54.2 percent of the population in Sub-Saharan Africa lived within a 25-kilometer range of an operational fiber optic network node, which marks a significant expansion of the reach of the internet beyond urban centers to thousands of towns in the periphery. In the same year, the 3G network coverage reached about 71 percent and the 4G coverage about 40 percent. However, it is important to note that mobile internet is available in urban areas; dedicated or fixed internet for schools and offices is mostly not available; and internet in rural areas is mostly not available.

Invisible mile: The invisible mile consists of the hidden elements that are vital to ensuring the integrity of the value chain. This includes the network components that are not visible, including the radio spectrum, network databases (for example, for numbering), cyber security, but can also include potential bottlenecks such as market concentration, multi-layered taxation of activities and inefficient regulations. While mobile technology has a leading role in extending broadband access and the significance of satellite services in African continent, the availability of frequency spectrum is limited in most of the African countries. Africa has amongst the lowest allocation of spectrum to the mobile network operators (MNOs).

Africa’s connectivity gap: Despite some progress in the deployment of ICT infrastructure, much of Africa is still unconnected and large populations cannot fully realise the benefits of connectivity. Nearly all urban areas in Africa are now covered by mobile networks, but less than half of the rural population lives within reach of a network. It is estimated that approximately 45% of Africa’s population is further than 10 km from fiber network infrastructure, which is a higher percentage than on any other continent. In addition, it is estimated that nearly 300 million Africans live more than 50 km from a fibre or cable broadband connection; hence, the lack of widespread availability of high-speed (broadband) internet remains a significant hurdle for Africa to fully harness the full potential of digital transformation.

Extending rural access, therefore, is another important imperative in the digitisation of Africa. The infrastructure for Internet connectivity is sometimes unavailable in rural areas, and the private sector is understandably less inclined towards rural projects. Accordingly, to reach universal access, it is critical to assess the specific connectivity gaps and monitor the progress of digital infrastructure on the continent. Thus, nearly 250,000 new 4G base stations and at least 250,000 kilometers of new fiber across the region would be required to achieve universal access to broadband connectivity in Africa by 2030.

3.8.3. PRINCIPLES FOR DIGITAL DEVELOPMENT

The Principles for Digital Development have been developed though a community-based approach and are accessible to anybody that works in digital development. In developing the Principles, participating organisations included The Bill and Melinda Gates Foundation, the Swedish International Development Agency (SIDA), the UN’s Children’s Fund (UNICEF), UN Development Program (UNDP), the World Bank, and the U.S. Agency for International Development (USAID), and the World Health Organization (WHO). Smart Africa wishes to Endorse the Principles for Digital Development and in the future, intends to participate in the Digital Principles Forum. Smart Africa subscribes to
Under the leadership of the Republic of Zimbabwe and Smart Africa

the Principles for Digital Development for the design and development of technologies to revolutionise agriculture. Designers and developers of AgriTech solutions are advised to adhere to the Principles for Digital Development which are presented and explained in Figure 33.

Figure 40: Principles of digital development (Source: Digital Principles Forum (2020))

3.9. RECOMMENDATIONS AND SMART AFRICA IMPLEMENTATION STRATEGIES

The recommendations per each cluster of the countries in the quadrant are deemed to be undertaken by all Stakeholders that include the government, private sector, academia, farmers, NGOs, etc.

3.9.1. QUADRANT RECOMMENDATIONS
<table>
<thead>
<tr>
<th>Quadrant</th>
<th>Short term</th>
<th>Medium Term</th>
<th>Long term</th>
<th>Cross-Cutting Recommendations</th>
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<tbody>
<tr>
<td>FAST ADOPTERS</td>
<td>Ensure that the existing technologies are harnessed for agricultural productivity. For collaboration among agronomists and growers digitally, enhancing relationships and ways of working to enable better sharing and communication of data, leading to more insightful and data driven decision For precision agriculture</td>
<td>Evaluate the degree of technological deployment among smallholder farmers and conduct awareness campaigns with existing AgriTech solutions</td>
<td>Design programmes for capacity building in AgriTech solutions for both commercial and smallholder farmers</td>
<td>Improve hard and soft infrastructure especially bandwidth to reach the majority of citizens both in urban and rural areas. Develop plans to improve internet access and affordability by all especially underserved communities where smallholder farming is the mainstay Organise periodic discussion forums (monthly or quarterly) in-person or on virtual forums with university and college students to present interactive, insightful and inspirational lecture series and global case studies of benefits of agriculture and how technology has transformed agriculture in diverse contexts. Involve thought leaders, change-makers, movers and shakers from around the world in intimate conversations with the youths on agriculture.</td>
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<tr>
<td></td>
<td>Evaluate already on-going AgriTech initiatives (Low hanging) ready for scale e.g. CICs in Zimbabwe and mapping who is doing what for which specific target farmers group</td>
<td>Deploy on-going AgriTech initiatives to all farmers - Stakeholder and commercial</td>
<td>Establish strong R&amp;D centres in strategic agricultural zones around the country</td>
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<td></td>
<td>Export market linkages especially for large scale farmers</td>
<td>Customized Financing models</td>
<td>Legal and Institutional frameworks review</td>
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<td></td>
<td>Establish the level of participation of youth in agricultural activities and the level of technology penetration among women in agriculture. Identify and deploy low-cost technologies to women in agriculture.</td>
<td>Youths and women to be ring-fenced for training and access to credit and markets. Expose women to AgriTech solutions and organise medium to long term financing facilities to tech StartUps</td>
<td>Develop robust monitoring and evaluation system to ensure women and youths are benefitting from agro-financing and also to ensure systems interoperable with existing systems to ensure accountability and optimal land utilization</td>
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<td></td>
<td>Put in place systems for value addition and beneficiation leveraging aggregation to saturate domestic market</td>
<td>Develop models for strengthening Academia-Private sector -Farmer linkages strengthening</td>
<td>Development of comprehensive insurance models to cushion against major shocks in Agriculture</td>
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<td></td>
<td>Data Management Systems- Farmer electronic databases on productivity and land use tracking</td>
<td>Smallholder database with granular details of each farmer and their farming activities. Investment into precision farming – time and energy efficiencies</td>
<td>Promote global economy participation through bilateral and multilateral long term partnerships to promote sustainable AgriTech growth</td>
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<tr>
<td></td>
<td>Hackathons to catalyse development of needful solutions for AgriTech- Tertiary institutions and tech savvy youths can be harnessed as front leads</td>
<td>Establish AgriTech hubs and put in place incentive mechanisms to attract talent into developing AgriTech applications</td>
<td>Sustainable talent pool management through rewarding career opportunities in AgriTech and needful institutionalization</td>
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</table>
### AGRIC-FIT

