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**Republic of Sudan**  
**Ministry of Agriculture and Forests**

**Sudan E-Agriculture**  
**Strategy and Action Plan**  
**(2018-2022)**

*December 2017*

# Sudan E-Agriculture Strategy and Action Plan (2018-2022)

## 1. INTRODUCTION:

Sudan is endowed with immense natural resources that could constitute a strong springboard for the development of the agriculture sector. It has the largest irrigated area in the continent as well as large herds of livestock, which exceed other large countries in Sub-Saharan Africa, as well as ample lands exploited by rain-fed agricultural systems. However, despite its rich natural resources, the agriculture sector in Sudan has performed poorly in the past decades.

As indicated, in the Sudan's National Agriculture Investment Plan (SUDNAIP) 2016-2020, by the Strengths, Weaknesses, Opportunities and Threats (SWOT) and the sector performance analysis, the agriculture sector suffers from structural problems such as low productivity and high marketing costs that reduce competitiveness and result in lower prices for farmers. This situation has, to a large extent, been caused by volatile and poor economic and sectoral policies as well as by weak institutional capacities. Also, the prevailing distortions in land rights have led to misuse of the land resource and have further exacerbated the low productivity syndrome. Without the above being addressed, it will be extremely difficult to attract full engagement of the private sector and achieve any meaningful sustained growth in the sector.

The SUDNAIP (2016-2020), as a vehicle, constitutes a renewed opportunity for Sudan to reorient its priorities, to focus on optimizing its scarce resources and to turn agriculture into an engine of growth. To achieve this goal, the SUDNAIP creates investment packages of interrelated interventions that aim to catalyse sector growth through the removal of its structural bottlenecks, thus laying the foundation for subsequent strong private sector-led growth in the future.

These investments would need to be supported by major institutional reforms, which aim to ensure efficient management of the numerous irrigated schemes, thus avoiding past management mistakes.

The problems of the agriculture sector in Sudan are often exacerbated by an under-developed agro-industrial sector. Agro-industries increase incomes and employment and can promote industrialization and urban employment, break the productivity gap, reduce food costs and supply uncertainties, improve diets and reduce vulnerability of rural households. They also play a role in improving the balance of payments through either import substitution or the promotion of exports, thus leading to a more stable macroeconomic environment. To add value to agriculture, the SUDNAIP proposes expanding capacities for selected agro processing products in which Sudan has a comparative advantage with import substitution commodities (sugar, edible oil and milk).

The private sector is key to the development in the agriculture sector. International, and acquired national experience clearly suggests that efforts are needed to remove barriers to productivity growth, competitiveness and economic integration if the private sector is to play its intended role. Countries in Africa that have improved their investment climates and have invested in removing supply bottlenecks have grown faster and became more competitive. Recognizing and enabling the leading role of the private sector in Sudan will require strategic public investments to address key sector constraints facing the private sector. Consequently, investments in market infrastructure like roads and rail will be given priority.

These investments will enhance the connectivity of Sudan with its neighbouring African countries and will enable the private sector to benefit from the opportunities created by expanding regional market access which is in line with strategic priorities envisioned by the COMESA, the Intergovernmental Authority on Development (IGAD) etc. These investments will not only generate economic benefits but will also contribute to peace, security and stability in the region. Investments in an enabling environment through policy changes such as the rationalization of taxes and fees, ensuring transparent exchange rates and pricing policies as well as legal and institutional reforms are all required to help unlock private investments.

The SUDNAIP will translate the strategy into actions by: (i) increasing production and productivity through modernization of the agriculture systems; (ii) enhancing production by support services and establishing knowledge and information network; (iii) developing marketing infrastructure to increase competitiveness and increase value-addition through agro-industrialization and value chain development; (iv) protecting and conserving natural resources with a priority of addressing the agriculture land issue as a key factor in the natural resource management; (v) mainstreaming food and nutrition security and safety; (vi) creating an enabling policy and a legal environment for sustained agriculture growth; and (vii) reforming the institutions and increasing capacities of staff and producers in the agricultural sector.

SUDNAIP is a five-year investment plan, which maps the investments needed to achieve the Sudan Comprehensive Africa Agriculture Development Programme (CAADP) target of six % annual growth in Agriculture Domestic Product (GDP). The Sudan will pursue this target through allocating a minimum 10% of its budget to the agricultural sector. The Sudan also seeks the support of the international community and the private sector in bridging the funding gap between the funding requirements and the amount that has already been identified from a variety of domestic, international, public and private sources.

The SUDNAIP is not a new agricultural development strategy or programme. Rather, it is a sector-wide plan for coordinating and harmonizing the resources needed to accelerate the implementation of existing initiatives and to launch new initiatives which address national and regional development priorities for sector development. Sudan aims to attain a comprehensive national socio-economic development led by a dynamic agricultural sector capable of rapid and sustainable growth and biased towards the weak and vulnerable sectors of the population and having strong linkage to agricultural industrialization. This vision guides public actions and investments in the sector over the next five years.

The objectives of the SDNAIP are:

- Promotion of exports of crops and livestock with a view to safeguarding against the risks of collapse of the whole economy as a result of neglect of the agricultural sector and distortions to agricultural incentives.
- Increasing productivity and efficiency at the production and processing stages.
- Realization of food security and nutrition.
- Reducing rural poverty by 50 % by 2020, generation of job opportunities, especially for youth and women, and increasing per capita income.
- Achievement of a regionally-balanced sector and economic growth in order to encourage settlement in the rural areas.
- Development and protection of natural resources to ensure its renewal and sustainability.

In order to achieve the above objectives, the investment plan is structured under seven Investment Programme Areas (IPAs), each with its own Strategic Objective, major investment programmes, sub programmes and components:

- IPA1: Enabling Environment for Sustainable Agricultural Development.
- IPA2: Institutional Reform, Change Management and Enhanced Capacity Building of Producers and Staff in the Agricultural Sector.
- IPA3: Increasing Agricultural Production and Productivity through Development and Modernization of Agricultural Systems and Improved Agricultural Management.
- IPA4: Development of Agricultural Support Services and Establishment of Knowledge and Information Network.
- IPA5: Agricultural Industrialization, Development of Value Chain and Market Access.
- IPA6: Addressing the Issues of Agricultural Land, Protecting and Developing Natural Resources, including Wildlife.
- IPA7: Realization of Food Security and Nutrition and Implementation of Quality Control and Safety Measures for Domestic Consumption and Export.

## 2. THE E-AGRICULTURE AND ACTION PLAN

The **Sudan E-agriculture Strategy an Action Plan** lays down a roadmap by which ICT developments can significantly contribute towards achievement of the country's agricultural vision and development objectives. It integrates standalone ICT experiments under a collaborative and inclusive framework while prioritizing solutions that can be scaled up and supported through the required ecosystem. This document provides an analysis and evaluation of current and prospective roles of Information Communication Technology (ICT) in agriculture in Sudan, lays down a vision for e-agriculture in the country and recommends specific actions plans. The strategy document has been prepared based on the framework guide proposed by the Food and Agriculture Organization (FAO) and the International Telecommunication Union (ITU), beside the ICT in Agriculture: Connecting Smallholders to Knowledge, Networks, and Institutions produced by world bank Group and Others.

The strategy has been prepared through extensive discussion and stakeholder consultation from multiple sectors and has taken into consideration the fact that ICT would influence people's life from many different aspects, not only agriculture, and will act as an efficiency multiplier that enables people and processes to achieve higher level of efficiency, effectiveness and enhance the overall quality of life. It leverages on the existing ICT developments that impact agriculture in Sudan and aims to mainstream it.

E-Agriculture is evolving in scope as new Information and Communication Technologies (ICTs) applications continue to be harnessed in the agriculture sector. It is seen as an emerging field focusing on the enhancement of agriculture and rural development through improved information and communication processes. In this context, ICT is used as an umbrella term encompassing all information and communication technologies including devices, networks, services and applications; these range from innovative Internet-era technologies and sensors to other technologies that have existed for much longer such as telephones, mobiles, television, radio and satellites.

More specifically, it involves the conceptualization, design, development, evaluation and application of innovative ways to use ICTs in the rural domain, with a primary focus on agriculture and allied fields. Provision of standards, norms, methodologies, tools as well as development of individual and institutional capacities, and policy support are all key components of e- agriculture.

Access to the right information at the right time through the right medium is crucial for people involved in the agricultural sector. This includes farmers, fishers, foresters, policy makers, industries and other actors in the agricultural value chain. Increasingly, the challenges faced by small holder farmers as a result of climate change, irregular rainfall patterns, attack of pest and the onset of diseases, drought, desertification are detrimental to the agriculture sector's goals.

