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POLICY DISCUSSION DOCUMENT:

TOWARDS OPEN DATA FOR AGRICULTURAL TRANSFORMATION IN GHANA

31 December 2019

Policy Discussion Document:

Towards Open Data for Agricultural Transformation in Ghana

Final version

31 December 2019

Prepared under the leadership of the e-Agriculture Unit of the Ministry of Food and Agriculture (MoFA) in Ghana, and facilitated by the Dutch Ministry of Land, Nature and Food Safety (LNV), with participation of national experts from Ghana, and coordinating consultants from Wageningen University Research (WeNR) and CTA, The Netherlands.

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Foreword

Ghana's agricultural sector plan – *Investing for Food and Jobs* – sets out a clear agenda for transforming Ghana's agriculture into a vibrant, modern and sustainable business. Opening up data – so that anyone can access, use and share it – is viewed as critical for achieving this agenda. Effectively harnessing the growing volumes of data across agri-food chains can create jobs, stimulate youths back into farming, boost agricultural productivity, improve profitability and affordability, and enhance resilience to climate change.

Recognising this potential, the Ministry of Food and Agriculture launched its e-Agriculture Programme in 2015, leveraging digital technologies and open data to help provide more affordable, prompt and efficient agricultural services. This policy discussion document supports strategic planning and investment activities of both the e-Agriculture Programme and its stakeholders who influence open data policy and practice in Ghana. Over 50 stakeholders were mobilised in its development, representing government, local farmer organisations, local NGOs, development agencies, research organisations, and media. The document presents a shared goal, and common principles, policy objectives and action plans culminating from this stakeholder process. The action plans build on existing initiatives of government, business, development agencies and researchers, to collectively operationalise the long-term policy objectives in the next few years. The cooperative development of this policy discussion document is a valuable first step and has demonstrated the willingness of stakeholders from many different sectors and agencies to work collectively towards unlocking the vast benefits that open data can provide to Ghana's food, nutrition and job security.

[has been submitted by e-Agriculture coordinator for signature by Chief Director]

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Acronyms

MoC	Ministry of Communications
GSS	Ghana Statistical Services
ICT4AD	ICT for Accelerated Development Policy
APIs	Application Programming Interfaces
TRACTOR	Transforming Rural Agricultural Communities through Organic Re-engineering
GINKS	Ghana International Network for Knowledge Sharing
GODAN	Global Open Data for Agriculture and Nutrition
CAPI	Computer-assisted personal interviewing
EPA	Environmental Protection Agency
FDA	Food and Drugs Authority
GRA	Ghana Revenue Authority
MoFAD	Ministry of Fisheries and Aquaculture Development
GIPC	Ghana Investment Promotion Centre
GSA	Ghana Standards Authority
TELCOS	Telecommunications
GEPA	Ghana Export Promotion Authority
MOFEP	Ministry of Finance
GCX	Ghana Commodity Exchange
GSA	Ghana Standards Authority
FDA	Ghana Food and Drugs Authority
CSIR	Council for Scientific and Industrial Research
MoFA	MoFA Directorate of Agricultural Extension Services
CROPS	Directorate of Crop Services
CRI	Crops Research Institute
IRM	Innovation Recommendation Mapping
ISRIC	ISRIC

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Executive summary

Ghana's national development policies and its agricultural sector policies place strong emphasis on transforming and modernizing the agricultural sector in order to achieve food and nutrition security, boost the country's economy, create jobs and use resources sustainably. Open data is data that anyone can access, use and share. Opening up data offers a powerful tool for agricultural transformation by providing any actor in agricultural value chains with information that can be used to improve their daily decision making. The effective opening up of data would undoubtedly create jobs, stimulate youths back into farming, improve efficiencies and incomes in agricultural value chains, and empower local farmers to enhance agricultural productivity.

Ghana has recognised that opening up data for agriculture provides benefits and have made several national policy decisions to support this. For example, Ghana's national development plan, the *Agenda for Jobs* (2018-2024) specifically states the importance of information communications technology (ICT) to minimise cost in agriculture and improve efficiencies. Activities are explicitly identified to achieve this and are taken up in the agricultural investment plan of the Ministry of Food and Agriculture (MoFA) – *Investing in Food and Jobs* (2018-2021) within the e-Agriculture programme. Activities include the setting up a database on all farmers linked to the national identification system; promotion of an electronic payments system; technology transfer and input delivery; and dissemination of information on weather and prices.

This document is intended to support a range of policy, strategic planning and investment activities by MoFA as well as by other stakeholders who influence open data policy and practice in Ghana to coordinate these efforts and deliver on these pledges. The report proposes a number of datasets which should be opened up by government to support the agricultural value chains. These were identified by drawing on the expertise of an inclusive multi-stakeholder platform comprising those involved in data sharing and management across the value chain from producer to consumer to support policy decisions. This group has identified priority datasets including: Market Data; Land use and productivity data; Meteorological data (short-term weather data) and Production advice data.

Guiding principles are suggested, which draw on global best practice on open data, as well as principles underpinning national policies. These principles should underpin subsequent open data goals, strategies, plans and activities, and include accessibility, inclusiveness, participation, coordination and collaboration with advice on how to achieve these.

The report proposes an open data goal for agricultural transformation in Ghana, which is shown in Figure E1. Implementation towards this open data goal would provide many benefits to local Ghanaian citizens, such as improving yields, increasing income, lowering input costs, securing land tenure, creating jobs especially for youths, catalyzing new partnerships and opportunities (yellow box, Figure E1). These in turn support the achievement of global, regional and national outcomes such as food and nutrition security, agricultural development and contribution to GDP, job creation, social inclusion, and environmental sustainability (orange box, Figure E1).

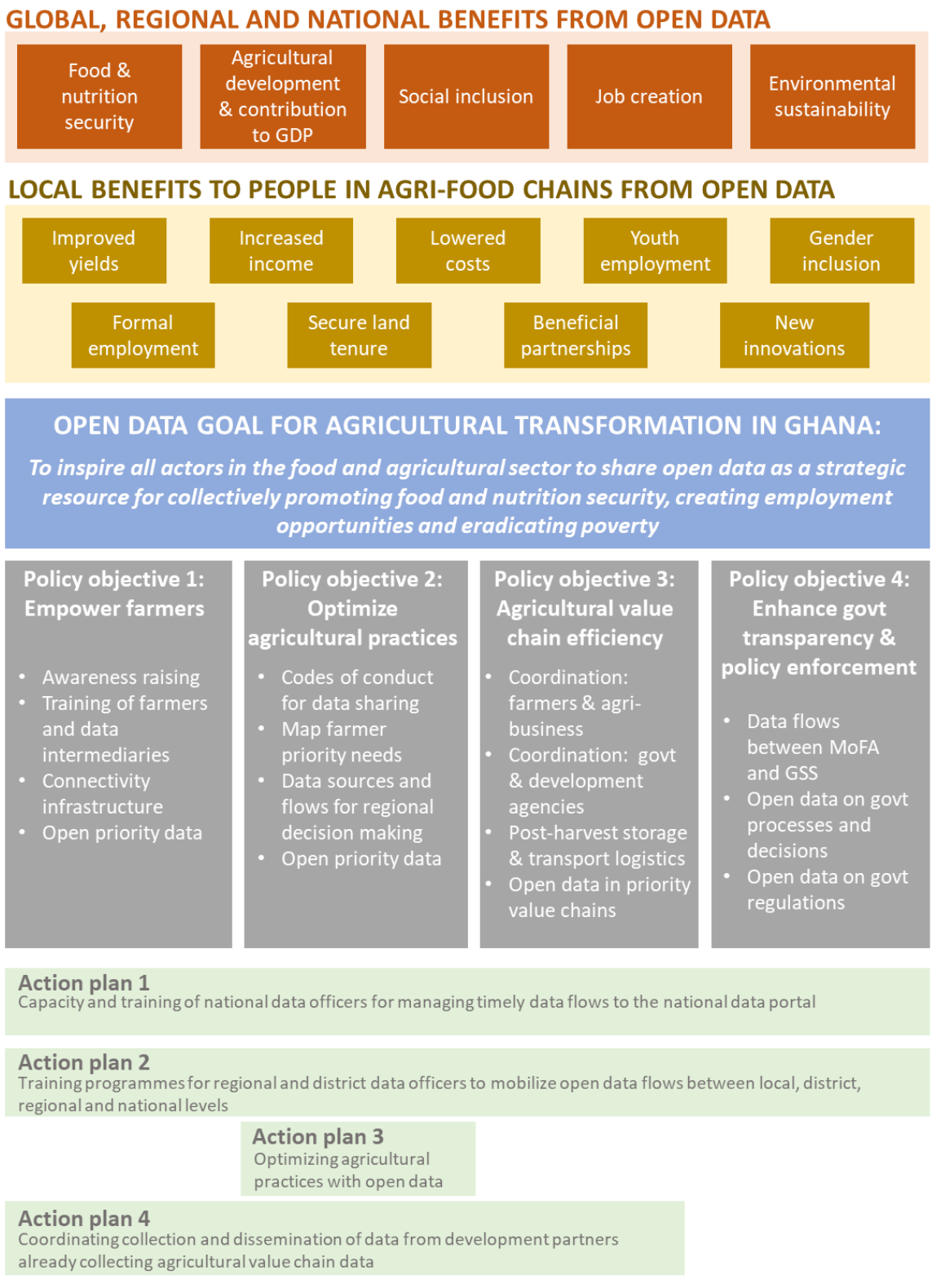

Figure E1: The open data goal (blue box) for agricultural transformation provides multiple benefits to local Ghanaian citizens (yellow box) and supports global, regional and national outcomes (orange box). The goal is underpinned by two 'application layers': the policy objectives and associated recommendations (grey boxes) and the action plans (green boxes) to catalyse their implementation. The position of the green boxes relative to grey boxes shows the association of action plans with each policy objective.