<table>
<thead>
<tr>
<th>Intensify awareness campaigns and practical demonstrations on return on investment in AgriTech at grassroots levels and offering needful support to early adopters of ICTs in Agriculture</th>
<th>Establishment of Innovation Hubs, catalysing Public Private Partnerships (PPPs) for ICT infrastructure and connectivity in underserved geographies.</th>
<th>Increase the availability of finance for investments into hard infrastructure (roads, energy, water, logistics) that support the feasibility and cost competitiveness of scaling agricultural production and agribusiness</th>
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<tbody>
<tr>
<td>Exchange programmes through bilateral engagements with Fast Adopters and other out of African nations leading in AgriTech</td>
<td>Human Capital Investment in ICTs especially mainstreaming in formal education curriculum</td>
<td>Needful reforms in Land Tenure systems to attract private sector long term investments</td>
</tr>
<tr>
<td>Enhance gender-responsive research, monitoring, and evaluation and publicise success stories in Agriculture</td>
<td>Invest in value addition capacity development and improvements in domestic market linkages and trade corridors to eliminate market failures</td>
<td>Develop framework for Private Sector led Agric Industrialization</td>
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<tr>
<td>Scale up and replicate programs to stimulate domestic demand for agro products to raise access to quality nutrition and end hunger, including community-based nutrition programs to promote breast-feeding and nutrient supplements for infants and children in their first 1000 days; vouchers or subsidies for value added biofortified maize, cassava, and other staple food; school meal programs; and advocacy for greater</td>
<td>Data and information management</td>
<td>Integration of Agri Database into central registry and financing institutions</td>
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<tr>
<td>Mobile Network Operators (MNO) infrastructure sharing possibilities on already established assets to enhance connectivity in marginalized areas</td>
<td>Community engagements and capacity development to stimulate demand for ICTs</td>
<td>Policy reforms to attract private investors to promote ICT infrastructure development</td>
</tr>
<tr>
<td>Exchange programmes through bilateral engagements with Fast Adopters and other out of African nations leading in AgriTech</td>
<td>Human Capital Investment in ICTs especially mainstreaming in formal education curriculum</td>
<td>Needful reforms in Land Tenure systems to attract private sector long term investments</td>
</tr>
<tr>
<td><strong>EMERGING ADOPTERS</strong></td>
<td><strong>Establishment of governance structures at national and sub-national levels to coordinate AgriTech programmes planning and implementation (Steering Committees)</strong></td>
<td><strong>Introduce and implement CAADP principles and policy among commercial and smallholder farmers</strong></td>
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<tr>
<td>Reward, fund and scale currently running (low hanging) and exceptional cases in AgriTech and embark on mass awareness campaigns to build interest in agriculture among communities</td>
<td><strong>Human Capital development in AgriTech through enhancing needful infrastructure development for training institutions</strong></td>
<td><strong>Stimulate demand for ICTs in Agriculture through subsidies for sector specific investments</strong></td>
</tr>
<tr>
<td>Establish quick wins in national expertise in ICT and human capacity development</td>
<td><strong>Establish AgriTech hubs in strategic zones - tertiary institutions and youth groups</strong></td>
<td><strong>Invest in R&amp;D initiatives and programmes at national and sub-national levels</strong></td>
</tr>
<tr>
<td>Investing in smallholder farmers (especially Women and Youth) mass capacity development coupled with access to innovative financial models which promote productivity</td>
<td><strong>Initiate Agriculture Technology start-ups with exchange programmes with other countries like France that youths can be attracted to AgriTech through agricultural networking, and linking to finance and global opportunities</strong></td>
<td><strong>Regulatory framework review and alignment to promote AgriTech</strong></td>
</tr>
<tr>
<td>Government led Promotion of sustainable market linkages between rural young farmers and urban markets through e-commerce or m-commerce platforms, such as the Agrocenta in Ghana, 2Kuze and SokoNect in Kenya</td>
<td><strong>Development of needful platforms for value chain players engagement, coordination, capacity development and tracking</strong></td>
<td><strong>Development of long-term strategy for AgriTech growth in line with national macro-level development strategy and global frameworks</strong></td>
</tr>
</tbody>
</table>
| **ICT -FIT** | **Explore proven models for non land intensive production** | **Develop long term plans for harnessing ICTs in Agriculture** | **Establish continental collaborations and partnerships for sharing innovative technologies and agricultural knowhow. AgriTech solutions developed in one country should be available for sharing and improvement by partner countries.**
| | **Invest in smallholder farms via innovative financial models and development of relevant AgriTech information management systems covering databases, access to technical Agro-information** | **Regulatory framework review** | **Establish databases of all farmers in the country (both commercial and stakeholder farmers). The databases should contain data on agricultural activities, location, gender, etc for tracking purposes. This makes it easy for training and capacity building programmes for AgriTech applications.**
| | **Work with FSPs to develop financial tools and products that facilitate access to finance and technical information for agriculture-related activities by youth** | **Position the youth in risk management mechanisms among smallholder farmers and agri-businesses, along selected agriculture value chains** | **Market led expansionary reforms aligned to regional and global trends to sustain AgriTech development.**
| | **Promoting sustainable market linkages between rural young farmers and urban markets through e-commerce or m-commerce platforms, such as the Agrocenta in Ghana, 2Kuze and Sokonect in Kenya** | **Drive large scale dissemination of productivity raising technology** | **Develop needful policies to attract long term investors in AgriTech**
| | **Launch funding programs which will increase the availability of financing and participation of underrepresented actors in agribusiness, with particular focus on women and rural populations** | **Human Capital Training in AgriTech through mainstreaming Agriculture in existing tertiary institutions and establishing specialized AgriTech Polytechnics and Universities** | **Market led expansionary reforms aligned to regional and global trends to sustain AgriTech development.**
### 3.9.2. GENERIC RECOMMENDATIONS, KEY LESSONS AND CALL-TO-ACTION