However, opportunities exist through innovative ICT solutions to address a number of these challenges. In recent past, the role that ICTs play in promoting innovation in the agricultural sector has been phenomenal and potentially transformative. Smallholder farmers, particularly women and youth involved in the sector, have a huge advantage when the right ICTs are induced into the agricultural value chain. The access to the right information at the right time gives them the capacity to make informed decisions that would improve their livelihoods, make agri-business more attractive and play a major role in ensuring food security.

The rapid growth of mobile voice and internet globally provides new avenues to share and access information. In Sudan, there are 29.5. million mobile subscriptions (86%); total tele-density (mobile and fixed) is 34%; 34% internet access in terms of households; and 19.1% broadband in terms of population with the fixed broadband connectivity being 3% while the mobile broadband connectivity comprised a significant 16%.

Digitization has provided the capability for convergence of these traditional network technologies and the emerging ones (e.g. Machine to Machine (M2M), Internet of Things (IoTs]) using information technology platforms (e.g. mobile apps, data analytics). These networks when combined with data

availability, required applications and the right enabling environment, can unleash the tremendous innovation potential of the Sudan agriculture sector.

The cross-sectoral nature of ICTs propels growth in other sectors that can be further leveraged by the Agriculture sector. Use of data gathering and data analysis by weather department can make micro insurance for the agriculture sector more efficient. The deployment of mobile banking and mobile money by the Telecom and Banking sector can significantly address financial and transactional challenges for the rural communities. The two combined can create a base for providing social safety net for people involved in agriculture sector activities. E-government services too can provide packages of services as well as guidelines critical for e-agriculture growth in the country.

While in many farming communities people in different farming system of Sudan still rely on feature phones, which offer mainly voice and text services, smartphone access are becoming affordable and their use is increasing. Social media platforms such as Facebook, WhatsApp, Twitter, etc., are becoming services of common use. The rapid growth of broadband, especially mobile broadband provides a great opportunity for the agricultural sector. Also, access to Internet at the telecentres with guided assistance can significantly improve livelihoods and reduce human work intervention to the minimum. With added banking services, the potential is manifold.

In terms of service capabilities offered by ICTs, new technologies pave the way to advance the services from 'push' (e.g. radio, television, SMS) and 'interactive' services (e.g. Government to Customer(G2C) services, interactive website) further on to transactional (e.g. mobile payments, banking services, payment platforms) and finally connected services. (e.g. a network of sensors and databases integrated over secure platforms monitoring and offering services on various devices and providing timely, accurate and real-time information). Transactional capabilities are the key to linking revenue to services being offered over ICT platforms.

More specifically, e- agriculture has the potential to meet the agricultural goals of Sudan by contributing in the following areas:

- Improving national agricultural research systems.
- Improving National Agricultural Information Systems within the framework of the impact chain.
- Facilitating trade and domestic market access.
- Improving agricultural extension and advisory services.
- Promoting sustainable farming practices.
- Improving postharvest handling and logistics.
- Enhancing disaster management and early warning systems.
- Facilitating financial inclusion, credit, insurance and risk management schemes.
- Advising policies and monitoring effective implementation.
- Improving data availability and analysis for food safety and traceability.
- Enhancing linkage between government, researchers and producers which in turn facilitates effective policies.
- Improving farmers' incomes and productivity on a sustainable basis.
- Enhancing knowledge management and access to information.
- Improve Forest Governance
- Using ICT for Remote Sensing, Crowdsourcing, and Big Data to Unlock the Potential of Agricultural Data
- Using ICT for Land Administration and Management

The agriculture sector forms the centre stage in the Sudan's development agenda with about 70% of population engaged in agriculture. It is an essential pillar for rural development. The country also has a vibrant ICT sector with some e-agriculture solutions in place or in pipeline, and is very keen on harnessing its potential. The wide adoption and awareness of ICTs in Sudan not only in agriculture but

also in other critical areas such as telecom, banking, e-governance etc. provides transformative potential for agriculture stakeholders to leverage upon. It is also characterized by significant roles played by individuals, public enterprises, private sector, and international development and donor agencies. A vision for ICT deployment in this sector, therefore, needs to build upon the development across multiple sectors while recognizing the varying expectations and roles of different types of stakeholders.

The ICT in Agriculture (updated version 2016) and the FAO-ITU framework for development of e-agriculture vision entails establishment of an e-agriculture Steering Committee and Task Force;

- Understanding the national agriculture goals, priorities and challenges;
- Development of an initial e-agriculture vision;
- Detailing the e-agriculture outcomes to meet the vision; □
- Analysing the ICT solutions that can realize the outcomes; and □
- Refining and finalizing the e-agriculture vision and outcomes.

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

A national approach will also help improve the coordinated planning and funding of e-agriculture solutions/service development, avoid duplication and the waste of resources. ICT for agriculture projects are sometimes duplicated in different ministries, agencies as well as service providers targeting the same stakeholders. Systematic effort in planning and setting up a national e-agriculture approach allows for a streamlining of government efforts, ensuring the judicious use of scarce resources while providing a clear direction to the private sector, donors and other stakeholders.

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

The work on e-agriculture strategy started in 2014, where initial issues and challenges were identified. In August 2017, the Ministry of Agriculture and Forestry in Collaboration with FAO RNE Office and support from National Information Centre and National Telecommunications Corporation organized a one-day expert workshop to launch the work of development of the National E-agriculture Strategy. In October 2017, the Ministry of Agriculture and Forestry in Collaboration with FAO and CARDNE organized a three-day experts workshop on the “role of ICT in Agriculture: current and future prospects”. The two workshops and series of meetings done by the e-agriculture governance framework in Sudan that been established comprised of a Leadership Committee, a Steering Committee and a Task Force, discuss issues related to lesson learned, succeed stories and good practice e-solutions in agricultural and rural development, food security, value chains, markets and marketing, finance that related to development of the National E-agriculture Strategy.

These Key stakeholders, from the policy makers, public and private sectors, identified issues and challenges pertaining to the agriculture sector in Sudan and the result of the brainstorming, were identified under these following 8 categories:

- Policies, guidelines and regulatory frameworks
- Resource constraints

- Value chain, farm inputs and logistics
- Natural resource management and climate change
- Marketing and financing
- Data availability, accessibility and reliability
- Knowledge, information and awareness
- Lack of services

### 3. SUDAN AGRICULTURAL SECTOR CHALLENGES:

|           |   |
|-----------|---|
| <b>A.</b> | <b>Policies, guidelines and regulatory frameworks</b>                               |
| 1         | Lack of a consistent and long term national agricultural policy                     |
| 2         | Lack of a comprehensive national agricultural production plan (presently available) |
| 3         | No adequate/suitable subsidy schemes  |
| 4         | Lack of clear ICT policy for agriculture information dissemination                  |
| 5         | No proper value chain certification scheme (e.g. quality seeds, planting material)  |
| 6         | Lack of schemes for seed industry development                                       |
| 7         | Inadequate framework for land use and development                                   |
| 8         | No certified price (minimum guarantee price) for agricultural products              |
| 9         | Inadequate enforcement measures on biodiversity                                     |
| 10        | Inadequate enforcement of Soil Conservation Act                                     |
| 11        | Inadequate enforcement of Pesticide Act   |
| 12        | Inadequate enforcement of Land Rights   |
| 13        | Inadequate enforcement of other legal frameworks                                    |
| 14        | Inadequate enforcement for quality control of agriculture products                  |
| 15        | Inadequate enforcement measures on plant protection                                 |
| 16        | Inadequate framework for IPR on plant variety                                       |
| 17        | Inadequate legal framework for seed transfer, quality etc.                          |
| <b>B.</b> | <b>Resource constraints</b>   |
| 18        | Lack of coordination and integration among the related organizations                |
| 19        | Inadequate finance, human resources & infrastructure                                |
| 20        | Slow process of research and development  |
| 21        | Inadequacy of subject matter specialists and research staff                         |
| 22        | Insufficient opportunities for capacity building of public servants                 |
| 23        | Inadequacy of extension and surveillance staff                                      |
| 24        | Unavailability of resources to implement, maintain and update databases             |
| <b>C.</b> | <b>Value chain, farm inputs and logistics</b>                                       |
| 25        | High involvement of middlemen   |
| 26        | No value addition on farm and off farm  |
| 27        | Post-harvest losses   |
| 28        | Insufficient supply of agricultural inputs  |
| 29        | Lack of improved varieties  |
| 30        | Poor genetic diversity of crop varieties (Germ plasm)                               |
| 31        | Poor product quality at harvesting  |
| 32        | Lack of suitable machineries / mechanizations                                       |