The open data goal is further underpinned by two 'application layers' (Figure E1). The first layer proposes a set of four policy objectives and associated recommendations (grey boxes, Figure E1), encompassing a diverse range of policy perspectives. These are intended to provide a shared agenda for cross-sector coordination and cooperation on open data for agricultural transformation. They are adapted from global best practice guidelines, and include:

1. Empower farmers with access to information and agri-finance;
2. Optimize agricultural practices through digital extension services;
3. Facilitate coordination and efficiency in agricultural value chains; and
4. Enhance transparency and accountability, and policy enforcement.

These policy objectives have a longer term focus and are intended to provide a shared agenda for cross-sector coordination and cooperation on open data for agricultural transformation. The second 'application layer' puts forward a set of four action plans to operationalise the policy objectives and some of the recommendations in the next two to five years, using a combination of funding sources and partners (green boxes, Figure E1):

(i) Capacity and training of national data officers for managing timely data flows to the national data portal;
(ii) Training programmes for regional and district data officers to mobilize open data flows between local, district, regional and national levels;
(iii) Optimizing agricultural practices with open data; and
(iv) Coordinating collection and dissemination of data from development partners already collecting agricultural value chain data.

Activities within these action plans serve to operationalize across different policy objectives, as shown in Figure E1 by the positioning of the green boxes (action plan) relative to the respective grey boxes (policy objectives). The action plans were developed using information provided in the multi-stakeholder platform as well as a desktop situation assessment on the main opportunities and challenges for opening up data for food and agriculture in Ghana. They align as much as possible with current initiatives so as to leverage existing momentum and funding. The action plans address four of the seven agricultural sector policy objectives in MoFA's *Investing for Food and Jobs*: all action plans inherently address the application of science, technology and innovation (objective 5) and the promotion of agriculture as a viable business among the youth (objective 6); action plan (ii) also promotes a demand driven approach to agricultural development (objective 2); and action plan (iii) directly contributes to improving agricultural production efficiency and yield (objective 3).

The intended way forward would now be to work with government, business and Civil Society Organizations in Ghana together with relevant development partners to adequately resource the action plans, building on and leveraging existing initiatives as much as possible. To this end, a regional workshop will be held in early 2020 to consider the options for leveraging public, private and development partner investment in the action plans.

1 Introduction

1.1 Agricultural transformation

An extensive body of international, regional and national policies and tools have been drawn up or enacted to direct and support agricultural development in Africa. A central tenet of all these policies is the need for agricultural transformation, that is, to develop agriculture into a vibrant, modern and sustainable business that creates value for farmers, entrepreneurs, youth and women, and produces affordable, nutritious and healthy food for all[1]. In line with this, both Ghana's national development policies and its agricultural sector policies place strong emphasis on transforming and modernizing the agricultural sector in order to achieve food and nutrition security, boost the country's economy, create jobs and use resources sustainably. But this is by no means a simple task. As with many food and agricultural systems in the world, Ghana faces the challenges of poverty and inequality, climate change, droughts, land degradation, loss of biodiversity, dwindling genetic resources, global trade volatility and inefficient supply chains – all of which have a powerfully disruptive effect on food and nutrition security. Overcoming these challenges requires sustainably increasing agricultural productivity, while creating more resilient food production systems, and shaping more accessible and equitable markets and consumer behaviour.

Harnessing the growing volumes of data and rapidly evolving digital technologies can help to respond to these challenges and accelerate agricultural transformation. The availability of the right information, at the right time, in the right format, and through the right medium offers enormous benefits to all actors in agricultural value chains. If implemented at scale, this has the potential to develop a highly connected, real-time agricultural ecosystem, which would be much more productive, efficient and transparent than before. Open data is a critical component for achieving this.

1.2 Open data and its benefits for agricultural transformation

Open data is data that anyone can access, use and share. Opening up data offers a powerful tool in a global economy which is increasingly information driven. Open data for food and agriculture provides information that can be used by any actor in the agricultural value chain in their daily decision making. Sharing data across agricultural value chains fosters new discoveries, innovation and collaboration among government, business, and civil society. This helps to shape solutions to problems that would otherwise be expensive, time intensive or impossible to solve.

Opening up data for agriculture holds promise for many actors across the whole agricultural value chain, and includes benefits such as: empowering farmers; optimising agricultural practices; supporting agri-finance; promoting coordination and efficiency in value chains; enforcing policies; and enhancing government decision making, transparency and efficiency (these benefits are explained further in Chapter 5). These open data benefits contribute directly to people, their livelihoods, and

[1] https://www.cta.int/en/digitalisation/all/issue/the-digitalisation-of-african-agriculture-report-2018-2019-sid0d88610e2-d24e-4d6a-8257-455b43cf5ed6

achieving sustainable and equitable development. Beyond these direct benefits, open data can also provide an important and growing evidence base for tracking progress towards national development priorities and global SDGs.

1.3 Open data embedded within e-Agriculture

Open data for agriculture is most effectively harnessed when it is embedded within the broader development of e-Agriculture. E-Agriculture is an emerging field which focuses on enhancing agricultural and rural development through improved information and communication technologies (ICT). The rapid growth of ICT is providing new ways to share and access information using a combination of both traditional and emerging approaches. For example, models, artificial intelligence, data mining techniques, as well as a diverse range of data collected from sensors, crowd sourcing and other resources are used to generate data to inform decision making, while the internet, emails, mobile phones, fixed telephones, televisions, and radios are used to convey information. Combining these ICT approaches with open data and the right enabling environment holds enormous innovation potential for transforming and modernising the agricultural sector in equitable and sustainable ways.

1.4 Open data and e-Agriculture in Ghana

Ghana is one of the leading countries on open data in Africa. The government of Ghana acknowledged its pivotal role in open data innovations as early as 2011 by joining the Open Government Partnership and setting up Ghana's Open Data Initiative (GODI) to take this commitment further under the auspices of the National Information Technology Agency (NITA). Early activities around open data in Ghana were focussed on providing data through the open data portal. These initiatives and others that followed (see Chapter 3) have built a level of interest and implementation readiness among ministerial departments. Activities are now turning to issues beyond data provision, which seek to more clearly tailor data supply to data use and demand, use new digital technologies to collect and disseminate data, and develop an open data community where all citizens can access and use regularly updated open data.

The Ministry of Food and Agriculture (MoFA) in Ghana has played a key role in national government's commitment to open data. Indeed, agricultural data make up the largest dataset on the country's open data portal. MoFA's national e-Agriculture Programme, launched in 2015, acknowledges the potential that open data and digitalisation plays in transforming and modernizing agriculture. The programme works across all agricultural sectors and sub-sectors. Its main objective is to provide affordable, prompt and efficient agricultural service delivery through the use of the internet and other ICT. This policy discussion document is developed as a primary source of input into strategic planning and investment for MoFA's e-Agriculture Programme, with a focus on the open data aspects.

1.5 Purpose and scope of this document

The purpose of this policy discussion document is to support the development of guiding principles, shared policy objectives and short- to medium-term action plans that will help to advance the opening up of data for transformation of the food and agricultural sector in Ghana. The document is intended to support a range of policy, strategic planning and investment activities by MoFA as well as by other stakeholders who influence open data policy and practice in Ghana. This includes stakeholders from other government agencies, as well as development agencies, businesses and civil society organisations. It reflects the perspectives and priorities identified from an assessment of the current global, regional and national open data situation, as well as iterative stakeholder consultation and deliberation that took place amongst stakeholder representatives in Ghana between February and October 2019. While it focusses primarily on finding common ground for national-level coordination in Ghana, it also draws on essential linkages and activities at the local and district levels within Ghana, as well as at regional or global levels.

Ideally, this policy discussion document should lead to consensus among MoFA and its stakeholders on a common policy statement and cooperative implementation plan for using open data to transform and modernise the food and agricultural sector in Ghana. It should guide and help catalyse investment into strategic priorities identified in the short- to medium-term action plans in Chapter 7. These action plans should be seen as a step in a much longer process that works towards a situation where all relevant parties are able to combine their respective skills and resources to leverage the potential of open data in transforming and modernising agriculture in a way that is both equitable and sustainable.

The document begins with a desktop review of the global, regional and national situation pertaining to policy and practice within the food and agricultural sector and the open data community (Chapters 2 and 3). Chapter 4 extends this desktop review to elicit stakeholder perspectives on challenges, opportunities and challenges. Drawing on the desktop and stakeholder review and the existing evidence base in global and regional best practice, Chapter 5 then outlines guiding principles and from this recommends a goal for advancing open data for agricultural transformation in Ghana. Chapter 6 outlines a set of recommended cross-sector policy objectives to achieve this goal. These policy objectives are in line with global and regional perspectives, while being adapted to country-specific implementation in Ghana. Chapter 7 points to the operationalising of these policy objectives, by outlining several short- to medium-term action plans that will help to advance the opening up of data for transformation of the food and agricultural sector in Ghana. These action plans were identified through iterative deliberation with MoFA and its stakeholders and cover a range of policy objectives. Each action plan is intended to provide a concept note that can be used to source funding, or as a basis of a Terms of Reference, for furthering this work.