At the intersection of all four categories, lie the generic recommendations which all countries in Africa are expected to take cognisance of. Most countries have ICT policies, strategies or plans in place, but very few are specific to creating a digital agro economy. At the confluence of all categories, is the need to improve on ICTs and Agriculture capacities. African countries should develop strategies that lie at the intersection of ICTs and Agriculture. All countries are therefore recommended as follows:

**Political will to Digital Economy Strategic Planning**

- National Strategic Coordination of AgriTech plans leading to harmonized policy and regulatory frameworks
- Prioritised funding towards AgriTech growth. Effective cooperation between private and public stakeholders can lead to possible public private partnerships (PPPs). Traditional finance, Leasing and factoring, Savings/ Crowdfunding, Private equity, Venture capital, Angel capital, Family loans, Credit Unions
- Coordinated infrastructure investment and rollout, extending connectivity to low-income and marginalised populations, and creating incentives for private sector infrastructure investments
- Prioritised investment into digital skills and human capacity
- Regional collaboration and global alignment to make SMART Africa a reality through promoting knowledge sharing, trade, and digital economic integration across the continent
- Managing agriculture data (Afgri-data) as a strategic resource at all levels. Agricultural innovations are reaching a level of maturity that requires agricultural data pooling platforms to maximize their added value to farmers. At the same time, they realize that the data they generate and collect has value. Various stakeholders in the agricultural world (farmers, sensors, decision support tools, cooperatives, equipment manufacturers, etc.) can protect and share their data. Data issues to be considered include data security, data ownership, data monetization, data policies, etc
- Managing User Applications. Human-device interface should be considered when deploying applications to be used by farmers who in many cases are not techy savvy. Issues to do with content management applications, applications hosting, training and usability of applications interfaces, etc are important to consider. farmers should own and have control over their applications and data.
- Even though developing an AgriTech strategy differs by country, there are some common experiences and recommendations that should be followed as a general rule
- There should be a clear owner of the process who has the mandate to implement the strategy, and who is committed to the process. While the agriculture sector is best positioned to lead this, it is important to have high-level buy-in from the ICT sector.
- The right stakeholders should be identified and involved at every stage of the process.
Efforts should be made to incorporate all relevant ongoing ICT in agricultural projects/programmes into the planning process.

Defining clear roles and responsibilities for all participants in the development process is critical.

Decision-makers should be involved at all levels of the process to ensure their total buy-in and their understanding of the process. Their total commitment throughout the process is also essential.

The vision/strategy should respond to broad national, regional and international policies, plans and strategies.

AgriTech visions/strategies should be incorporated in future agriculture sector policies and plans so that in implementing the sector policy, issues of AgriTech will be dealt with.

The right resources should be available for the development and implementation processes.

The process should be transparent and considerable awareness should be created before and during the development process.

Agricultural experts supported by relevant stakeholders from other key sectors (e.g. telecommunications, banking, insurance, disaster management, rural development, etc.) should be involved in the development of AgriTech strategies. This will make them understand the benefits of AgriTech, and also the underlying challenges.