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| 33        | High cost for labor   |
| 34        | Lack of safe / quality agro-chemicals   |
| 35        | Lack of facilities post-harvest (pack houses, packing material, certified farm fields, cold storage etc.) |
| 36        | Inadequate infrastructure (transport, road)   |
| 37        | Lack of telecom network infrastructure  |
| 38        | Seasonality of production   |
| 39        | Overproduction and off seasonal production  |
| <b>D.</b> | <b>Natural Resource Management and Climate Change</b>   |
| 40        | Underutilization of agricultural land   |
| 41        | Soil degradation / poor soil conservation   |
| 42        | Water pollution   |
| 43        | Climate change impact   |
| 44        | Natural disasters   |
| 45        | Lack of irrigation water  |
| 46        | Environmental hazards   |
| 47        | Threat of desertification   |
| 48        | Poor management of agricultural and animal waste  |
| 49        | Extreme weather events and biotic and abiotic stresses (Climate change unpreparedness)                    |
| 50        | Poor water management/ Silt depositions/ water conservation   |
| 51        | Low productivity of land  |
| <b>E.</b> | <b>Marketing and financing</b>  |
| 52        | Inadequate marketing, unavailability of facilities  |
| 53        | Pricing discovery / behavior  |
| 54        | Lack of proper market access (strategies, channels etc.) for farmers                                      |
| 55        | Improving insurance schemes   |
| 56        | Market demand, supply and consumer requirements   |
| 57        | Credit and loan availability  |
| 58        | Lack of information on buyers and producers   |
| 59        | Lack of international branding (e.g. Ceylon) for local products   |
| 60        | Lack of Geographic Indicators (GI) branding for products from Sudan                                       |
| <b>F.</b> | <b>Data availability, accessibility and reliability</b>   |
| 61        | Inadequate real-time data on pesticides, Maximum Residue Limit (MRL)                                      |
| 62        | Inadequate real-time data of food production in the country   |
| 63        | Inadequate real-time data on food demand  |
| 64        | Inadequate real-time data on land availability and land use   |
| 65        | Inadequate real-time data on agro-meteorology   |
| 66        | Lack of agriculture information sharing amongst stakeholders  |
| 67        | Unreliability of data   |
| 68        | Lack of inventory on biodiversity information   |
| 69        | Inadequate data storage, forecasting and analytical framework   |
| 70        | Inadequate availability of data for insurance schemes   |
| 71        | Inadequate data for land use  |
| 72        | Inadequate data for seed and plant demand   |



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| <b>G.</b> | <b>Knowledge, information and awareness</b>  |
| 73        | Lack of real-time information on pest population and disease                         |
| 74        | Inadequate information dissemination on pests and disease                            |
| 75        | Diagnosis of pests and diseases, and early response                                  |
| 76        | Public awareness program   |
| 77        | Poor mechanisms for technology dissemination   |
| 78        | Farmer attitudes (awareness on new schemes, technology adoption etc.)                |
| 79        | Lack of knowledge on international market standards                                  |
| 80        | Lack of public awareness on quality standard   |
| 81        | Poor access to Good Agricultural Practices (GAP) and organic certification standards |
| 82        | Lack of awareness on safe crop husbandry (Green houses, poly tunnels)                |
| 83        | Overuse of inorganic fertilizer and abuse of chemicals                               |
| 84        | Non-compliance to Government / institutional recommendations                         |
| 85        | Food habits of the general public  |
| 86        | Lack of collective approach in farmer community                                      |
| 87        | Lack of knowledge on climactic change  |
| 88        | Youth moving away from agriculture   |
| 89        | Lack of information and awareness on financial and insurance schemes                 |
| 90        | Inadequate linkages between researchers, extension system and farmers                |
| 91        | Improve education on agriculture at school and university level                      |
| <b>H.</b> | <b>Lack of services</b>  |
| 92        | Need efficient emergency advisory services   |
| 93        | Poor weather forecasting system  |
| 94        | No proper risk management system   |
| 95        | Need efficient quarantine and taxonomic facility                                     |
| 96        | No traceability mechanism for pesticide misuse                                       |
| 97        | Poor status of IT applications for agriculture                                       |

#### 4. POROPSED AND EXISTING E-SOLUTIONS

E-agriculture Strategy would be built on the existing solutions developed through Field/Regular Programs/Projects. Some of the potential applications of ICTs that could be considered to improve existing agriculture system information collection, efficiencies and services in Sudan include:

- **Mobile based integrated agriculture advisory service:** An integrated ICT approach is required to streamline and strengthen agriculture extension and advisory services including call centers, SMS service (push and pull), field problems diagnostic tools, field visits of extension staff, experts' consultancies and progress monitoring.
- **Food crop forecasting and marketing information service:** Real time information system for cultivation extent and yield forecasting is an urgent need to monitor the progress of National Food Crop Production Program. This information is also important to strengthen the value chain in agriculture to avoid over production or scarcity of food crop production in the country.

- **Pesticide registration and pesticide information e-service:** Registration, marketing and use of pesticides are governed by the Pesticide Registration Act and implemented by the Office of Registrar of Pesticides of the DOA. Pesticide testing and registration process can be monitored through an information system, which may increase awareness to pesticide companies, administrators and policy makers. Pesticide recommendations with relevant information can be transferred through an e-service.
- **Plant protection e-service:** Pest and disease diagnostic tools can be introduced as mobile and web based applications. This may reduce the over use of pesticides and promote Integrated Pest Management Methodologies.
- **Research information management system:** Agriculture Research Corporation Policy compiles information collected from research institutions, but there is a need to establish full-fledged information system that enables research information to be shared among scientist and provides an access to online repository.
- **Soil test results e-service:** Agricultural stations provide soil-testing facilities to farmers. All results are given manually and processes can't be monitored. Web based and mobile based information system can provide e-service for soil testing results as well as enable tracking progress.
- **E-agriculture library service:** IMMCDs, video on demand, bibliography service will be effective through an IT solution. E-learning mechanism could also be introduced through this system.
- **Natural resources management information services:** Natural resource management centre of the Ministry will implements Soil Conservation Act and Regulations. Access to e-applications and e-reports related to the regulations should be available online. Access to soil and weather information for different agro climatic zones can also be made possible through IT solution.
- **Plant genetic resources information service:** Ministry has one of most important plant genetic resource centre and information related to conservation could be made available online.
- **Agriculture diploma students' information system:** Ministry will conduct agriculture diploma course at agriculture schools, which can be made available online to students. At the same time, e-learning mechanism could be introduced to strengthen the agriculture education in the country.
- **Plant quarantine e-service:** National Plant Quarantine Service (NPQS) of the Ministry is authorized to implement plant quarantine regulations under the Plant Protection Act. The plant quarantine offices have been located at the major seaport and airports. Imports and exports at those locations are under control of the Custom Authority which plans to introduce a single window platform. NPQS involves in issuing phytosanitary certificates to exporters as well as for searching pest and disease risk in importing agriculture living material. There is a need for an information system to monitor all plant quarantine activities at the seaport and airport.
- **Weather forecasting and advisory service:** As climate change has adversely affected agriculture sector, daily weather forecasting and advisory service (especially location specific services) will be very useful to farmers. Such a system could be implemented as a joint program of the Natural Resource Management Centre of the DOA and the Meteorological Department.
- **Land use and soil conservation mapping and e-information system:** Land development and soil conservation has been identified as crucial factors of agriculture in the country and such information system may help all stakeholders in agriculture in improving the land information and use.
- **Geo-spatial information service:** Establishment of geo-spatial information service will help the Department of Agriculture, the Ministry of Agriculture and other stakeholders, to take correct decisions based on real time information. It would also empower the current crop insurance scheme.
- **Farm Machinery e-information service:** Farm mechanization is a high priority in accordance with the present National Food Production Program. Proper ICT solution may increase the production, distribution and use of farm machineries.
- National Agricultural Investment Mapping System
- National Agricultural Research Information Management System – Agricultural Research for Development Network
- Virtual Extension and Research Communication Network - VERCON

- Rural Development Communication Network - RADCON
- Horticulture Information Support Network
- Desert Locust Information System
- Avian-Diseases Monitoring and Awareness Network - Digital Early Warning System for Control of Poultry Diseases in Sudan
- Anima-Diseases Monitoring and Awareness Network - Digital Early Warning System for Control of Animal Diseases in Sudan

### Existing E-Solutions

- **National E-agricultural Solutions Systems Portal:** It is planned to be available in <http://e-agriculture.sd> as agreed with the Director of the National ICT Centre. It is available now at the following address: <http://e-agriculture.sudanagriculture.net> – E-Agriculture Core System
- Food Security Information System - Sudan  
<http://fsis.sd> – Food Security Information System/Network
- Health and Nutrition Information System - Sudan  
<http://hnis.sudanagriculture.net> – Health and Nutrition Information System/Network
- Plant Genetic Resources Knowledge Network - Sudan  
<http://sudan.plantgenetic.com/> - Plant Genetic Resources Knowledge Network

The Sudan E-agriculture Strategy and Action Plan was built on SUDNAIP 2016-2020 and follow the same process aiming at harnessing the ICT potential of Sudan in achieving its agricultural goals. This strategy was developed following the framework proposed by the FAO-ITU E-agriculture Strategy Guide.