1.6 Process followed to date

The high level of expertise and political will on open data in Ghana provides a foundational level of implementation readiness on which to build. This prompted the Dutch Ministry of Agriculture, Nature and Food Quality (LNV) to offer support to MoFA for advancing their open data policy for food and

agriculture. The support was in the form of providing expert consultants from May 2019 to December 2019 to work with their staff and help facilitate a stakeholder engagement process in the development of this policy discussion document, which is intended to support agricultural sector policy and planning on open data, both for MoFA and other stakeholders. In May 2019, MoFA accepted this offer and embedded the project in their e-Agriculture unit. A Project Reference Group was constituted to ensure that the policy discussion document produced by the project are relevant to Ghana's agricultural sector and well positioned within Ghana's national development and ICT priorities. The Project Reference Group is comprised of staff from MoFA, NITA, the Dutch Ministry, and a team of expert consultants specializing in open data, training and stakeholder engagement processes.

The project process and timeline are shown schematically in Figure 1. While the process is depicted in a linear fashion, it involved several iterations to develop and refine the information contained in this policy discussion document. After several virtual meetings to jointly frame the purpose of the project with the Project Reference Group, the team of expert consultants undertook a situation assessment of available relevant documentation in Ghana, which is summarized in Chapters 2 and 3. This situation assessment was followed with a week of face-to-face scoping in May 2019 with the Project Reference Group and over 50 stakeholders in the open data and agriculture sectors (Figure 2). Stakeholders included Ghana Statistical Services, National Development Planning Commission, and numerous stakeholders from business and Civil Society Organizations (see Chapter 4). The information collected from stakeholder engagements was used together with the situation assessment to identify priority actions for opening up data across a range of policy perspectives. These were iteratively refined over the course of two additional stakeholder engagement periods, which occurred in a special session at the "Africa Geospatial Data and Internet Conference, 22-24 October 2019" held in Ghana and at the National Forum, both of which were hosted by MoFA. The contents of this final version of the policy discussion document have been informed by inputs from the Project Reference Group (see Acknowledgements).

Figure 1: Project process followed in developing this document
While the process is depicted in a linear fashion, it involved several iterations to develop and refine the information contained in this policy discussion document

(a)

(b)

Figure 2: Two large stakeholder workshops informed (a) the development of a draft policy discussion document and (b) the review of its content, as well as many focus group meetings and one-on-one interviews (see Chapter 4)

2 International and regional context

This chapter focuses on the relevant global and regional policy commitments on agricultural development and open data (Section 2.1). The policy commitments and the recommendations stemming from this chapter are used, together with information in Chapter 3 (national policy context) and Chapter 4 to inform the development the guiding principles, goals and policy objectives outlined in Chapters 5 and 6.

A plethora of global toolkits have been developed to support the various global and regional commitments. These tools help track the open data performance of both developed and developing countries. It is useful to understand what they are indicating for Ghana, as they point to areas where improvement can be made, which are viewed as strategic priorities in which prospective investors interested in supporting open data in Ghana can invest. The tools and associated results (if they have been applied in relation to Ghana) were also reviewed to support the development of this policy discussion document, and a summary is provided in Appendix 1.

2.1 International and regional policy obligations

2.1.1 The Sustainable Development Goals (2015-2030)

https://sustainabledevelopment.un.org/

The Sustainable Development goals 2030 agenda was adopted in 2015 by all United Nations Member States. It comprises a comprehensive list of 17 Sustainable Development Goals (SDGs) that include strategies to tackle global issues such as gender inequality, climate change, hunger and poverty, among others. While the clearest link with agriculture and food is in SDG-2 (zero hunger), there are several other SDGs that include agri-food components, e.g SDG-1 (no poverty), SDG-12 (responsible consumption and production), SDG-13 (climate action), and SDG-15 (life on land).

The National Development Planning Commission (NDPC) in Ghana is responsible for coordinating and reporting on SDG-related activities, and for integrating the SDGs into national development planning. The recently updated medium-term national development policy framework, the *Agenda for Jobs* (Section 3.2.2) serves as a vehicle for localising and implementing Ghana's commitments to the SDGs and explicitly links its policies and strategies to the SDG targets.

There is a global emphasis and strong political drive behind the SDGs, which extends to the data collection and dissemination. Monitoring and evaluation systems are being set up to assess and report on the progress towards these goals and their associated targets. Reporting against the SDG outcomes is thus expected to generate many streams of potentially open data, facilitated by (1) better resources to collect well-defined, consistent data streams that might be opened up and used by others; and (2) better ability to supply and disseminate the data through SDG reporting structures. In Ghana, the SDG policy process offers promise for enhancing the availability and publishing of open data, with a strong

coordinating mechanism for implementation through the National Data Roadmap process, coordinated by national statistics office, Ghana Statistical Services (Section 3.4.2.2).

Benefits of open data for the SDGs can be achieved through direct improvement of the SDGs or through effective monitoring, evaluation and adaptive management. A recent publication by the World Bank on 'Open Data for Sustainable Development'[2,3] describes how open data can serve as a tool to meet these goals and measure progress towards their targets, identifying four types of benefits:

1. Fostering economic growth and job creation
2. Improving efficiency and effectiveness of public services
3. Increasing government transparency, accountability, and citizen participation
4. Facilitating better information sharing within government

The paper specifically mentions the role of open data in relieving hunger and improving food security and concludes with some recommendations for governments and users to support the development of open data initiatives, such as:

- Support open data use through legal and licensing frameworks
- Make data available for free online
- Publish data inventories for the government's data resources
- Create feedback channels to government from current and potential data users
- Prioritize the datasets that users want
- Address quality issues in key government datasets
- Make detailed, disaggregated, inclusive data available
- Protect privacy rights
- Provide sufficient data about the data.

2.1.2 Maputo Declaration (2003) and Malabo Declaration (2014)

https://www.nepad.org/caadp/publication/au-2003-maputo-declaration-agriculture-and-food-security

https://www.nepad.org/caadp/publication/malabo-declaration-accelerated-agricultural-growth

At the African Union summit in Maputo, Mozambique in 2003, member states, including Ghana, signed the Maputo Declaration to respond to the stagnation of agricultural development in Africa. This committed the African heads of state to allocating at least 10% of public expenditure to agriculture, an investment deemed necessary to achieve an average agricultural productivity of 6% annually and eradicate extreme poverty and hunger. The Comprehensive Africa Agriculture

[2] http://pubdocs.worldbank.org/en/741081441230716917/Open-Data-for-Sustainable-development-PN-FINAL-ONLINE-September1.pdf

[3] http://blogs.worldbank.org/ic4d/new-report-how-open-data-can-drive-sustainable-development

Development Programme (CAADP) was adopted at this time as Africa's policy framework to implement the Maputo Declaration (see section 2.1.3).

At the 2014 African Union summit in Malabo, Equatorial Guinea, the commitments, values and principles in the Maputo Declaration and the CAADP framework were reaffirmed when African heads of state adopted the Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods. The Declaration was a recommitment to the principles and values of the CAADP, as well as additional commitments and targets for enhancing resilience of livelihoods in the face of climate variability, improving mutual accountability for implementation, boosting intra-African trade of agricultural goods and services, and enhancing investment finance in agriculture. The role of data in informing national investment plans and associated multi-stakeholder consultations has been a clear part of CAADP.

As signatory to the Maputo and Malabo Declarations, Ghana's agricultural policy is in line with the principles outlines in the CAADP. These are articulated in the long-term strategy for Ghana's agricultural sector policy (Section 3.2.3) as well as the associated short- to medium term results framework (Section 3.2.4), which explicitly addresses the need to increase public spending to the 10% requirement.

2.1.3 Comprehensive Africa Agriculture Development Programme (2003)

http://www.un.org/en/africa/osaa/peace/caadp.shtml

The Comprehensive Africa Agriculture Development Programme (CAADP) serves as an implementation framework for agricultural transformation across Africa, in line with the Maputo Declaration in 2003, and its subsequent re-commitment through the Malabo Declaration in 2014. It provides a set of principles and broadly defined strategies to help African countries critically review their situation, identify strategic investment opportunities, and measure targets for achieving the values and results in the renewed Malabo Declaration. Signatories to CAADP commit to developing and implementing CAADP-based National Agricultural Investment Plans (NAIPs) to achieve the targets of public investment in agriculture and agricultural productivity. The CAADP results framework provide countries with a set of goals and results to be pursued for agricultural transformation within 10-year outlooks. Ghana's long term agricultural policy (Section 3.2.3) and short- to medium-term results framework (Section 3.2.4) aspire towards these principles and goals, although challenges have been experienced in both government spending on agriculture and improving agricultural productivity (Section 3.1.2).

Country-level Strategic Analysis and Knowledge Support Systems (SAKSS) provide complementary tools to implement this the CAADP results framework, focussing on improving data collection, data analysis and data management systems for agricultural statistics. The intention of SAKSS is to strengthen country-level monitoring and evaluations systems and to improve evidence-based planning and practice through regional-level systems, or 'ReSAKSS'. A Ghana-SAKSS[4] has been set up

[4] http://ghanasakss.org.gh/index.php

to support the implementation of Ghana's short- to medium-term agricultural policy in line with the CAADP policy, amongst others (Section 3.3.3.1).