There should be clear business benefit (economic or brand building) for the private sector stakeholders for long-term support and adoption.

Content and data related standards (metadata, quality assurance etc.) should be established at the early stage of AgriTech implementation.

### DEVELOP AN AgriTech RESULTS FRAMEWORK

By this point, a government would have established its national AgriTech vision and the AgriTech action plan. The action plan would have been endorsed by the agriculture and ICT sector leadership and supported by the broader stakeholder environment. A monitoring and evaluation (M&E) framework enables a government to track and assess the results of implementing the AgriTech action plan. ‘Results-based management’ is the management strategy used by the United Nations and adopted in this guide. A clear distinction should be made between an M&E framework for a national AgriTech strategy and the programme management activities that are designed to implement and manage a large-scale AgriTech action plan.

### DEVELOPING AN AGRITECH MONITORING AND EVALUATION FRAMEWORK

This section describes the elements to be considered in establishing an M&E framework for a national AgriTech programme (Figure 41).

**Indicators for AgriTech:** An effective M&E framework is constructed around a set of meaningful indicators, the measurement of which provides insight into the adoption, use and results that AgriTech is delivering. Meaningful indicators should include the perspective of
stakeholders, as this ensures that changes or improvements important to stakeholders are measured. Developing and selecting these indicators requires an understanding of AgriTech outcomes and outputs that are important to each stakeholder. There are two types of indicators to consider.

1. Output indicators provide information and insight on the adoption of AgriTech.
2. Outcome indicators provide information and insight on the results obtained.

**Figure 41: Preview of Monitoring and Evaluation AgriTech Framework**

**Indicator measures:** Monitoring the progress of the action plan requires an understanding of where a country is starting from (baseline measures), and what it is expecting to achieve (target measures). Targets should be defined for a range of time frames throughout the duration of the action plan.

**Governing, monitoring and evaluation:** National governance provides oversight, coordination and guidance for M&E efforts, and ensures timely intervention when there appears to be divergence between what is actually happening and what a country was aiming to achieve through its AgriTech programme. Governance must be supported by processes that direct how the adoption and results of AgriTech are monitored and evaluated.

**Developing the framework: overview:** This section describes how an M&E framework can be developed. This is a sequential process that begins with determining the indicators to be monitored and outcomes to be evaluated. Baseline and target measures are set for each indicator. Targets serve as the basis for tracking actual progress against planned progress, and determining whether corrective action is required. An M&E framework also describes the governance model and processes through which national M&E will be performed. Stakeholders are consulted throughout the process in order to gain commitment and understanding, as well as to ensure that their roles are considered in the governance structure and processes.
Define indicators for AgriTech: This step determines the purpose of M&E, based on the AgriTech vision, action plan and stakeholder perspectives. It focuses on developing a set of AgriTech output and outcome indicators that will measure the results that AgriTech delivers. An important aspect is to consider the consultations completed with stakeholders in Part 1, and to link a number of the indicators to outcomes important to stakeholders. It is also important to link indicators to time frames for measuring other agriculture outcomes, where possible, to show the contribution of AgriTech to these outcomes and to avoid creating separate reporting processes (for example, productivity figures that are already being reported).

Define baseline and target measures for indicators: This step validates the baseline measures and creates target measures for each indicator. Target measures are defined for different time frames so that progress can be monitored throughout the execution of the plan.

Define supporting governance and processes: This stage defines the governance and processes within which the M&E of AgriTech adoption and associated results will be undertaken. Experience shows that monitoring the progress and evaluation of AgriTech may be carried out at multiple levels and by multiple parties.

3.11. CONCLUSION

The Continental AgriTech Blueprint serves only as a guideline to the design and development of country specific strategies as well as cross-border pilots. Country strategies should be partnership projects with stakeholders involving but not limited to government, academia, non-governmental organisations, research institutions, technology companies, farmers and farmer organisations, commercial and rural communities, women and youths organization. Having developed country strategies, the most important step is the implementation and operationalization of the strategy and plans. A results framework is necessary at every stage of the implementation process as it provides monitoring and evaluation to ensure conformity to vision and set targets. From strategy formulation to implementation, all stakeholders should understand that they do not work FOR each other, but they work WITH one another. Hence, co-design, co-development, co-implementation and co-monitoring are key concepts in the entire project cycle.
REFERENCES


Under the leadership of the Republic of Zimbabwe and Smart Africa


World Bank (2017). *ICT in Agriculture: Connecting Smallholders to Knowledge, Networks, and Institutions*
PART IV: ANNEXES
APPENDIX A

Data Files

<table>
<thead>
<tr>
<th>Country</th>
<th>2019-GDMA Mobile Connectivity Index</th>
<th>ICT regulation tracker</th>
<th>DMA/ICT Index on laws/regulations and policies</th>
<th>ITK Development Index 2017</th>
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APPENDIX B:

AgriTech BLUEPRINT SOLUTIONS
On the basis of the goal of the framework, this section presents in further detail the specific AgriTech strategic solutions that are recommended for each of the different quadrant as a solution to accelerate agriculture productivity using technologies in Africa. The quadrants being referenced comprise Fast Adopters, ICT-Fit, Agric-Fit, Emerging Adopters. The AgriTech solutions will aim to first of all address the challenges specific in each quadrant and leverage the potential of the digital transformation for the agriculture sector in Africa learning from other African and Global success cases. This section also includes recommendations for each of the quadrants and an M&E system to monitor the blueprint implementation and expected outcomes.