The E-agriculture governance framework in Sudan was established to comprise of National ICT Steering Committee, National ICT Technical Committee and Task Force to admin the Ministry of Agriculture network ([moaf.gov.sd](http://moaf.gov.sd)) and e-agriculture Portal ([e-agriculture.sd](http://e-agriculture.sd)).

An e-agriculture task force was set up in Sudan comprising of members from various departments of the Ministry of Agriculture (MOA) and the Telecommunications Corporation Commission of Sudan. Other critical stakeholders from Departments of Ministry of Agriculture, Information and Communication Centre were also consulted during the process. Technical assistance was provided by the FAO office in Sudan together with the FAO RNE and ITU Regional office in the development of this strategy.

## 5. SUDAN E-AGRICULTURE VISION

Innovations in ICT is happening at a very fast pace and this document has captured the effects of future disruptive technologies and recommends roadmap for adoption and evolution of current ICT initiatives, to be relevant and useful in future. The cross-sectoral nature of agriculture as well as ICTs requires formal mechanisms for collaboration amongst critical stakeholders. A leadership committee, steering committee and task force structure team has been established to guide the implementation.

ICTs form an important pillar to address agricultural challenges and facilitate meeting national agricultural goals. As a first step, developing an e-agriculture vision would provide a strategic direction to the desired outcomes. E-solutions can then be adopted to achieve these outcomes.

Recognizing the transformative potential of ICTs in the agriculture sector, the e-agriculture vision for Sudan is **aims to address the challenges and in doing so envision achieving “*Excellence in adopting e-solutions to transform agriculture for national prosperity capable of rapid and sustainable growth, inclusive of smallholders and with strong linkages to agricultural industrialization.*”**

Although the adoption of e-solutions is an ongoing activity, the current **action plans** are set for a timeline of **2022**. The vision embodies the strategy to accelerate the growth of the agriculture sector, increase production and reduce imports, reduce the demand and supply gap of food produce and consumption,

improve the quality and safety of food and improve livelihoods more effectively. The expected outcomes are detailed in the subsequent section.

It specifies a set of e-agriculture outcomes and makes the following strategic objectives:

- Increase the availability and accuracy of agricultural information by creating, updating, analyzing and linking critical databases.
- Develop accessible, affordable and secure ICT platforms, networks and devices with enhanced sensing, hosting, analytical, identification, tracking and communicating features.
- Improve the awareness, education and skills of farmers, extension staff, livestock herders and other sector end-users by creating and disseminating credible agricultural knowledge remotely.
- Reduce the demand-supply gap, and enhance outreach and profitability of Sudan products and services through vibrant e-agriculture market places and efficient logistics.
- Improve the research capability, quality, credibility and reach of extension advisory using ICTs.
- Promote innovation in e-agriculture services.
- Reduce the individual risks of agriculture sector stakeholders
- Improve the financing, investing and banking outreach to agriculture sector leveraging on electronic and mobile technologies.
- Improve the existing framework of policies, legislations, regulations and guidelines critical for e-agriculture and ensure its effectiveness implementation.

To realize these outcomes, and implement the strategic recommendations, a set of ICT solutions were identified and an action plan for 2018-2022 was developed. The action plan is envisioned to be implemented in three phases. A detailed monitoring and evaluation (M&E) plan would need to be developed after adoption of the strategy for the expected outcomes and the action plan for each phase.

The E-Agriculture strategy provides users with a fairly comprehensive overview of current and upcoming ICT-in-agriculture applications and how they might improve agricultural interventions or programs. Its min modules that are intended to serve as a practical resource for development professionals seeking a better understanding of the opportunities and existing applications offered by ICT as tools for agricultural development. Overall, each module seeks to provide guidance in the following areas:

- Providing a landscape of existing ICT applications that assesses applications in their local context.
- Understanding current trends in ICT as they pertain to agriculture and the contributions that ICT can make to enhance agricultural strategies and their implementation.
- Designing, implementing, and evaluating appropriate and sustainable ICT components of agricultural projects.
- Building effective partnerships—public and private—to promote ICT access and innovation for agriculture.
- Including ICT in policy dialogue and planning with country counterparts on agricultural and rural development goals and priorities.

#### **Themes and Solutions Treated in E-Agriculture Strategy**

| <b>Opportunities, access, and crosscutting themes</b>  | <b>Enhancing Productivity On the farm</b>  | <b>Accessing markets And value chains</b>  | <b>Improving public service Provision</b>  |
|--|--|--|--|
| <ul style="list-style-type: none"> <li>• Access and affordability</li> <li>• Mobile applications</li> <li>• Gender and ICT services</li> </ul> | <ul style="list-style-type: none"> <li>• Increasing productivity</li> <li>• Agriculture innovation systems</li> <li>• Rural finance</li> <li>• Farmer organizations</li> </ul> | <ul style="list-style-type: none"> <li>• Market and price information</li> <li>• Supply chain management</li> <li>• Risk management</li> <li>• Traceability and food safety</li> </ul> | <ul style="list-style-type: none"> <li>• Rural governance</li> <li>• Land administration</li> <li>• Forest governance</li> </ul> |

## 6. E-AGRICULTURE EXPECTED OUTCOMES

Effective deployment of ICTs in agriculture by **2022** would make a transformative impact on the sector in Sudan. It is expected to deliver the following e-agriculture outcomes through a number of ICT solutions (or e-Solutions):

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

It is important that the vision and outcomes are actionable and can be realized through feasible solutions. These outcomes should realize the expected transformation that ICTs could bring about in the sector. The expected changes that ICT solutions should make to realize these outcomes and the vision and the feasibility of each solution were discussed. A monitoring and evaluation framework for these outcomes would help report on the progress.

## 7. ICT PROGRAMMATIC AREAS

In order to meet the expected outcomes of E-Agriculture and realize the vision, the following ICT Programmatic Areas are important.

### **ICT Programme Area 1: Increase the availability and accuracy of agricultural information by creating, updating, analyzing and linking critical databases:**

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

### **ICT Programme Area 2: Accessible, affordable and secure ICT platforms, networks and devices with enhanced sensing, hosting, analytical, identification, tracking and communicating features:**

- Ensure universal access to affordable broadband and low-cost smartphones. Although, a number of services can also be launched over feature phones, the full potential of ICTs requires capability to share multimedia;
- A secure digital application platform for e-agriculture should be established (or used if existing) for delivery of services and sharing of information with government and non-government entities;
- Integration of databases with application platform and transactional capability is very important to unleash the growth of government and third-party services;

- Make accurate information available in real time or near real time for the sector leveraging on smart sensing technologies and integration of required databases;
- Enhance the sensing capabilities of agriculture and associated services using modern technologies (e.g. satellite, drones, Internet of Things (IOTs)) and systematically integrate into database;
- Effective monitoring of agriculture sector using ICTs;
- Strengthening tracking and traceability framework nationwide;
- Need to harness the big data generated in the agriculture sector by deploying effective analytics systems and capabilities; and
- Strengthen the existing call centres capabilities in scope and quality

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

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

**ICT Programme Areas 4: Reduce the demand-supply gap, and enhance outreach and profitability of Sudan products and services through vibrant e-agriculture market places and efficient logistics:**

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

**ICT Programme Areas 5: Improve the research capability, quality, credibility and reach of extension advisory using ICTs:**

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

**ICT Programme Areas 6: Promote innovation in e-agriculture services:**

Given the emphasis of e-agriculture in Sudan, a dedicated centre for such services could be considered. This centre can be hosted by the Department of agriculture and focus on

- Development of applications to deliver priority e-agriculture services;
- Development of the ecosystem for innovative e- agriculture services;
- Strengthen the call centre services and extend its scope to all e-agriculture services;
- Enhance the efficiency and sustainability of existing e-agriculture services;
- Develop a framework for service delivery by private sector using digital platform;
- Provide hosting for private sector application and services and serve as a one stop shop for e-agriculture services. The detailed scope, however, would need to be developed;
- The consumer protection framework and language remain a bottleneck for developing trust around use of ICTs in agriculture. It is recommended to build a consumer protection system in consultation with public and private sector entities involved in e-agriculture services; and
- Encourage universities and academia to strengthen research and capability to develop applications and services. Facilitate availability of timely data and platform for development and delivery of these services.