2.1.4 Nairobi Declaration (2017)

https://www.godan.info/sites/default/files/Presentation%20-%20Africa%20Nairobi%20Declaration.pdf

The Nairobi Declaration was formulated as a result of the June 2017 Ministerial Conference on Open data for Agriculture and Nutrition hosted by the Kenyan Minister for Agriculture, Livestock and Fisheries. With the declaration, Ghana, as one of 15 African countries commit themselves to strengthening the role of open data in agricultural development, in line with CAADP. The Nairobi Declaration recognizes the opportunities that data and innovation can create for society and that sustainable agriculture can only be achieved with a broad alliance of people, particularly women and youth, governments, small holder farmers, civil society and the private sector, working together to secure a world that is food secure, without hunger and malnutrition.

2.1.5 Regional Agricultural Policy for West Africa (ECOWAP)

The Economic Community of West African States (ECOWAS) sets out a regional ECOWAS agricultural policy, ECOWAP, to address food security in the sub-region in line with existing regional and global commitments. Programme objectives include increased food production and income generation, increased inter-country trade, strengthened producers' organisations and greater involvement of women in socio-economic decisions that affect household livelihood opportunities. The policies and strategies for agricultural development in Ghana, as articulated in the national agricultural investment plan of 2018, Investing for Food and Jobs (Section 3.2.4), are consistent with ECOWAP, especially in relation to food security.

3 National context

This chapter provides a desktop review of Ghana's medium and long-term development goals which need to be considered in developing country-appropriate policies, strategies and priorities for open data. It begins by reviewing the the role of agriculture in Ghana's national and rural development and the likely directions of agricultural development, including the challenges and opportunities (Section 3.1). It then outlines the policies, goals and relevant initiatives pertaining to food and agriculture (Section 3.2) and open data (Section 3.4). The chapter concludes with a synthesis of key principles underpinning the polices, and an assessment of the challenges and opportunities for operationalising open data that have been identified from this policy review (Section 3.5).

3.1 Role of agriculture in national and rural development

3.1.1 Current situation and future trends

The agricultural sector accounts for one-fifth of Ghana's Gross Domestic Product (GDP), employs nearly half of the workforce and is the main source of livelihood for the majority of the country's poorest households[5]. The sector is viewed as having a critical medium-term role in transforming the country's economy, despite its current declining growth relative to extractive sectors. There are several recent summaries of the role of Ghana's agricultural sector in the country's growth and development: MoFA (2018)[6], World Bank (2017)[7], SRID (2017)[5]. Table 1 summarises the key points from these documents and Dzanku and Aidam (2013)[8].

[5] http://mofa.gov.gh/site/wp-content/uploads/2018/05/Agric%20in%20Ghana%20F&F%202016_Final.pdf

[6] http://mofa.gov.gh/site/wp-content/uploads/2018/11/Final%20Draft%20Agric%20Invetment%20Guide%20%202018-10-19.pdf

[7] http://documents.worldbank.org/curated/en/336541505459269020/pdf/119753-PN-P133833-PUBLIC-Ghana-Policy-Note-Ag-Sector-Review.pdf

[8] Dzanku, F.M. and Aidam, P. (2013). Agricultural sector development: policies and options. In: Ewuzi, K. *Policies and options for Ghana's economic Development, 3rd edition*. Institute of Statistical, Social & Economic Research (ISSER), University of Ghana, pp. 100-138. Available at:

https://www.researchgate.net/publication/283010318_Agricultural_sector_development_Policies_and_options

Table 1: The current situation for a range of published agricultural statistics (as recently as published statistics allow), together with future trends and their implications for Ghana's development

Development dimension	Current situation	Future trends and implications
Gross Domestic Product (GDP)	Ghana's agricultural sector contributes about a fifth of the country's economy. The contribution declined from around 30% between 2007 and 2010 to 25.8% in 2011, 20.3% in 2015, 18.9% in 2016, and 18.3% in 2017.	The agricultural sector contribution to GDP is diminishing relative to the rapid growth of the extractive sector (minerals, oil and gas), having declined by 10% between 2010 and 2016. Nevertheless, in the medium-term it will still support the highest labour force and contribute to the bulk of household livelihoods.
National and rural labour force	Despite a steep fall in its share of overall GDP, agriculture accounted for as much as 45.0% of national labour force in 2013. Agriculture and related sectors also offer the highest potential to employ women and youth.	The declining contribution to GDP but concurrent large contribution to employment is an indication of the low levels of investment and productivity in the sector. The agricultural sector will likely continue to contribute to net job growth over the medium term, and agricultural development will remain vital to employment and income generation. In addition, open data and ICT offer an exciting career for attracting youth into agriculture, offering the potential of improving not just subsistence livelihoods, but increasing household incomes.
Poverty alleviation	Agriculture provides livelihoods for more than 70% of Ghana's rural population, that have poverty rates significantly higher than the national average. Because rural households are dependent primarily on agriculture for livelihoods, agricultural development in these areas is seen in the national development planning as a critical strategy for reducing poverty.	The country's transition to a more urbanized industrial and service-based economy has had very limited impact on rural income and employment. Even with more rapid rural-urban migration, most of the poor in Ghana will continue to be rural for several decades, relying primarily on agricultural development. This is expected for many decades to come.
Public and donor investment in agriculture	While the share of agriculture in national expenditure grew from 6.6% to 11.2% (average 9.3%) in 2001 to 2011, there are indications that it has decreased again to around 5% by 2014.	The 10% target for public sector investment, as set out in the Maputo/Malabo Declaration, CAADP and Agenda for Jobs, is currently not being met. The high operational investment in salaries and subsidies also compromises development of other needs such as infrastructure, irrigation, research and development and extension services. Evidence indicates that input subsidies are currently inefficient and generate low returns. Interrogation should also be done on salary expenditures, because the staff strength shows that MoFA is currently operating only at 47% capacity, which is inadequate to carry out the services required.

Development dimension	Current situation	Future trends and implications
Growth rate	Annual agricultural growth rate is highly erratic and has varied between 0.8% and 5.7% (average 3.5%) between 2010 and 2016.	The growth rate is below the 6% target set out in CAADP and Agenda for Jobs, and well below the overall GDP growth rate. Beyond the macro-economy, the social impact this may incur is concerning given agriculture's importance to employment of poor and marginalised people.
Agricultural productivity	Despite the global importance of cocoa, yields for this and other staple and cash crops are low, and below regional standards. Currently, agricultural productivity does not meet the CAADP goal of 6% annually. Strategies to increase total yield have mainly focused on increasing crop surface area rather than increasing productivity. Advice to farmers on crop potential in different areas, particularly in view of climate and climate change, is not accessible. Neither are guidelines on fertilisers and pesticides, or access to high quality seeds.	Given population increases and food demand, productivity growth will need to intensify the use of productivity-enhancing inputs, particularly high-quality seed, fertilizer and pesticides.
Agricultural value chain efficiencies	Agricultural potential is constrained by inadequate infrastructure (especially roads and irrigation), low education and skills, poor access to finance and complicated land tenure arrangements. Post-harvest losses stem from poor farm-level practices, poor transport and handling, inadequate information on market prices and poor storage that expose produce to moulds, rodents and other pests. Conventional storage solutions usually tend to be very expensive for smallholder farmers.	Production inefficiencies and the high cost of production have negatively affected the profitability of agricultural production locally and made imports cheaper and more attractive to traders. While post-harvest losses of major staple crops declined by about 16% between 2008-2015 (average of 2%), the losses remain very high (up to 30%).
Imports and exports	Although agriculture is a major foreign exchange earner (dominantly cocoa), Ghana is a net importer of basic foods (raw and processed) including rice, poultry, sugar, and vegetable oils. The annual food import exceeds that earned from cocoa exports.	Food import costs are projected to increase fourfold over the next 20 years, unless local production is substantially increased.
Social stabilization	Agriculture in Ghana is increasingly acknowledged for its role in social stabilization, providing a buffer during economic shocks and contributing to cultural values associated with farming	With increasing volatility in global commodity markets, domestic agriculture can help to provide stability. The resilience of domestic agriculture should be managed across the whole agricultural value chain, especially in relation to reducing vulnerability to climate change.

3.1.2 Key challenges affecting agricultural transformation

An assessment of agricultural transformation for economic growth, job creation and food security (World Bank 2017)[9] recently summarised several key challenges affecting sector growth and competitiveness in Ghana. The first 17 points below synthesise key challenges that overlap in this document and those indicated as a priority in the medium-term national agricultural investment plan (*Investing for Food and Jobs*, Section 3.2.4). Points 17 to 21 summarise the challenges identified in the World Bank report.