ACTION PLAN
This section lays out the recommended AgriTech solutions, associated implementation timeline, possible impact and estimated level of budget to deliver the ultimate goal to accelerate agriculture productivity and efficiency on the continent. The recommended actions are guided by the benchmarking process that was done leading to status of ICT and Agriculture on the continent, hence the four Quadrants. This is also based on previous blueprints developed by Smart Africa such as the Digital Economy blueprint as AgriTech exist within the digital economy space. Additionally, the recommendations are also inspired from the discussion within the Working Group over the months of February-March 2021, the documents presented and recommended by the Working Groups.
## AgriTech Solutions

<table>
<thead>
<tr>
<th>No.</th>
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<th>Expected Results</th>
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<tr>
<td>1.</td>
<td>Agriculture Informa-&lt;br&gt;tion Management System (AIMS) – A platform that operationalises the whole agribusiness value chain (from farm to fork). The platform is meant to align with the government SMART Africa flagship viz AgriTech. AIMS will have an integrated central database drawing from various sub information systems.</td>
<td>Availability of accurate and timely agriculture statistical data and information&lt;br&gt;Coordinated and integrated agriculture statistical systems that provide evidence for decision making for the government, private sector and farmers.</td>
<td>H</td>
<td>3 years</td>
<td>Zimbabwe</td>
<td>Government, Private Sector, Commercial Farmers, Smallholder farmers, Research Institutions</td>
</tr>
<tr>
<td>2.</td>
<td>PrecisionHawk provides a portfolio of geospatial data analytics services and tools. Used for crops, vegetation indices, sensors and drones</td>
<td>Availability of drone-based agriculture solutions including drones, sensors and A.I&lt;br&gt;Availability of quantifiable measures of crop health data&lt;br&gt;Automated crop counting and sizing, on-demand vegetative indices and flexible zonal statistics</td>
<td>M</td>
<td>2 years</td>
<td>Ghana, Canada</td>
<td>Commercial Farmers, Smallholder farmers, NGOs</td>
</tr>
<tr>
<td>3.</td>
<td>Hydropoint used by property managers, and landscapers for water conservation products and services</td>
<td>Availability of smart irrigation systems</td>
<td></td>
<td>0.5 years</td>
<td></td>
<td>Commercial Farmers, Smallholder farmers</td>
</tr>
</tbody>
</table>

<p>| | | | | |</p>
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</thead>
<tbody>
<tr>
<td><strong>4.</strong></td>
<td><strong>E-kakashi</strong>&lt;br&gt; An IoT solution for identifying important growth and stunting factors at each stage of crop growth</td>
<td>Integration of environmental and farming data to give farmers the best solutions to a wide range of field conditions</td>
<td>H</td>
<td>0.5 years</td>
</tr>
<tr>
<td><strong>5.</strong></td>
<td><strong>Niwa Pro</strong>&lt;br&gt; It is an automated gardening system with grow room sensors &amp; a smart garden monitoring system</td>
<td>Availability of automatic garden systems including grow room and smart garden sensors.</td>
<td>M</td>
<td>1 year</td>
</tr>
<tr>
<td><strong>6.</strong></td>
<td><strong>HandsFree Hectare</strong>&lt;br&gt; It is an autonomous combine harvester for commercial smart farming</td>
<td>Emergence of Africa’s fully automated cropping cycles</td>
<td>H</td>
<td>1 year</td>
</tr>
<tr>
<td><strong>7.</strong></td>
<td><strong>Plantagon</strong>&lt;br&gt; develops technology to move food production into high-density cities on a large scale by integrating farms into existing city infrastructure.</td>
<td>Enhancement of vertical agriculture of vegetables in urban areas&lt;br&gt;Emergence of office buildings that incorporate agriculture production into half of the building’s interior</td>
<td>M</td>
<td>0.5 years</td>
</tr>
<tr>
<td><strong>8.</strong></td>
<td><strong>Kuka robots</strong>&lt;br&gt; Agricultural robots, including drones, autonomous tractors, and robotic arms</td>
<td>Emergence of fully automated welding processes for general welding, cutting, palletizing or even handling agricultural machinery</td>
<td>M</td>
<td>0.5 years</td>
</tr>
<tr>
<td><strong>9.</strong></td>
<td><strong>ASC Software</strong>&lt;br&gt; Provides farm location information for farm audit purposes</td>
<td></td>
<td>M</td>
<td>1 year</td>
</tr>
<tr>
<td><strong>10.</strong></td>
<td><strong>FoodLogiQ</strong>&lt;br&gt; connect the world’s food supply chain, promoting food safety through traceability and sustainability</td>
<td>Enhancement of food safety, traceability and quality incident management</td>
<td>M</td>
<td>0.5 years</td>
</tr>
<tr>
<td>11.</td>
<td>Botswana Animal Information and Traceability System</td>
<td>Availability of information on livestock</td>
<td>H</td>
<td>1 year</td>
</tr>
<tr>
<td>12.</td>
<td>eFARMS digital agriculture model deployed to tackle the problems of paucity in funding for agriculture, food insecurity and under-utilization of abundant arable land</td>
<td>Availability of agri-financing and training</td>
<td>H</td>
<td>1 year</td>
</tr>
<tr>
<td>13.</td>
<td>eLEAF offers satellite based applications and data to optimise crop production and water management</td>
<td>Providing farmers with targeted extension services</td>
<td>M</td>
<td>0.5 years</td>
</tr>
<tr>
<td>14.</td>
<td>Nosets Simplified Irrigation for precision irrigation system</td>
<td>Automating the irrigation process</td>
<td>H</td>
<td>1 year</td>
</tr>
<tr>
<td>15.</td>
<td>H2O Catchers a fog farming project that aims to use fog to produce fresh water, which can then be used for small- and large-scale consumption, sanitation and irrigation, without putting strain on the struggling municipal fresh-water supply systems.</td>
<td>Use of fog to produce fresh water for small-scale consumption, sanitation and irrigation</td>
<td>H</td>
<td>1 year</td>
</tr>
<tr>
<td>16.</td>
<td><strong>Local sensor based information systems for agronomists, extension workers and farmers.</strong> For example, weather stations and soil moisture sensors, grain storage monitoring and water tank monitoring communicating via LoRaWAN and backhauled either by public cellular networks or satellite communications.</td>
<td>Enables data driven crop management decisions that lead to greater yield and quality.</td>
<td>H</td>
<td><strong>Minfarm Tech</strong> (<a href="https://www.minfarmtech.com">https://www.minfarmtech.com</a>)</td>
</tr>
<tr>
<td>17.</td>
<td><strong>Provide Capacity Training for Women and Youth</strong></td>
<td>Structured Farming Entrepreneur program</td>
<td>H</td>
<td>6-12 months</td>
</tr>
<tr>
<td>18.</td>
<td><strong>Provide Regional Hackathons specific to opportunities</strong></td>
<td>Establishment of Innovation hubs</td>
<td>H</td>
<td>6-12 months</td>
</tr>
</tbody>
</table>