**ICT Programme Areas 7: Reduce the individual risks of agriculture sector stakeholders**

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

**ICT Programme Areas 8: Improve the financing, investing and banking outreach to agriculture sector leveraging on electronic and mobile technologies:**

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

**ICT Programme Areas 9: Improve the existing framework of policies, legislations, regulations and guidelines critical for e-agriculture and ensure its effective implementation:**

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

**8. NATIONAL E-AGRICULTURE ACTION PLAN AND ICT SOLUTIONS**

E-agriculture solutions were discussed as part of the strategy development exercise and the team arrived at forty-nine (49) possible e-agriculture solutions were identified for forty-nine outputs (solutions) in the context of Sudan.

The E-agriculture action plan would enable the government to:

- Identify all components of e-agriculture expected outcomes, how they should be governed, funded, implemented and coordinated to ensure that results are achieved at a national, state and local level;
- Identify key stakeholders and engage with them effectively in designing, implementing and sustaining the activities; and
- Prioritize the activities in implementation phases to achieve tangible outcomes.

The challenges of the agriculture sector were discussed by the expert group and possible solutions were identified. ICT does not have similar impact on all agriculture challenges and to gauge the impact of ICT solution on each challenge a detailed analysis was carried out taking into account solutions that must, should, could or would be developed. When reclassified on the basis of solutions, 48 independent ICT solutions were identified and briefly described. Each of these could address one or more challenges and would have an impact on one or more than one e-agriculture outcome.

**Table below:** List of identified solutions and their brief description

|    | <b>Name of solution</b>   | <b>Brief description</b>  |
|----|---|---|
| 1  | Integrated natural resource management information system                                       | Information system that includes GIS data (incl. high resolution satellite image) and other information on land use / land cover / land degradation, Soil map/ land fertility, forest resource use, Geo portal and geo morphology, Irrigation and water management, Bio-diversity, invasive alien species, Disaster management, weather forecasting, fire history and forest preservation.  |
| 2  | Social network amongst agriculture users  | To create a network of agriculture sector stakeholders including (producers, marketers, extension workers, policy makers etc.) to distribute information (informal) and enhanced engagement.  |
| 3  | Credible GAP content aggregation and packaging  | Creation of agriculture content, which is packaged for various dissemination medium (video, audio, website, text) or could be repurposed for capacity building.   |
| 4  | E-agriculture advisory services (with possible consumer protection)                             | Advisory services offered by extension workers, consultants, researchers in country or abroad through electronic media (phone, Internet, email, video chat), face to face meetings or paper reports. Recognizing that the lack of credibility may deter agriculturists to deploy good agricultural practices, credible advisory services with consumer protection can be created. These can be paid or reused and would complement availability of content in open mode. The dissemination can be through computers, telecom, Internet or broadcasting network. |
| 5  | Capacity development and education using ICT  | Use of videos, audios, texts, brochures on good agricultural practices and their dissemination through web based, mobile based, print or broadcasting networks. Using multimedia tools to build skills and offer distance education. It also includes vocational and skill based courses.   |
| 6  | Smart water management  | Deployment of sensors, GIS maps to manage information around water and manage their smart utilization. Knowledge sharing, access to weather data online, geo-referenced (map) water source identification (ground water, river, etc.) and sub-surface moisture sensors.   |
| 7  | E-market place for agriculture  | Creation of e/m-market place, market information and scalable payment systems for national and international trade, promotion and awareness raising on use of e/m-services.   |
| 8  | Logistics (storage and transport) information linking agriculture service providers and markets | Creation of database of storage and transportation service providers with information management, tracking and payment capability   |
| 9  | Certified higher yielding seeds/ planting/ breeding materials verification and traceability     | Database with web interface (barcoded) to verify the authenticity of seeds  |
| 10 | Online Agriculture workforce information and services   | Creation of an online workforce (skilled and non-skilled) requirement and availability information system.  |



|    |   |   |
|----|---|---|
| 11 | Agromet data and services   | Online availability of weather and other climate data, forecasting, and knowledge base.   |
| 12 | Agriculture Early warning system  | Early warning systems for agriculture stakeholders against disasters and hazards alert and response system, integration with disaster management  |
| 13 | Information on climate smart technologies and Climate resilient crops & breeds  | Information, access to training on climate smart agricultural practices, and new technologies   |
| 14 | GIS animals' movement (e-animal surveillance), Area mapping of animals' crop damage/prone, Online system for animal conflict management, animals cyber tracking and alert | Traps, trackers, sensors with capability to inform on animals' movement   |
| 15 | Online compensation for affected crop and livestock   | Database of livestock with capability of remote verification and online compensation  |
| 16 | Electronic Pest surveillance system   | Pest online database with historic vector linked with crop lifecycle, climate data, video based verification, remote compensation and GIS maps. Pests and pest management online database, advisories and knowledge sharing |
| 17 | Online food quality and safety verification and bio-safety monitoring   | Online monitoring of food quality and bio-safety  |
| 18 | Online information on offseason crop production technology package  | Information, access to training on offseason crop production.   |
| 19 | Accessible information resources on government policies and guidelines  | Information and access to government policies and guidelines.   |
| 20 | Farm mechanization information and service  | Creation of online machine and equipment information system linked with market machine availability and rentals.  |
| 21 | Information on enabling environment and agri-business opportunities   | Information on investment opportunities for entrepreneurs and international investors, buyers and suppliers   |
| 22 | Electronic banking and payment  | Creation of banking facilities for all using electronic / mobile banking.   |
| 23 | Credit rating and loan availability   | Create a credit management system that makes credits available using simplified procedure and online verification. A credit rating mechanism can also be developed.   |
| 24 | Linking research institutes with industry, extensions, producers and other stakeholders   | linking research institutes with extensions, producers and agriculturists for anytime anywhere learning, certification or business etc.   |

|    |  |   |
|----|--|---|
| 25 | Setting up / strengthening of IVR systems  | A system to provide voice based services  |
| 26 | Policy guidelines and support to agri. insurance providing companies                   | Guidelines to enable micro-insurance, field database, disaster and compensation.                                |
| 27 | Monitoring of groups / cooperatives through online systems                             | Creation of database, linking of database, registration and monitoring processes.                               |
| 28 | E-agriculture extension monitoring   | Creation of monitoring feedback and extension service request and complaint redressal.                          |
| 29 | Traceability and DNA coding of prioritized species                                     | DNA bar coding of wildlife & plants and tracking at checkpoints.  |
| 30 | Information on fertilizer history by land area   | An application to provide history of fertilizer use in the land area.   |
| 31 | Universal mobile broadband connectivity, deployment of low cost mobile phones, tablets | 3G, 4G connectivity with tablets and broadband services.  |
| 32 | Interoperable and secure e/m-agriculture applications platform with content            | An integrated application platform interoperable with e-government services for E-agriculture service delivery. |
| 33 | Integrate e-agriculture services with G2C  | Service integration of e-government and e-agriculture services including security, interoperability.            |
| 34 | Remote video based surveillance  | A solution to carry out remote video based information capture and remote surveillance.                         |
| 35 | ICT policy on data sharing, data classification, data formats, secure e-documents      | Policy and guidelines on data formats, data classification, implementation                                      |
| 36 | E/M App for certification standard, compliance and traceability                        | Electronic /Mobile Applications for certification standard, compliance and traceability.                        |
| 37 | Monitoring of compliance to government policies, guidelines                            | Systems for monitoring of compliance to government policies, guidelines.  |
| 38 | Database of approved chemicals, fertilizers  | Database of approved chemicals, fertilizers.  |
| 39 | Traceability of agro-chemical movement through value chain                             | Traceability of agro-chemical movement through value chain.   |
| 40 | Climate change modeling  | Estimating the impact of climactic parameters (change) on crop, fisheries and livestock productivity.           |
| 41 | Commodity outlook modeling   | Forecasting future demand and supply of specific commodity.   |

|    |   |  |
|----|---|--|
| 42 | Data capture and analytical tool  | Data capture and analytical tool to syndicate demand from farmers.   |
| 43 | Nutrition sensitive agriculture content   | Information on linkage between food nutrition and health and promoting indigenous nutrition diets  |
| 44 | Plant genetic resource database   | Information on plant genetic resources at the Plant genetic resource centre  |
| 45 | Global plan of action for plant genetic resources-information sharing mechanism | Information on conservation, utilization and capacity building on PGR in the country   |
| 46 | Central database of research programmes and new technologies                    | Repository of research findings/abstracts and information on on-going research programs to find and analyses the present and past research titles/findings toward designing appropriate research for the benefit of farmers and the country  |
| 47 | Central database of agriculture statistics                                      | Reliable data collection and updating mechanism with compliance to national data from census and statistic department  |
| 48 | Database for seed and planting material   | Planning seed and planting material production public and private both to meet the farmers/country need, monitoring the progress of the production programs, forecasting the seed and planting material production, making awareness and access to the information on available seed and planting materiel stocks. |