1. Public investment is low – below the international commitments under CAADP and the lowest in Africa. Investments that are made are often inefficient and not well targeted.
2. Low and aging institutional capacity at all levels of government (national, regional, districts) – the department operates at 47.6% of its required staff strength, and of this 36% are over the age of 50.
3. Local agricultural extension and other services are poor, mainly due to low capacity and limited and untimely provision of public funding. Currently this ration between farmers and extension officers is 1 : 1,862.
4. Weak regulatory regime to enforce standards land management and sustainability standards
5. Low agricultural competitiveness and integration into domestic and international markets.
6. High production costs and high cost of conventional storage solutions for smallholder farmers.
7. Poor storage and transportation systems
8. Seasonal variability in food supply and prices
9. Poor farm level practices
10. Low average yield of staple crops and high post-harvest losses. Low productivity, especially in cocoa, threatens Ghana's competitiveness and position in the international market.
11. Low quality and inadequate agricultural infrastructure; low levels of agriculture mechanisation and adoption of appropriate technology and inadequate disease monitoring and surveillance system. This leads to lower productivities.
12. Inadequacy of farmer insurance especially to smallholders, and lack of long-term credit for agriculture
13. Inadequate private investment in agribusiness ventures
14. Low-quality genetic material of livestock species and low level of husbandry practices, leading to low livestock productivity
15. Weak nutrition sensitive food production systems
16. Agricultural research and development, which is a key driver of productivity growth, is inadequately funded and coordinated.
17. Land tenure challenges affect the sustainability of Ghana's major crops.
18. Expenditure on input subsidies (e.g. fertilizers) need better coordination as they are currently inefficient and generate low returns. Irrigation infrastructure is limiting. There is inadequate investment in agriculture business ventures.

[9] http://documents.worldbank.org/curated/en/336541505459269020/pdf/119753-PN-P133833-PUBLIC-Ghana-Policy-Note-Ag-Sector-Review.pdf

19. Poor management and inefficiencies along the agricultural value chain. The seed value chain is still largely dependent on public support, has inherent cost inefficiencies and offers smallholder farmers limited access to good quality seed.
20. Collection and analysis of agricultural data and statistics is still weak, and this undermines effective development planning in the sector.
21. Ghana's agriculture is vulnerable to the threat of climate change.

3.2 National development and agricultural policies, goals and initiatives

This section focuses on national policies that set the priorities for agricultural transformation in Ghana. Open data initiatives should provide information that are relevant and responsive to the needs of these policies. The Ministry of Food and Agriculture (MoFA) is the lead agency and focal point for developing and executing policies and strategies for Ghana's agriculture sector, and implementation is decentralized to regional and district levels. The main national policies guiding agricultural development, outlined in the sections below, are:

1. NDPC-led policy objectives
    - President's Coordinated Programme of Economic and Social Development Policies (CPESDP): Agenda for Jobs (2018-2024)
    - Medium Term National Development Policy Framework (MTNDPF): *Agenda for Jobs* (2018-2021)

2. MOFA-led policy objectives
    - Long-term Food and Agricultural Sector Development Policy (FASDEP II)
    - Medium term National Agriculture Investment Plans (NAIPs): *Investing for Food and Jobs* (IFJ) (2018-2021)

3.2.1 Coordinated Programme of Economic and Social Development Policies (CPESDP)

This is the Presidential medium-term national development plan which is the main driver of the national development agenda and serves as a framework for activities across Ghana's public Ministries, Departments and Agencies (MDAs). The Ghanaian Constitution requires the President to submit the plan within two years of assuming office. The current programme is called the '*Agenda for Jobs: Creating Prosperity and Equal Opportunity for All*' (2018-2024), and the recently-updated medium term national agriculture investment plan, *Investing for Food and Jobs*, is strongly aligned to this policy (Section 3.2.4).

The values of economic prosperity, equity, transparency and participation, sustainability and safety/stability underpin the vision and goals of the Agenda for Jobs. It sets out four main goals:

- Creating opportunities for all Ghanaians
- Safeguarding the natural environment and ensuring a resilient built environment
- Maintaining a stable, united and safe country

- Building a prosperous country

In order to achieve these goals, the agenda focuses on strongly on improving the enabling conditions for private sector investment (to date, public investment has dominated sectoral development), creating jobs (particularly for youths), and increasing incomes for all. The agenda acknowledges agriculture as the main driving force for job creation, rural development and transformation, and identifies seven pillars for agricultural development: (i) market-focused product development across the agricultural value chain (particularly around promoting value addition in major agricultural commodities); (ii) institutional reforms; (iii) production efficiency; (iv) post-harvest management; (v) cost minimisation; (vi) promoting youth in agricultural development; and (vii) enhancing communication. These are adopted as the policy objectives guiding the medium-term national agricultural investment plan, *Investing for Food and Jobs*.

The *Agenda for Jobs* specifically states the importance of information communications technology (ICT) in the agricultural value chain in order to minimise cost in all operations and improve efficiencies. Activities explicitly identified to achieve this are taken up in MoFA's e-Agriculture programme (Section 3.3.1.1), and include: setting up a database on all farmers linked to the national identification system; promotion of an electronic payments system; technology transfer and input delivery; and dissemination of information on weather and prices.

3.2.2 Medium Term National Development Policy Framework (MTNDPF)

Medium Term National Development Policy Framework is the medium-term implementation framework for operationalising Ghana's national development objectives set out in the Coordinated Programme of Economic and Social Development Policies (Section 3.2.1). The current framework, named the same as the policy framework it guides – the '*Agenda for Jobs: Creating prosperity and equal opportunity for all*' (2018-2021) – is in its sixth cycle. It builds on the successes and addresses the challenges of previous medium-term operational frameworks: the Ghana Shared Growth and Development Agenda I and II (implemented during 2010-2013 and 2014-2017 respectively), and the Ghana Poverty Reduction Strategies (GPRS): GPRS (2003-2005) and GPRS (2006-2009).

The current framework views the agricultural sector as playing a critical medium-term role in transforming the country's economy. Its five development dimensions address the goals of the Coordinated Programme of Economic and Social Development Policies (Section 3.2.1), and include: economic development; social development; environment, infrastructure and human settlements; governance, corruption and public accountability; and Ghana's role in international affairs. Rural and agricultural development is an explicit focus area under the economic development dimension, and seven policy objectives are identified that have subsequently been adopted to guide the recently-updated medium-term national agricultural investment plan (Section 3.2.4).

Policy objective 4.5 allows for public investment in the application of science, technology and innovation (Table 2), which is strongly focused on developing e-Agriculture and open data for enhancing access, use and benefits of local farmers. While this specific policy objective serves as the core investment and outcomes framework for open data, there are also numerous policy objectives

and outcomes that could benefit from leveraging the potential of e-Agriculture and open data, such as enhancing market support services, improving productivity and yield, improving agricultural extension services, and reducing post-harvest food loss and waste.

The framework also explicitly deals with statistics for development in its approach to monitoring and evaluation. It acknowledges the need for growing the capacity to collect and use statistical information at all institutional levels. This includes investment in ICT for improved statistical production and developing policy and legal frameworks required for international best practice on Big Data. The investment plan allows for the development of a national monitoring and evaluation system by the NDPC.

The Government of Ghana's flagship programmes are intended to operationalise the medium-term strategies in the *Agenda for Jobs* in a way that cuts across ministries, departments and agencies and includes relevant external stakeholders. There are several flagship programmes highly relevant to open data and e-Agriculture, including Planting for Food and Jobs, Planting for Export and Rural Development, Rearing for Food and Jobs, One-District-One Factory, One-District- One-Warehouse (amongst others). The Planting for Food and Jobs provides a significant contribution of public funding towards activities to advance the work of MoFA's e-Agriculture Unit, and is described in Section 3.3.5.

Table 2: Key policy objective relevant to e-Agriculture and open data from the medium-term framework guiding the implementation of 'Agenda for Jobs' (2018-2021).

4.5 Enhance the application of science, technology and innovation	4.5.1	Promote the application of information and communications technology (ICT) in the agricultural value chain in order to minimise cost in all operations **(SDG Targets 2.4, 2.c, 5.b, 9.c, 17.8)**	Ministry of Food and Agriculture Ministry of Environment, Science, Technology and Innovation Council for Scientific and Industrial Research Association of Ghanaian Industries Ghana National Association of Farmers and Fishermen Peasant Farmers' Association of Ghana Best Farmers' Association
	4.5.2	Improve the effectiveness of Research-Extension-Farmer Liaison Committees (RELCs) and integrate the concept in the agriculture research system to increase participation of end users in technology development **(SDG Target 2.a)**	
	4.5.3	Establish a database on all farmers, drawn from the national identification system **(SDG Targets 16.9, 17.18)**	
	4.5.4	Promote insurance schemes to cover agriculture risks **(SDG Targets 8.10, 10.5)**	
	4.5.5	Disseminate information on weather and prices **(SDG Target 12.8)**	
	4.5.6	Strengthen research programmes of the Council for Scientific and Industrial Research (CSIR), as well as of the agricultural and related sciences departments of public universities and other institutions **(SDG Target 2.a)**	
	4.5.7	Develop local fertiliser industry based on gas and petroleum resources to improve agricultural yield and save foreign exchange **(SDG Target 2.3)**	

3.2.3 Long-term Food and Agriculture Sector Plan (FASDEP)

FASDEP is the long-term strategy for Ghana's agricultural sector policy that supports the national development outcomes (Section 3.2.2) and the Malabo-CAADP commitments (Sections 2.1.2 and 2.1.3). It is led by MoFA but is intended to stimulate collaboration across multiple actors in the agricultural sector. It is currently in its second cycle (FASDEP II) and, having been launched in 2007, is now requiring update in line with changing national development outcomes. Nevertheless, the main

aims still reflect broad aspirations, and emphasise the transformation and modernization of the agricultural sector in order to achieve food security and create jobs. It has six objectives:

1. Food security and emergency preparedness
2. Improved growth in incomes
3. Increased competitiveness and enhanced integration into domestic and international markets
4. Sustainable management of land and environment
5. Science and Technology applied in food and agriculture development
6. Improved Institutional Coordination

Greater engagement of, and collaboration with, the private sector is emphasized throughout as a means to facilitate implementation. The science and technology objectives do not explicitly mention the leverage capacity of e-Agriculture and open data and instead focus on issues such as provision of irrigation infrastructure, access to seed and post-production value-add. This is possibly because the Africa data revolution took off exponentially after 2007. However, these objectives have more recently been taken up in both the medium-term frameworks guiding implementation of national development and agricultural development, as these are seen as key strategies for agricultural transformation.