### ICT-FIT

<p>| 1. | <strong>Connected Aquaponics computer and internet connected “smart” gardens</strong> | Availability of integrated aquaponics and hydroponics | M | 1 year | Morocco, South Africa, Kenya |
| 2. | <strong>Fisher Friend Mobile Application.</strong> It is a decision support system to fishers | Availability of real-time knowledge and information services on weather, potential fishing zones, ocean state forecasts, and market related information | H | 6 months | Malawi, Guinea |
| 3. | <strong>AgriFin Mobile</strong> provides market information and financial support to smallholder farmers and small businesses | Availability of agricultural information via SMS | 1 year | Nigeria, Tanzania | Smallholder farmers, financial institutions |</p>
<table>
<thead>
<tr>
<th></th>
<th>Service/Platform</th>
<th>Description</th>
<th>Availability</th>
<th>Run Time</th>
<th>Region</th>
<th>Stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>Farmforce</td>
<td>Is a cloud-based platform for managing farming activities, establishing traceability and ensuring compliance.</td>
<td>Availability of farm management information for smallholder farmers, including supply chain visibility, trainings, auditing &amp; surveying, planting campaign management, harvesting &amp; purchasing, SMS communication as well as Bluetooth scales &amp; integration</td>
<td>H</td>
<td>2 years</td>
<td>Ethiopia, Sudan, Uganda</td>
</tr>
<tr>
<td>5.</td>
<td>Taobao</td>
<td>Assists farmers to sell agricultural products directly to urban consumers, eliminating the inefficient supply chain.</td>
<td>Availability of livestreaming for shopping agricultural products</td>
<td>H</td>
<td>1 year</td>
<td>China</td>
</tr>
<tr>
<td>6.</td>
<td>Esoko</td>
<td>Helps nonprofits, agribusinesses and governments digitize data collection and service delivery projects.</td>
<td>Availability of virtual marketplaces and digital data collection services</td>
<td>H</td>
<td>1 year</td>
<td>Rwanda, Ghana, Kenya</td>
</tr>
<tr>
<td>7.</td>
<td>Kilimo Salama</td>
<td>Is a climate smart crop-index insurance scheme helping smallholding farms face the risks posed by adverse weather.</td>
<td>Availability of insurance for farmers</td>
<td>M</td>
<td>2 years</td>
<td>Kenya</td>
</tr>
<tr>
<td>8.</td>
<td>iCow</td>
<td>Is a mobile phone based agricultural information platform for small holder farmers.</td>
<td>Availability of agricultural information via SMS</td>
<td>H</td>
<td>1 year</td>
<td>Ethiopia</td>
</tr>
<tr>
<td>No.</td>
<td>Initiative/Project</td>
<td>Description</td>
<td>Availability</td>
<td>Duration</td>
<td>Location</td>
<td>Stakeholders</td>
</tr>
<tr>
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</tr>
<tr>
<td>9.</td>
<td>iProcure</td>
<td>Provide complete procurement and distribution solution for farm supply to partners that want to streamline their distribution and improve efficiency and customer service</td>
<td>Availability of digital agricultural supply chain management services for smallholder farmers</td>
<td>M</td>
<td>1 year</td>
<td>Egypt, Rwanda, South Africa</td>
</tr>
<tr>
<td>10.</td>
<td>Kenya Agricultural Commodity Exchange</td>
<td></td>
<td>Availability of a farmers trading platform</td>
<td>H</td>
<td>1 year</td>
<td>Kenya</td>
</tr>
<tr>
<td>11.</td>
<td>Agrimark Trends</td>
<td>Provides a one-stop-shop for agricultural market information to enable South African farmers to make informed decisions.</td>
<td>Providing a one-stop-shop for agricultural market information</td>
<td>H</td>
<td>1 year</td>
<td>South Africa</td>
</tr>
<tr>
<td>12.</td>
<td>M-Farm</td>
<td>Is a transparency tool for Kenyan farmers get information pertaining to the retail price of their products</td>
<td>Availability of agricultural information, especially on prices of products</td>
<td>M</td>
<td>2 years</td>
<td>Kenya</td>
</tr>
<tr>
<td>13.</td>
<td>mFisheries</td>
<td>Presents a channel for the integration of technology-excluded small scale fisher-folk into the global information society</td>
<td>Availability of fishing and aquaculture information, especially on market prices, weather as well as fish handling and safety best practices</td>
<td>M</td>
<td>2 years</td>
<td>Ivory Coast, Ghana</td>
</tr>
<tr>
<td>14.</td>
<td>Twiga Foods</td>
<td>Links farmers and vendors to fair, trusted, modern markets. Providing a complete supply chain for quality produce in urban areas.</td>
<td>Serves as a meeting point for vendors and farmers and provides loans to sustain and expand their businesses</td>
<td>M</td>
<td>2 years</td>
<td>Kenya</td>
</tr>
</tbody>
</table>
### 15. Kitovu
Kitovu creates market access for farmers by using multi-platform compatible mobile applications.