**9. E-AGRICULTURE ACTION PLAN PRIORITIES FOR THE PERIOD 2016-2022**

|    | Name of e-agriculture solution   | Impact                               | Exists | Dependency | Feasibility | MUST<br>SHOULD<br>WOULD<br>COULD | 2018 | 2019 | 2020 | 2021 | 2022 |
|----|--|--------------------------------------|--------|------------|-------------|----------------------------------|------|------|------|------|------|
|    |  | <b>High (H), Medium (M), Low (L)</b> |        |            |             |                                  |      |      |      |      |      |
| 1  | Integrated natural resource management information system                              | H                                    | L      | H          | L           | <b>MUST</b>                      |      |      |      |      |      |
| 2  | Social network amongst agriculture users   | M                                    | H      | H          | H           | <b>MUST</b>                      |      |      |      |      |      |
| 3  | E-Agriculture advisory services (with possible consumer protection)                    | H                                    | M      | H          | M           | <b>MUST</b>                      |      |      |      |      |      |
| 4  | Capacity development and education using ICT   | H                                    | L      | H          | M           | <b>MUST</b>                      |      |      |      |      |      |
| 5  | E-market place for agriculture   | H                                    | L      | H          | H           | <b>MUST</b>                      |      |      |      |      |      |
| 6  | Agromet data and services  | H                                    | M      | H          | M           | <b>MUST</b>                      |      |      |      |      |      |
| 7  | Accessible information resources on government policies and guidelines                 | H                                    | H      | H          | H           | <b>MUST</b>                      |      |      |      |      |      |
| 8  | Electronic banking and payment   | H                                    | M      | H          | H           | <b>MUST</b>                      |      |      |      |      |      |
| 9  | Credit rating and loan availability  | M                                    | M      | H          | H           | <b>MUST</b>                      |      |      |      |      |      |
| 10 | Setting up / strengthening of IVR systems  | H                                    | H      | M          | H           | <b>MUST</b>                      |      |      |      |      |      |
| 11 | E-Agriculture extension monitoring   | H                                    | L      | H          | M           | <b>MUST</b>                      |      |      |      |      |      |
| 12 | Universal mobile broadband connectivity, deployment of low cost mobile phones, tablets | H                                    | M      | H          | M           | <b>MUST</b>                      |      |      |      |      |      |
| 13 | Integrate e-Agriculture services with G2C  | H                                    | M      | H          | H           | <b>MUST</b>                      |      |      |      |      |      |

|    |   |   |   |   |   |               |  |  |  |  |  |
|----|---|---|---|---|---|---------------|--|--|--|--|--|
| 14 | ICT policy on data sharing, data classification, data formats, secure e-documents               | H | L | H | H | <b>MUST</b>   |  |  |  |  |  |
| 15 | Database of approved chemicals, fertilizers   | H | H | M | H | <b>MUST</b>   |  |  |  |  |  |
| 16 | Data capture and analytical tool  | H | L | H | L | <b>MUST</b>   |  |  |  |  |  |
| 17 | Plant genetic resource database   | M | H | M | H | <b>MUST</b>   |  |  |  |  |  |
| 18 | Global plan of action for plant genetic resources-information sharing mechanism                 | M | H | M | H | <b>MUST</b>   |  |  |  |  |  |
| 19 | Central database of research programme and new technologies                                     | H | L | M | H | <b>MUST</b>   |  |  |  |  |  |
| 20 | Database for seed and planting material   | H | M | H | H | <b>MUST</b>   |  |  |  |  |  |
| 21 | Interoperable and secure e/m agriculture applications platform with content                     | H | L | H | M | <b>MUST</b>   |  |  |  |  |  |
| 22 | E/M App for certification standard, compliance and traceability                                 | H | L | M | M | <b>MUST</b>   |  |  |  |  |  |
| 23 | Commodity outlook modeling  | H | L | H | H | <b>MUST</b>   |  |  |  |  |  |
| 24 | Central database of agriculture statistics  | H | M | H | H | <b>MUST</b>   |  |  |  |  |  |
| 25 | Credible GAP content aggregation and packaging  | H | L | L | M | <b>SHOULD</b> |  |  |  |  |  |
| 26 | Logistics (storage and transport) information linking agriculture service providers and markets | H | L | M | M | <b>SHOULD</b> |  |  |  |  |  |
| 27 | Information on climate smart technologies and Climate resilient crops & breeds                  | M | L | H | M | <b>SHOULD</b> |  |  |  |  |  |

|    |  |   |   |   |   |        |  |  |  |  |  |
|----|--|---|---|---|---|--------|--|--|--|--|--|
| 28 | Farm mechanization information and service   | H | L | L | M | SHOULD |  |  |  |  |  |
| 29 | Information on enabling environment and agri-business opportunities                          | H | L | H | M | SHOULD |  |  |  |  |  |
| 30 | Policy guidelines and support to agri insurance providing companies                          | H | L | L | H | SHOULD |  |  |  |  |  |
| 31 | Nutrition sensitive agriculture content  | H | L | M | M | SHOULD |  |  |  |  |  |
| 32 | Agriculture Early warning system   | H | L | H | M | SHOULD |  |  |  |  |  |
| 33 | Online compensation for crop and livestock affected  | H | L | L | M | SHOULD |  |  |  |  |  |
| 34 | Electronic Pest surveillance system  | H | L | M | M | SHOULD |  |  |  |  |  |
| 35 | Online food quality and safety verification and bio-safety monitoring                        | H | L | M | M | SHOULD |  |  |  |  |  |
| 36 | Linking research institutes with industry, extensions, producers and other stakeholders      | H | M | H | M | SHOULD |  |  |  |  |  |
| 37 | Remote video based surveillance  | M | L | M | L | SHOULD |  |  |  |  |  |
| 38 | Monitoring of compliance to government policies, guidelines                                  | H | L | H | M | SHOULD |  |  |  |  |  |
| 39 | Traceability of agro-chemical movement through value chain                                   | H | L | M | L | SHOULD |  |  |  |  |  |
| 40 | Climate change modeling  | H | L | M | M | SHOULD |  |  |  |  |  |
| 41 | Online information on offseason crop production technology package                           | M | M | L | H | WOULD  |  |  |  |  |  |
| 42 | Smart water management   | H | L | M | L | WOULD  |  |  |  |  |  |
| 43 | Certified higher yielding seeds / planting/ breeding materials verification and traceability | M | L | M | M | WOULD  |  |  |  |  |  |

|    |   |   |   |   |   |       |  |  |  |  |  |
|----|---|---|---|---|---|-------|--|--|--|--|--|
| 44 | GIS animal's movement (e-animal surveillance), Area mapping of animal's crop damage/prone, Online system for animal conflict management, animals cyber tracking and alert | H | L | L | M | WOULD |  |  |  |  |  |
| 45 | Information on fertilizer history by land area  | M | L | M | M | WOULD |  |  |  |  |  |
| 46 | Online Agriculture workforce information and services   | M | L | L | L | COULD |  |  |  |  |  |
| 47 | Monitoring of groups / cooperatives through online systems  | M | L | L | M | COULD |  |  |  |  |  |
| 48 | Traceability and DNA bar coding of prioritized species  | L | L | M | M | COULD |  |  |  |  |  |

## 10. IMPLANTATIONS PHASES OF E-AGRICULTURE ACTION PLAN

The action plan is divided into three phases as implementing 48 solutions simultaneously is challenging both in terms of resources and management. The phases are classified in biennium (2-year periods).

Phase 1: 2018-2019

Phase 2: 2020-2021

Phase 3: 2022 onwards

### First phase (2018-2019)

The first phase focuses on strengthening existing services, the launch of high impact feasible services, preparing and linking databases, improving financing and risk mitigation solution, creating an enabling environment and the necessary guidelines for other solutions.