3.2.4 Medium Term National Agriculture Investment Plans (NAIPs)

The National Agriculture Investment Plans (NAIPs) are the agricultural sector's medium-term policy and investment framework, which outlines the strategy, budgetary requirements and reporting outcomes to guide cross-sectoral activities in the medium term. The plan responds to obligations of the national development agenda (Sections 3.2.1 and 3.2.2), as well as global (SDGs; Section 2.1.1), continental (CAADP-Malabo; Sections 2.1.2 and 2.1.3) and regional (ECOWAP; Section 2.1.5) development frameworks. The current medium-term plan is called '*Investing for Food and Jobs (IFJ) (2018-2021)*' and is in its third cycle, with predecessors being the Medium Term Agricultural Sector Investment Plans (METASIP I and II).

The plan adopts verbatim the values articulated in the national development agenda, namely those of economic prosperity, equity, transparency and participation, sustainability and safety. Its emphasis is on modernising the agri-food system to increase incomes and create jobs. Strategies to modernise and transform the agri-food system emphasise structured public investment to at least 10% of the national budget, in line with Malabo-CAADP commitments (Sections 2.1.2 and 2.1.3), as well as building enabling conditions for better private sector investment. It builds on the seven agricultural sector policy objectives identified in the medium-term national development policy framework (*Agenda for Jobs*; Section 3.2.2):

1. Promote a demand driven approach to agricultural development
2. Ensure improved public investment
3. Improve production efficiency and yield
4. Improve post-harvest management
5. Enhance the application of science, technology and innovation

6. Promote agriculture as a viable business among the youth
7. Promote livestock and poultry development for food and nutrition security and income generation

These policy objectives will be implemented through four programmes, and their various sub-programmes and investment areas. These investment areas are also intended to stimulate the implementation of Government of Ghana's flagship programmes, which were specifically established for operationalising national development policy objectives. The flagships include (but are not limited to): Planting for Food and Jobs; Rearing for Food and Jobs; Planting for Expert and Rural Development. e-Agriculture is explicitly acknowledged as one of the five pillars of the Planting for Food and Jobs programme (Section 3.3.5).

The medium-term plan is structured hierarchically around four programmes and its sub-programmes, investment areas, and policy tools. Each investment area is committed to report on key performance indicators to track progress. Policy tools have not been developed for all investment areas, but are intended to provide well-defined aims, rationales, and implementation arrangements that include targets for the investment period and a budget. Most of the relevant activities for the e-Agriculture programme and its related open data interest fall under sub-programme 2.4: Crops and Livestock productivity development (Table 3), as well as sub-programme 1.4: Research, statistics, information, communication and public relations (Table 4). Sub-programme 2.4 is more concerned with reaching farmers, whereas sub-programme 1.4 is more around managing open data.

Table 3: Three policy tools and their respective indicators outlining the core work for investment area 2.1.5 (Promoting technology dissemination). This will form the core work in MoFA's e-Agriculture programme

Sub-programme	Policy tool	Indicator
2.1: Crops and Livestock productivity development	2.1.5 Promoting technology dissemination, which has 3 policy tools each with a budget and several indicators for monitoring and performance purposes	• Number of farmers who have received extension services through the PFJ program • Percent of targeted farmers with access to E-extension and/or E-voucher schemes • Number of extension SMS messages sent to Farmers by DADs • Number of farmers who visit the Agriculture Information Centres (AICs) • Number of Agriculture Information Centres (AICs) functional • Percent of PFJ beneficiaries accessing extension information via ICT channels
	2.1.5.1: Dissemination of technologies to meet value chain players' demand	• Number of farmers who have received extension services through the PFJ program • Percent of targeted farmers with access to E-extension and/or E-voucher schemes • Number of extension SMS messages sent to Farmers by DADs • Number of farmers who visit the Agriculture Information Centres (AICs) • Number of Agriculture Information Centres (AICs) functional • Percent of PFJ beneficiaries accessing extension information via ICT channels
	2.1.5.2: Dissemination of knowledge packages	• Number of extension demonstrations facilitated by AEAs or project staff • Number of radio broadcasts on extension related materials • Extension officer-farmer ratio (excluding cocoa extension officers) • Number of FBOs trained in extension services delivery • Number of extension demonstrations facilitated by AEAs or project staff • Number of radio broadcasts on extension related materials • Extension officer-farmer ratio (excluding cocoa extension officers) • Number of FBOs trained in extension services delivery
	2.1.5.3: Promotion of youth's access to Competency Based Trainings through the ATVET approach	• Number of individuals benefiting directly from programmed skill-based training • Percent of resources budgeted for Skill Based Trainings for the Youth that was approved and disbursed

Table 4: Six investment areas and their respective indicators outlining the core work for the bub-programme 1.4: Research, statistics, information, communication and public relations

Sub-programme	Investment area	Indicator
1.4: Research, statistics, information, communication and public relations	1.4.1 Collection, processing and analysis of area, yield and production data on major crops	• Number of RADs producing quarterly results-oriented reports • Percent of DADs who report annually on cropped area, yield and production • Number of districts collecting SRID required agricultural data
	1.4.2 Collaboration with relevant stakeholders to collect, process and analyse livestock and poultry data	• Percent of required livestock and poultry data available and analysed for scheduled reporting
	1.4.3 Monitoring agricultural trade statistics, producer prices, farm input prices and transport charges for agricultural commodities	• Number of agriculture trade related data compiled by SRID
	1.4.4 Collection and analysis of weekly market prices of various agricultural produce at wholesale and retail levels	• Average number days used for collection and analysis of national data on commodity prices
	1.4.5 Preparation of annual crop budget for major crops	• Date of the last production budgets for major selected crops prepared
	1.4.6 Establish and maintain a national operational and geo-database	• Setting–up and operating a geo-referenced information system has evolved to one of the following stages: **Stage 1: Analysed **Stage 2: Drafted proposal and presented for public/stakeholder consultation **Stage 3: Presented for legislation **Stage 4: Passed/approved **Stage 5: Implementation has begun **Stage 6: Monitoring of implementation on-going • Number of individuals accessing and using geo-referenced information from Ghana AGIS

3.3 Relevant MoFA directorates, programmes and partnerships

Mobilising open data for agricultural transformation will require the coordination of functions across at least three national line directorates in MoFA: Information Communication Technology Directorate (ICTD); Statistics Research and Information Directorate (SRID); and the Policy, Planning, Monitoring and Evaluation Directorate (PPMED). The Women in Agriculture Development Directorate (WADD) and the programme on Planting for Food and Jobs (PFJ) are also included here because open data has huge potential to catalyse innovations for job creation and the promotion of youth and woman in food and agriculture, and therefore are both a core component of e-Agriculture.

3.3.1 Information Communication Technology Directorate (ICTD)

http://mofa.gov.gh/site/?page_id=630

The ICTD is responsible for ensuring robust information technology infrastructure, effective management systems and associated support services, and access to relevant and timely information by MoFA and its stakeholders. The directorate's strategy emphasises five key elements:

- ICT policy and regulation reform for promoting development
- ICT access to timely and accurate information, particularly for under-served populations
- ICT capacity development for directorates, projects, institutions, units and individuals to use ICT for development
- ICT applications across a diversity of development objectives

The strategy includes several objectives of direct relevance to leveraging open data for agricultural transformation, including – amongst others – improving rural access to ICTs; digital dissemination using intermediate organizations; empowering extension agents, local NGOs, and producer associations to help farmers apply ICTs; and empowering women and youth to participate effectively and equitably in emerging ICT opportunities. MoFA launched its e-Agriculture programme in 2017 to help achieve the ICTD strategy and its objectives.

3.3.1.1 e-Agriculture programme

http://e-agriculture.gov.gh/index.php

Ghana's e-Agriculture programme has been around since 2011, with further support added from the World Bank in 2017. The programme seeks to provide affordable, prompt and efficient agricultural service delivery through the use of the internet and other ICT. Leveraging open data for agricultural transformation fundamentally depends on the successful implementation of the broader e-Agriculture objectives in Ghana, which include:

- Bridging the ratio farmers to extension officers enabling more dissemination of information and its assimilation. Currently this gap is 1 : 1,862!
- Providing applications and enhancing the use of technology tools to collect, collate, store, archive and share information
- Improving access and dissemination of information to farmers and other stakeholders, and in local languages
- Promoting the establishment of global and national public-private partnerships in the collation and dissemination of agricultural information
- Maintaining the National Agricultural Database of farmers, and other agricultural information
- Creating awareness of the e-Agriculture platform and linking it to the e-Government platform and relevant e-services for convergence, traceability and one-stop shop for agricultural stakeholders with unique identifier
- Improving the knowledge, skills and competencies of staff of MoFA, farmers and other stakeholders in utilizing e-resources

- Contributing to the goals and objectives of the Planting for Food and Jobs (Section 3.3.5).