- Analyzes soil and geo-location data from smallholder farmers and provides them with the soil and crop specific fertilizers, agro-chemicals, and better seedlings for their fields
- Ghana, Benin, Senegal

### 16. Aerobotics
A free data service for farmers using a range of spectral imaging technology

- Provides meaningful data to farmers to analyze their crops on a plant by plant basis by proposing curative actions which help to reduce costs and maximize resources
- South Africa, Mozambique, Zimbabwe

### EMERGING ADOPTERS

<table>
<thead>
<tr>
<th>1. Deepfield Connect</th>
<th>Availability of solutions to measure agronomic values for agriculture and horticulture</th>
<th>H</th>
<th>1 year</th>
<th>Somalia</th>
<th>NGOs, WFP, Government, Private sector, Research Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Fresh Direct</td>
<td>Harnessing technology for efficient production of vegetables</td>
<td>H</td>
<td>1 year</td>
<td>Nigeria</td>
<td>Small scale farmers, vendors, investors</td>
</tr>
<tr>
<td>3. Soil Scout</td>
<td>Availability of advanced fully buried underground wireless soil sensor and monitoring solution</td>
<td>H</td>
<td>1 year</td>
<td>South Africa</td>
<td>Government, Private sector, research institutions</td>
</tr>
<tr>
<td>No.</td>
<td>Project Name</td>
<td>Description</td>
<td>Duration</td>
<td>Country</td>
<td>Stakeholders</td>
</tr>
<tr>
<td>-----</td>
<td>--------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
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<tr>
<td>4.</td>
<td>Connected Cow</td>
<td>An IOT-based solution to track the activities of beef livestock, prevent cattle rustling and illnesses, and, in summary, facilitate cattle and livestock management.</td>
<td>H</td>
<td>6 month South Africa</td>
<td>Government, Private Sector, Commercial Farmers, Smallholder farmers</td>
</tr>
<tr>
<td>5.</td>
<td>Nokia Life Tools</td>
<td>Concept designed to deliver valuable and up-to-date information on the core topics of agriculture and education, providing rural communities without access to the internet, with timely information via SMS at a low cost.</td>
<td>H</td>
<td>6 months Nigeria</td>
<td>Government, Private sector, NGOs,</td>
</tr>
<tr>
<td>6.</td>
<td>Reuters Market Light</td>
<td>Market intelligence solution to bridge information gaps amongst farmers.</td>
<td>M</td>
<td>1 year Cameroon</td>
<td>Government, Private sector, NGOs,</td>
</tr>
<tr>
<td>7.</td>
<td>Livestock Identification Track Bank System</td>
<td>IOT based solution to track growth and manage livestock.</td>
<td>H</td>
<td>1 year Botswana and Kenya</td>
<td>Government, Commercial and small-scale farmers, Meet Processors, NGOs</td>
</tr>
<tr>
<td>8.</td>
<td>e-voucher</td>
<td>Virtual solution for purchases of farm inputs at selected outlets.</td>
<td>H</td>
<td>6 months Zimbabwe</td>
<td>Private Sector, NGOs Ecofarmer</td>
</tr>
<tr>
<td>9.</td>
<td>SavaNet</td>
<td>Digital networking and communication solution for farmers.</td>
<td>H</td>
<td>6 months Ghana</td>
<td>Government, NGOs</td>
</tr>
</tbody>
</table>