### Solutions that will be started in 2016-2017 and completed by 2017

| No. | Solution  | Priority | Start | End  |
|-----|---|----------|-------|------|
| 1   | Social network amongst agriculture users  | MUST     | 2018  | 2019 |
| 2   | E-Agriculture advisory services (with possible consumer protection)                             | MUST     | 2018  | 2019 |
| 3   | E-market place for agriculture  | MUST     | 2018  | 2019 |
| 4   | Agromet data and services   | MUST     | 2018  | 2018 |
| 5   | Accessible information resources on government policies and guidelines                          | MUST     | 2018  | 2018 |
| 6   | Electronic banking and payment  | MUST     | 2018  | 2019 |
| 7   | Credit rating and loan availability   | MUST     | 2018  | 2019 |
| 8   | Setting up / strengthening of IVR systems   | MUST     | 2018  | 2019 |
| 9   | ICT policy on data sharing, data classification, data formats, secure e-documents               | MUST     | 2018  | 2018 |
| 10  | Database of approved chemicals, fertilizers   | MUST     | 2018  | 2018 |
| 11  | Plant genetic resource database   | MUST     | 2018  | 2018 |
| 12  | Global plan of action for plant genetic resources-information sharing mechanism                 | MUST     | 2018  | 2016 |
| 13  | Central database of research programme and new technologies                                     | MUST     | 2018  | 2019 |
| 14  | Database for seed and planting material   | MUST     | 2018  | 2018 |
| 15  | Logistics (storage and transport) information linking agriculture service providers and markets | SHOULD   | 2018  | 2019 |
| 16  | Information on climate smart technologies and Climate resilient crops & breeds                  | SHOULD   | 2018  | 2019 |
| 17  | Farm mechanization information and service  | SHOULD   | 2018  | 2019 |
| 18  | Policy guidelines and support to agro-insurance providing companies                             | SHOULD   | 2018  | 2019 |
| 19  | Electronic Pest surveillance system   | SHOULD   | 2019  | 2019 |
| 20  | Climate change modeling   | SHOULD   | 2019  | 2019 |
| 21  | Online information on offseason crop production technology                                      | WOULD    | 2018  | 2019 |



This phase also starts laying the foundation for solutions that would be ongoing in nature or are required for solution in phase two and three. These include integrating natural resource management information, greater data capture and analysis systems, ensuring ubiquitous broadband ICT connectivity, development of application platforms, preparing content, developing agriculture early warning systems, and strengthening the monitoring and compliance mechanism etc.

**Activities that will be started in 2018 or 2019 and completed after 2019**

|    | <b>Solutions</b>  | <b>Priority</b> | <b>Start</b> | <b>End</b> |
|----|---|-----------------|--------------|------------|
| 1  | Integrated natural resource management information system                               | MUST            | 2018         | 2020       |
| 2  | Capacity development and education using ICT  | MUST            | 2018         | Ongoing    |
| 3  | E-Agriculture extension monitoring  | MUST            | 2018         | 2020       |
| 4  | Universal mobile broadband connectivity, deployment of low cost mobile phones, tablets  | MUST            | 2018         | 2020       |
| 5  | Integrate e-Agriculture services with G2C   | MUST            | 2018         | Ongoing    |
| 6  | Data capture and analytical tool  | MUST            | 2018         | Ongoing    |
| 7  | Interoperable and secure e/m-agriculture applications platform with content             | MUST            | 2019         | 2021       |
| 8  | E/M App for certification standard, compliance and traceability                         | MUST            | 2018         | 2020       |
| 9  | Central database of agriculture statistics  | MUST            | 2019         | Ongoing    |
| 10 | Credible GAP content aggregation and packaging  | SHOULD          | 2018         | Ongoing    |
| 11 | Information on enabling environment and agri-business opportunities                     | SHOULD          | 2018         | Ongoing    |
| 12 | Nutrition sensitive agriculture content   | SHOULD          | 2018         | 2020       |
| 13 | Agriculture Early warning system  | SHOULD          | 2019         | 2020       |
| 14 | Online compensation for crop and livestock affected                                     | SHOULD          | 2019         | 2020       |
| 15 | Linking research institutes with industry, extensions, producers and other stakeholders | SHOULD          | 2019         | 2020       |
| 16 | Monitoring of compliance to government policies, guidelines                             | SHOULD          | 2019         | 2021       |
| 17 | Traceability of agro-chemical movement through value chain                              | SHOULD          | 2018         | 2020       |
| 18 | Online Agriculture workforce information and services                                   | COULD           | 2019         | 2020       |

**Second phase (2020-2021)**

By the start of second phase, there would be visible changes in the use of ICTs in agriculture in terms of linked databases, greater content available online, near universal connectivity, better interoperability of data and services, development of mobile platform and deployment of mobile applications, significant ease of operations in financing and risk management, enhanced information availability and clarity on policy implementations and guidelines.

The second phase is characterized by take up of mobile application services, rise in connectivity, greater integration of databases, launch of innovative services, improved traceability and certification services, improved capability to develop advanced e-agriculture services, greater awareness and knowledge base, and greater confidence in use of ICT for risk management and financing.

Activities that will be started in 2018 or 2019 and completed by 2021

|   | <b>Solutions</b>  | <b>Priority</b> | <b>Start</b> | <b>End</b> |
|---|---|-----------------|--------------|------------|
| 1 | Commodity outlook modeling  | MUST            | 2019         | 2021       |
| 2 | Certified higher yielding seeds / planting/ breeding materials verification and traceability  | WOULD           | 2019         | 2021       |
| 3 | GIS animals' movement (e-animal surveillance), Area mapping of animals' crop damage/prone, Online system for animal conflict management, animals cyber tracking and alert | WOULD           | 2020         | 2021       |
| 4 | Information on fertilizer history by land area  | WOULD           | 2020         | 2020       |
| 5 | Traceability and DNA bar coding of prioritized species  | COULD           | 2020         | 2021       |

**Third phase (2020 +)**

By the start of third phase, the e-agriculture environment in Sudan would be fully matured with most of the priority solutions in place. This phase entails continued efforts in capacity development and education, data analysis, traceability, smart water management, effective monitoring and enhanced video based services.

Activities that will continue after 2019

|    | <b>Solutions</b>  | <b>Priority</b> | <b>Start</b> | <b>End</b> |
|----|---|-----------------|--------------|------------|
| 1  | Capacity development and education using ICT                          | MUST            | 2016         | Ongoing    |
| 2  | Integrate e-Agriculture services with G2C                             | MUST            | 2016         | Ongoing    |
| 3  | Data capture and analytical tool                                      | MUST            | 2016         | Ongoing    |
| 4  | Central database of agriculture statistics                            | MUST            | 2017         | Ongoing    |
| 5  | Credible GAP content aggregation and packaging                        | SHOULD          | 2016         | Ongoing    |
| 6  | Information on enabling environment and agri-business opportunities   | SHOULD          | 2016         | Ongoing    |
| 7  | Online food quality and safety verification and bio-safety monitoring | SHOULD          | 2018         | Ongoing    |
| 8  | Remote video based surveillance                                       | SHOULD          | 2018         | Ongoing    |
| 9  | Smart water management  | WOULD           | 2019         | Ongoing    |
| 10 | Monitoring of groups / cooperatives through online systems            | COULD           | 2020         | Ongoing    |

**11. E-AGRICULTURE BUDGET 2018-2022**

The costing and budgeting for the e-agriculture programme action plan areas was undertaken drawing on current and past realities of the Sudan. Financing and the speed of implementation of the e-agriculture action plan programme areas are evidence based, thus planned to avoid unrealistic expectations. This is critical given current resources constraints which are in turn related to some of the challenges facing Sudan that limit its ability to raise substantial revenues or have access to large foreign investment funding.

Following the identification of the Nine Programme Areas (IPAs) that will constitute the Action Plan strategic intervention, these IPAs will be divided into sub programs, and in turn the sub programs to be divided into components. For each component, specific quantitative output targets to be identified. The budget of the Action Plan will base on multiplying the targeted quantitative output of each sub component by the unit cost of each quantitative target to derive the total cost of the components and subsequently the total cost of the ICT programme areas below:

- ICT Programme Area 1: Increase the availability and accuracy of agricultural information by creating, updating, analyzing and linking critical databases;
- ICT Programme Area 2: Accessible, affordable and secure ICT platforms, networks and devices with enhanced sensing, hosting, analytical, identification, tracking and communicating features;
- ICT Programme Areas 3: Improve the awareness, education and skills of farmers, extension workers, livestock herders and other sector end-users by creating and disseminating credible agricultural knowledge remotely;
- ICT Programme Areas 4: Reduce the demand-supply gap, and enhance outreach and profitability of Sudan products and services through vibrant e-agriculture market places and efficient logistics;
- ICT Programme Areas 5: Improve the research capability, quality, credibility and reach of extension advisory using ICTs;
- ICT Programme Areas 6: Promote innovation in e-agriculture services;
- ICT Programme Areas 7: Reduce the individual risks of agriculture sector stakeholders;
- ICT Programme Areas 8: Improve the financing, investing and banking outreach to agriculture sector leveraging on electronic and mobile technologies;
- ICT Programme Areas 9: Improve the existing framework of policies, legislations, regulations and guidelines critical for e-agriculture and ensure its effective implementation;

However, it is clear that finance resources, if carefully planned, could yield more benefits if correctly allocated and administered. One of the areas that require special attention is ICT funding, through the E-Agriculture and Action Plan, to individual states. To ensure the commitment of the 18 States to the action plan process is challenging given the autonomous nature of managing their jurisdictions as stipulated in the Interim National Constitution. It is planned to enrich the development dialogue between the Federal Government and the States, thus ensuring an optimal use of the funds planned under the ICT in agriculture. The government will consider innovative options as an incentive for directing states funds into the action plan priorities. The modalities, areas and operationalisation of these options, as well as the required policy reform for implementation will be one of the action plan studies as part of the enabling environment required. Innovative financial mechanisms for investment will draw on similar experiences and success stories.