To accomplish these objectives, the e-Agriculture programme provides a range of services to Ghana's agricultural sub-sectors and its stakeholders, including:

1. e-Farm information service, a tollfree voice activated response service that provides best farming practices for cassava, yam, cocoyam, rice and maize
2. Tollfree call centres to connect with expert advisors or virtual meetings
3. Resource and e-Learning Centres
4. e-Field Extension Service Delivery (National Agricultural Database of farmers)
5. e-Library
6. e-Extension web portal
7. Fertilizer Subsidy which links to electronic payments of fertiliser companies to track fertilisers purchased.

The e-Field-extension and e-Extension web portal play an especially important role for open data, facilitating the collection and dissemination of farmer data, which is mobilised through use of digital technologies by agriculture extension officers. E-Field extension includes the capturing of farmer's details and their biometric data in the National Agricultural Database of farmers, the mapping of farmlands, and disease and pest monitoring to improve accuracy and early response to field needs.

3.3.2 Statistics Research and Information Directorate (SRID)

http://mofa.gov.gh/site/?page_id=79

The SRID aims to provide relevant, accurate and timely agricultural statistics and information for stakeholders to promote evidence-informed decisions and communication on progress. Its main functions are to collect agricultural data through surveys and provide demand-driven and quality agricultural statistics. The SRID collects data through Annual Crop and Livestock Surveys; annual market surveys on commodity prices (farm gate, wholesale and retail); and the preparation of weekly and monthly price data on major food commodities and agro-inputs. From this information, SRID provide agricultural statistics data (e.g. yield, agricultural inputs and prices, transport charges on commodities), undertake quarterly reporting on the food situation in Ghana; and develop an annual crop budget for major commodities. Weekly data on market prices are currently available through networks and making contact with the e-Agriculture call centres. However, they are not published online in entirety and in a re-usable format for use by, for example, information intermediaries.

Inadequate public funding has prevented the undertaking of a comprehensive agricultural census for over 30 years. Instead, SRID rely on the annual production data derived from the Annual Crop and Livestock Surveys conducted at the district level by agricultural extension officers. A more comprehensive survey is needed to re-establish a higher quality benchmark for future monitoring of

sector progress and improve sector planning, monitoring and evaluation for agricultural transformation[10].

New technologies for collecting and disseminating open data also hold enormous complementarities to these traditional survey methods. Acknowledging these benefits, SRID and the e-Agriculture programme already collaborate around several issues, such as the design and training of CAPI-based surveys[11] to be conducted by agricultural extension officers. Capacity development for extending the use of these new technologies is required at all levels of governance in MoFA (national, regional and district) as well as across a variety of actors in the agricultural value chain. Some of these are taken up as priority needs in the action plans of Chapter 7.

3.3.3 Policy, Planning, Monitoring and Evaluation Directorate (PPMED)

As its name conveys, the PPMED is the directorate for the development of policy and programmes and the monitoring and evaluation of these to assess the impact on agricultural productivity and reduced poverty. PPMED's main functions include:

- Review of sector policies and programmes
- Coordination of sector programmes
- Coordination of the preparation of MoFA's Annual Plan and Budget
- Facilitating the release of funds to Cost Centres
- Monitoring financial expenditures
- Monitoring and Evaluation of agricultural sector programmes, projects and expenditures
- Provision of technical support in project appraisal, mid-term and project completion evaluations of programmes and projects under the ministry
- Dissemination of information on the implementation of agricultural sector activities

There are two critical functions that PPMED plays of relevance to open data. The first is its function of monitoring and evaluation, which requires the continuous stream of relevant, suitably disaggregated, and timeous data for assessment and analysis. The second is its role in the preparation of the annual plan and budget, which requires that explicit attention be given to the collection, dissemination and use of data to inform policy and promote agricultural transformation.

A recent capacity needs assessment of MoFAs monitoring and evaluation activities[10] found that funding for agricultural sector monitoring and evaluation – including data generation, analysis, and dissemination activities – is currently extremely limited. This was found to be the main reason, amongst other, that monitoring and evaluation information is only available in marginal ways. In addition, while expertise in MoFA for these activities exist at national level, there is virtually no capacity for monitoring and evaluation activities at regional and district level. The recommendations

[10] http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/128859/filename/129070.pdf

[11] Computer assisted personal interview surveys in which the interviewer uses an electronic device to capture answers immediately, rather than first on paper.

stemming from this capacity needs assessment were to channel some public funding into monitoring and evaluation to set a better baseline of data and situation assessment, and to ensure that capacity development addresses organized knowledge management and sharing mechanisms at all levels of governance – district, regional and national. These recommendations were taken up in the identification and development of the action plans in Chapter 7.

3.3.3.1 Strategic Assessment and Knowledge Support Systems (SAKSS)

The SAKSS is a country-level platform, supported by the Regional Strategic Analysis and Knowledge Support System (ReSAKSS), which is an Africa-wide network that provides high-quality data, analysis, and tools to decision-makers, practitioners, and other agriculture stakeholders. Its strong coupling to monitoring and evaluation has led to recommendations that this programme be housed within MoFA's PPMED (Section 3.3.3). Momentum around SAKSS seems to have peaked in 2014-15, and then slowed down. However, the regional and country-level networks and platforms offered by this programme in support of achieving regional and national CAADP policy objectives (Section 2.1.3) are of high relevance to open data and e-Agriculture and options to re-invigorate this process should be investigated.

3.3.4 Women in Agriculture Development Directorate (WADD)

The focus of the WADD is on transforming livelihoods and promoting the wellbeing of especially women in the agricultural sector. It does this by promoting the delivery of improved technologies and information on agricultural production and post-production in an environmentally sustainable way, focusing particularly on policies and programmes that meet the needs of women farmers and processors. The WADD deploys regional and district officers to ensure that the extension technologies and messages reach women farmers and processors at local levels. In addition to offering training in the use of technologies, they also engage with communities to seek solutions to specific challenges, develop community collaboration programmes and projects, and monitor and evaluate the effectiveness of their outreach and how this impacts the lives of rural and urban citizens.

The on-the-ground outreach of WADD, its explicit seeking of new technologies and innovations to meet the needs of its stakeholders, and its requirements of data for monitoring and evaluation make this directorate a highly important player in open data and e-Agriculture, as there are many opportunities here to align policy objectives and associated activities.

3.3.5 Planting for Food and Jobs (PFJ) Programme

The PFJ is a 5-year flagship programme of the national government of Ghana launched in 2017. It is led by MoFA and aims to address the declining growth of the agricultural sector, and to modernize agriculture and inspire job creation for the country's growing youth population. The programme focusses on increasing productivity, reducing food imports and creating jobs by facilitating

partnerships with the private sector and local farmers. It is governed by demand- and market-driven approaches, and sets out to achieve its aspirations through five 'pillars':

1. Supply of improved seeds to farmers at subsidized prices (50% subsidy)
2. Supply of fertilizers to farmers at subsidized prices (50% discount)
3. Free extension services to farmers, with a focus on mobilizing the help of agricultural colleges to inspire the youth
4. Marketing opportunities for produce after harvest
5. Providing an e-Agriculture platform to monitor and track activities and progress of farmers through a database system.

The e-Agriculture platform of PFJ works to provide real time and cloud computing services, so that the data collected from beneficiaries can be validated. In 2017, the initiative has registered some 577,000 farmers with 202,000 farmers participating; this increased to 677,000 by 2018[12]. This facilitates the improved distribution of inputs and resources and will provide farmers access to markets for farm produce. By integrating ICT with the other pillars, e-Agriculture is able to strengthen the responsiveness, efficiency, transparency and accountability of both government and private service providers who supply inputs and services to farmers. The recognition of e-Agriculture as an explicit pillar in its own right acknowledges that the success of the PFJ relies substantially on effective implementation of e-Agriculture at farmer level – such as its ability to provide and collect accurate data and information, and the use of mobile technologies in facilitating timely information and payment of subsidies to farmers in remote areas. These opportunities have been taken up in the policy objectives and action plans in Chapters 6 and 7.

3.4 Open data policies, goals and initiatives

The government of Ghana has been involved in open data since at least 2011, when it joined the Open Government Partnership and committed to developing and implementing a national action plan for open data. In 2012 the government initiated the Ghana Open Data Initiative, facilitated by the National Information Technology Agency (NITA) which falls under the Ministry of Communications (MoC). This is supported by a Ghana Data Exchange Hub, that promotes the internal sharing of government data and a national open data portal (http://www.data.gov.gh/) to facilitate publishing and access to public. At the institutional level, NITA plays a critical role in developing an enabling digital environment and national framework to support the digitalization of the agricultural sector and thus the successful implementation of MoFAs e-Agriculture programme and open data activities. The national statistics office, Ghana Statistical Services (GSS), is another key ministry in MoFA's open data endeavours. This chapter provides a brief overview of the roles, mandates and initiatives of NITA and the GSS of relevance to open data for agricultural transformation. It then outlines several ICT business intermediaries of relevance to open data for agricultural transformation.