**Notes:**
- **H:** Hosted solution
- **M:** Mobile solution
- **N:** Network solution
<table>
<thead>
<tr>
<th>No.</th>
<th>Company Name</th>
<th>Description</th>
<th>Recommended Time</th>
<th>Region</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.</td>
<td>RONGEAD</td>
<td>Facilitate market access for value chain actors, to strengthen producer organizations capacities, to reduce environmental externalities in the process of transformation and promote adapted agricultural policies in developing countries.</td>
<td>M</td>
<td>1 year</td>
<td>France</td>
</tr>
<tr>
<td>11.</td>
<td>Farmerline</td>
<td>Mobile based solution for accessing weather and market information for farmers</td>
<td>H</td>
<td>1 year</td>
<td>Ghana</td>
</tr>
<tr>
<td>12.</td>
<td>Hello Tractor</td>
<td>On demand tractor access and collaboration</td>
<td>H</td>
<td>1 year</td>
<td>Kenya, Zimbabwe</td>
</tr>
<tr>
<td>13.</td>
<td>Apollo Agriculture</td>
<td>Builds credit profiles for its small-scale farmers using machine learning models. It does so by doing its due diligence of verifying the identity of farmers and taking satellite coordinates of their fields.</td>
<td>H</td>
<td>1 year</td>
<td>Kenya</td>
</tr>
<tr>
<td>14.</td>
<td>CowTribe</td>
<td>Network for linking livestock farmers with healthcare providers</td>
<td>H</td>
<td>1 year</td>
<td>Ghana</td>
</tr>
</tbody>
</table>
15. **FarmCrowdy**  
   Fundraising platform for farmers  
   Enabling investors to collaborate in farming projects through a crowd-funding platform and these partners receive returns on their investment after the farm cycle is complete  
   H  
   1 year  
   Nigeria  
   Farmers, Private Investors, Government

16. **EcoFarmer**  
   Econet’s mobile farming platform which allows agricultural businesses and farmers to deliver and access information, financial and value chain services.  
   Availability of financial inclusion platform for small-holder farmers  
   H  
   1 year  
   Zimbabwe  
   Small Scale and Commercial farmers, Private sector

Regional Marketing Campaign featuring Women-Youth Agricultural Entrepreneurs  
Stimulate investment  
H  
12-24 months  
Founders Institute FI that is regional is potential starting point

### AGRIC-FIT

1. **Hydropoint**  
   Landscape irrigation efficiency as well as advanced monitoring and reporting to show effective savings and a projected ROI, using sensor data analytics.  
   Availability of smart irrigation systems  
   H  
   1 year  
   South Africa  
   Private Sector Investors, Government, NGOs, Commercial Farmers

2. **Hortau**  
   Irrigation management service is based on soil tension, allowing growers to anticipate and avoid stress during crucial growing stages  
   Availability of web-based irrigation systems to enable better productivity and water conservation  
   H  
   3 years  
   Saudi Arabia, Egypt, Nigeria, and South Africa  
   Government, Private Sector, NGOs, Commercial farmers
<table>
<thead>
<tr>
<th></th>
<th>Project Name</th>
<th>Description</th>
<th>Sector</th>
<th>Duration</th>
<th>Location(s)</th>
<th>Investors</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Gamaya AgriTech innovation</td>
<td>Early detection diseases and weeds</td>
<td>M</td>
<td>2 years</td>
<td>Chad, Switzerland</td>
<td>Private Sector Investors</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Designed to improve the efficiency and sustainability of crop production by offering compelling digital agronomy solutions to B2B clients and large farming</td>
<td></td>
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</tr>
<tr>
<td>4</td>
<td>Shared Solar</td>
<td>Availability of smart microgrids for energy access</td>
<td>H</td>
<td>1 year</td>
<td>Uganda and Mali</td>
<td>Government, Private Sector Investors, NGOs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Small Scale suited solution to enable sharing of solar energy via network of micro-grids</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>5</td>
<td>African Cashew Initiative</td>
<td>Provision of support in research, production, processing, marketing, capacity development and policy advice</td>
<td>H</td>
<td>1 year</td>
<td>Ghana, Mozambique, Tanzania</td>
<td>Government, Private Sector, Commercial Farmers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention aimed at organizing and building a sustainable African cashew sector to reduce poverty.</td>
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<tr>
<td>6</td>
<td>Wakati</td>
<td>Smallholder farmers can store their produce on their farms in a protective microclimate inside a tent with a storage of 200-1000 kg, using one liter of water per week, and powered by a small solar panel.</td>
<td>H</td>
<td>1 year</td>
<td>Tanzania, Uganda</td>
<td>Government, Private Sector, Commercial Farmers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Standalone solution for preservation of fruits and vegetables without using cooling.</td>
<td></td>
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<tr>
<td>7</td>
<td>Illuminum Greenhouses</td>
<td>Availability of affordable modern greenhouses and installation of automated drip irrigation kits for smallholder farmers</td>
<td>M</td>
<td>1 year</td>
<td>Kenya</td>
<td>Private Sector Investors, Commercial Farmers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Agri-Tech greenhouse and drip installation solution to preserve water and improve irrigation efficiencies</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>