The total agriculture investment requirements for the next five years (2018-2022) are estimated at US\$ 110 million (with average requirements of about US\$ 22 million per year). To ensure conformity with the absorptive capacity in the agriculture sector will start with 20% of total annually.

**ICT Programme Areas (2016-2020); (US\$ “million”)**

| ICT Programme Areas  | 2018 | 2019 | 2020 | 2021 | 2022 | Total |
|--|------|------|------|------|------|-------|
| 1: Increase the availability and accuracy of agricultural information by creating, updating, analyzing and linking critical databases:   | 2    | 3    | 2    | 2    | 1    | 10    |
| 2: Accessible, affordable and secure ICT platforms, networks and devices with enhanced sensing, hosting, analytical, identification, tracking and communicating features:                          | 3    | 3    | 2    | 1    | 1    | 10    |
| 3: Improve the awareness, education and skills of farmers, extension workers, livestock herders and other sector end-users by creating and disseminating credible agricultural knowledge remotely: | 3    | 5    | 4    | 1    | 1    | 14    |
| 4: Reduce the demand-supply gap, and enhance outreach and profitability of Sudan products and services through vibrant e-agriculture market places and efficient logistics:                        | 2    | 3    | 5    | 2    | 1    | 13    |

|   |    |    |    |    |    |     |
|---|----|----|----|----|----|-----|
| 5: Improve the research capability, quality, credibility and reach of extension advisory using ICTs:  | 1  | 2  | 3  | 3  | 1  | 10  |
| 6: Promote innovation in e-agriculture services:  | 2  | 4  | 5  | 3  | 2  | 16  |
| 7: Reduce the individual risks of agriculture sector stakeholders   | 2  | 3  | 4  | 3  | 2  | 14  |
| 8: Improve the financing, investing and banking outreach to agriculture sector leveraging on electronic and mobile technologies:                            | 2  | 3  | 4  | 2  | 1  | 12  |
| 9: Improve the existing framework of policies, legislations, regulations and guidelines critical for e-agriculture and ensure its effective implementation: | 2  | 3  | 3  | 2  | 1  | 11  |
| Total Agriculture Investments   | 19 | 29 | 32 | 19 | 11 | 110 |

## 12. INSTITUTIONAL ARRANGEMENTS FOR IMPLEMENTATION

The issue of ICT Action Plan implementation to be place the under the under the Minister of Agriculture with a semi-autonomous sand Forests. The basic premise is that no new institutions will be created for the implementation; rather existing institutions will be used. The implementation of the projects and programs will be the responsibility of the respected ministries and agencies and the states as stipulated in the constitutional powers of both the federal government and the states and the subsequent Presidential Decrees stating the jurisdictions of the respective government organs.

However, the ICT Unit within the Ministry of Agriculture and Forests will be responsible for coordination and monitoring. The main task of the Unit will be to: (i) Collect necessary information related to the implementation from the respective bodies and ensure consistency between the government budgets, and policies with the E-Agriculture Strategy and Action Plan commitments, (ii) Establish a M&E system to get feedback for the Steering Committee on progress of the E-Agriculture Strategy and Action Plan implementation, (iii) Alert the steering Committee on challenges and policy requirements to correct deviations, (iv) Ensure that there is adequate coordination at the policy and projects identification level.

The Unit will have a small core staff with specially designed incentive system, and will establish a strong M&E system to track implementation of the E-Agriculture Strategy and Action Plan.

The involvement of several Government agencies and non-government parties necessitated by the broad range of interventions in the E-Agriculture Strategy and Action Plan requires coordinated decisions. The Unit will be overseen by a Steering Committee. The government will take the lead in the implementation; however, it will not shoulder this responsibility alone. Major stakeholders, namely the private sector and the farmers representatives will be represented in the Steering Committee.

To ensure coordination at the operational side, the Steering Committee will be at the Undersecretaries level and will meet quarterly to review the progress. The Unit will act as the secretariat for the Steering Committee.

The Major tasks of the steering Committee will be:

- enhancing coherence and alignment of current and planned activities within all the programs, projects and plans
- identifying development and priorities and gaps
- promoting an enabling environment (policies) and partnerships for the effective implementation of the E-Agriculture Strategy and Action Plan
- Overseeing the E-Agriculture Strategy and Action Plan implementation and Monitoring process

Political support for the process will be obtained at the Council of Ministers level. The Chairman of the Steering Committee (the Undersecretary of the Ministry of Agriculture and Forestry) can report directly to the Minister of Agriculture on progress and issues related to the E-Agriculture Strategy and Action Plan and the Minister will in turn report to the Council of Ministers.

Another avenue of reporting could be done by the chairman of the Steering Committee to the Economic Technical Committee of the Council of Ministers (The Undersecretary of the Ministry of Agriculture is a member in the Economic Technical Committee). The Economic Technical Committee reports to the Economic Ministerial Committee (The Minister of Agriculture and Forestry is a member in the Economic Ministerial Committee) which is one of the organs of the Cabinet.

### **13. MONITORING AND EVALUATION FOR E-AGRICULTURE STRATEGY AND ACTION PLAN (2018 -2022)**

The Monitoring and Evaluation (M&E) System will be result-based and will constitute an integral component of the knowledge management and innovation mainstreaming activities of the E-Agriculture Strategy and Action Plan.

The system is results-based, focusing mainly on the outputs, outcomes and impacts for the specified nine ICT programme areas, and will be employed to track, monitor and evaluate the E-Agriculture Strategy and Action Plan performance.

Also, the M&E System will monitor input deliveries, understand, facilitate and strengthen the existing M&E systems in the different projects, programmes and institutions. It will identify the right indicators that will ideally serve the planned objectives.

The crucial starting step will be setting and assigning the baseline indicators. While some indicators are readily available, others may need to be generated from surveys or through research and consultations with concerned organizations.

On the other hand, the end and annual targets will be derived from the strategic objectives of the various ICT programme areas. The baselines and targets will be the main focus for progress reporting.

The overriding goal of the M&E is to assist in the realization of the impact of the E-Agriculture Strategy and Action Plan. It is also important in ensuring that the interventions produce resilient and sustainable results. The system should effectively contribute to the following:

- Decision-making, which may be linked to interventions at all levels of the E-Agriculture Strategy and Action Plan. This includes macro-level decisions related to policies that cut across sectors and affect the overall development process;
- Accountability which provides critical assessments that demonstrate whether or not the interventions satisfy the target groups' needs and priorities. It should help to establish substantive accountability by generating answers to some critical questions regarding the achievements of E-Agriculture Strategy and Action Plan.
- Learning, sharing and knowledge management with the purpose of improving the overall quality of the ongoing and future interventions.

The system will report on the status of achievement of the objectives and annual targets during the five-year plan period at national and state levels. The M&E system will incorporate the formulation, monitoring and evaluation plan, a monitoring and evaluation systematic framework and a results framework. The M&E system will coordinate and streamline the E-Agriculture Strategy and Action Plan M&E activities at the state level.

A major objective of the E-Agriculture Strategy and Action Plan M&E system is to track the flows of the implemented projects and programmes out of the overall plan. The reports will be on 3-monthly bases all throughout the live span of the plan.

The E-Agriculture Strategy and Action Plan M&E will assist the implementation of the M&E Framework and will be the essential basis for the results framework. The M&E Plan will be updated for the actual requirements. Periodic monitoring missions will be organised as needed and an annual review will be conducted with the involvement of all stakeholders.

The e-agriculture monitoring framework includes monitoring of *outcomes* and *solutions (outputs)* for all ICT Programmatic Areas. A detailed monitoring and evaluation (M&E) plan would need to be developed after adoption of the strategy for the expected outcomes and the action plan for each phase.

#### **14. WAY FORWARD**

A Special focus would be given to MOAF partnership with NIC, NTC and ITU in E-Agriculture Strategy and E-Solution and Action Plan preparation, endorsement and implementation through Memorandum of Understanding.

NTC/ITU representative agreed to partnership and work closely with NIC, MOAF and FAO on the development of E-Agriculture Strategy and e-solutions for strategic implementation of ICT solutions for agriculture using ITU initiatives and tools. MOAF, NIC, NTC, ITU and FAO should officially endorse it to ensure their support and sustainability in the implementation phases.

The successful implementation of E-Agriculture strategy and solutions will depend on many diverse stakeholders and all participating organizations being committed and mutually accountable for achieving results.