[12] https://www.cta.int/en/digitalisation/all/issue/the-digitalisation-of-african-agriculture-report-2018-2019-sid0d88610e2-d24e-4d6a-8257-455b43cf5ed6

3.4.1 Ministry of Communications: National Information Technology Agency (NITA)

The National Information Technology Agency (NITA) was established in 2008 to implement the ICT policy of the Ministry of Communications (MoC). NITA is responsible for developing and promoting new, innovative technologies; ensuring the growth of ICT through continued research and development in partnership with the private sector; planning and technology acquisition strategies; and assisting the government to generate growth and employment by leveraging ICT and public-private partnerships. NITA facilitates the implementation of Ghana's National Data Sharing policy (Section 3.4.1.2), maintains the National Open Data Portal (http://www.data.gov.gh/) for the publication of open government data, and is in the process of creating and maintaining a central Data Exchange Hub for the internal sharing and use of government data. There are several NITA-facilitated initiatives of high relevance to open data for agricultural transformation.

3.4.1.1 ICT for Accelerated Development Policy (ICT4AD)

ICT4AD provides an overall policy framework for an ICT-led socioeconomic development process with the potential to transform Ghana into a middle-income, information-rich, knowledge-based and technology-driven economy and society. The policy and its framework were launched in 2003 and are currently in the fifth cycle (2019-2022). The current cycle focuses more on the production, development and delivery of ICT products and services with less emphasis on ICT deployment and exploitation, which had been the focus of earlier phases[13]. Within the ICT4AD, there is an explicit agricultural sector development goal to facilitate the rapid development and modernization of the agricultural sector through the deployment and exploitation of ICTs. Specifically, this target seeks to:

- Modernize the agricultural sector to improve its efficiency and productivity to ensure food security generate rural employment; contribute to economic growth and to improve the foreign exchange generation capacity of the sector;
- Aggressively promote and facilitate the development of a globally competitive agro-business industry to support the development of a vibrant agricultural value-added industry capable of supporting the development and modernization of the agricultural sector and its allied sub-sectors and industries;
- Promote basic and cutting-edge agriculture-based research and related research and development to improve agriculture yield of main crops and products; and
- Support the development of marketable value-added agricultural products capable of competing on the domestic, regional and global market.

The first of these targets is taken up in the action plans on improving open data on crop potential and productivity (Chapter 7). The strategy also seeks to revitalize agriculture extension services by

[13] https://www.mamopanel.org/resources/reports-and-briefings/byte-byte-policy-innovation-transforming-africas-f/

empowering and equipping farm extension service workers with relevant ICT skills (also taken up in Chapter 7), to establish an agriculture information system, to utilize ICTs to link farmers and farmer groups to resources and services, and to reduce preharvest and postharvest losses in agricultural production through the development and adaptation of improved technologies.

3.4.1.2 National Data Sharing Policy

The draft National Data Sharing Policy provides directives, guidelines and uniformity in implementing national government data sharing initiatives in Ghana. Currently in draft form, it aims to enable proactive sharing and greater access to data generated and commissioned by Ghana's ministries, departments and agencies in order to promote socio-economic development. The National Data Sharing Policy is strongly aligned with other existing national development policy and agendas, as well as ICT policy and legislation. Principles that underpin the policy include:

- **Specificity**: provision of specific policy guidelines on issues such as documentation, metadata, standards, publication frequency, datasets, data formats, granularity, and interoperability
- **Accountability**: provision of clear and specific mechanisms to ensure that government entities are held accountable for publishing and sharing government data
- **Alignment**: to existing legislation around the publishing and access to information (e.g. Data Protection Act of 2012 (Act 843), the Electronic Transactions Act of 2008 (Act 772), and the Constitution of the Republic of Ghana), as well as expected upcoming policies (e.g. Statistics Bill, Right to Information Bill).
- **Accessibility**: ensuring that government data is easily discoverable, accessible and made available without unnecessary bureaucratic or administrative barriers. This principle also incorporates the last two principles outlined here.
- **Timeous data**: this principle is incorporated under 'accessibility' and refers to the availability and update of machine-readable data.
- **Interoperability**: ensuring the easy integration of the data into other databases and information management systems, which includes for example use of common standards and Application Programming Interfaces (APIs) to support interoperability of data integration systems and software.

The National Data Sharing policy provides for the coordination of activities under seven themes: implementation and governance; publication and sharing of government data; data licencing, formats and standards; ensuring quality of government data; coordinating feedback and engagement between data providers and users; legal framework alignment; and financing of government data. It also provides a monitoring and evaluation framework to measure the successful implementation of these activities. The policy sets out standards for data licensing (according to the Open Data Commons Attribution license https://opendatacommons.org/licenses/by/1.0/), formats, timeliness of update cycles and metadata. It also provides a variety of coordinating platforms within government and beyond that are all pertinent to MoFA, including:

- Data Sharing Steering Committee chaired by NITA to steer the implementation of the National Data Sharing Policy, the Ghana Open Data Initiative and the Data Exchange Hub across all government MDAs. MoFA's e-Agriculture coordinator already serves as representative on this committee to report back on progress within MoFA.
- Data Task Teams led from within the different ministries, departments and agencies and who report to the Data Sharing Steering Committee. MoFA is required to lead its own task team, and within this, the identification and capacity development of data champions is crucial for effective implementation. The National Data Sharing Policy explicitly acknowledges and requires the development of the appropriate capacities both at the management and the technical levels to implement and embed the required change towards greater sharing of government data across the national data ecosystem. The requirement for capacity development to identify data champions and enhance MoFA's Data Task Team is taken up in the action plans in Chapter 7.
- Open Government Partnership Steering Committee which liaises with stakeholders external to government. The Data Sharing Steering Committee is also responsible for facilitating communication between publishers and users of open data, drafting a National Data Action Plan, and reviewing data quality issues.

3.4.1.3 Ghana Open Data Initiative (GODI)

GODI aims to foster "an open data community involving the government of Ghana, civil society organizations, industry, developer communities, academia, media practitioners, and the citizenry, to interact with one another with the aim of developing an open data portal to bring about transparency, accountability and efficiency in government"[14]. Its activities are guided by an Open Data Steering Committee, which includes representatives from Cabinet, NITA, civil society organisations, and the Ministry of Communications (Section 3.4.1.2). There is also a GODI portal which contains 133 datasets from 25 different agencies, with the agricultural sector data being the largest contributor. The early efforts of GODI focussed mainly on identifying open data and developing a portal to disseminate these. The efforts are now turning to developing an active community of practice among both users and suppliers, to foster innovations, promote harmonisation and interoperability of future data, and leverage the benefits of open data for agricultural transformation. GODI has gained recent momentum from SDG policy processes, particularly through the SDG roadmap process (Section 3.4.2.2).

3.4.1.4 E-Transform project

The e-Transform project, co-led by NITA and the World Bank, is a project to further develop Ghana's open data platform. The project development objective is to improve the efficiency and coverage of government services delivery using ICT, and to advance shared and accelerated development in four priority sectors: agriculture and nutrition, health, energy and education. Activities include:

[14] https://webfoundation.org/docs/2019/03/Africa-data-revolution-report.pdf

1. Conducting a baseline assessment of institutional, technical and training cybersecurity issues to feed into developing open data policy and legal framework
2. Upgrading Ghana's current open data portal in line with international best practices
3. Developing content on open data by using international best practice of bringing together all sides of the open data ecosystem
4. Providing training and capacity building for all segments
5. Developing a strategy on open data and data analytics for the government of Ghana to be incorporated into the medium-term strategy
6. Supporting the framework for the establishment of a Ghana Open Data Forum

The agricultural sector is a critical partner for all these activities. In particular, this policy discussion document provides inputs into activity 3 above through the identification of priority content on open data for agriculture in line with the international best practice of meeting both supply and demand across the data ecosystem. It also supports activity 5 above by providing agricultural sector inputs into the medium-term strategy on: common principles, a goal and four policy objectives for open data developed by MoFA and its stakeholders between May and October 2019 (Chapters 4 and 6). The priority needs identified in the action plans of Chapter 7 strongly support training and capacity development to enhance MoFAs coordinating capacity in the open data ecosystem, as well as the collection and use of open data content.

3.4.2 Ghana Statistical Services (GSS)

The GSS is responsible for the collection and analysis of statistical data and advising government and its stakeholders on all matters relating to statistical information. Its activities are guided by the National Strategy for the Development of Statistics, which is aligned to the GSGDA, as well as the African Union's Agenda 2063 and the SDGs. The activities supported by the implementation of this strategy, as well as several other GSS-led initiatives are of pertinence to open data for agricultural transformation and are described below.

3.4.2.1 National Strategy for the Development of Statistics (2018-2022)

This strategy serves as an operational framework for government, private sector and development agencies to deliver official statistics to enable evidence-based policy making, track policy impacts, and inform investment decisions and interventions. The strategy is in its second 5-year cycle (2018-2022), and it sets out six goals and related activities, as well as a budget for funding these activities together with external partners and timelines. Goal 5 of the strategy explicitly allows for leveraging the potential role that big and open data could play in the development and dissemination of official statistics through:

- Exploring the integration of non-traditional data providers and users
- Ensuring that the Statistical Law is updated in line with the Fundamental Principles of Official Statistics

- Collaborating with external partners on big or open data projects
- Promoting the effective coordination of data-related activities
- Promoting access to and the use of data using open data principles
- Ensuring data-related activities are adequately resourced

These activities provide an important supportive base on which to coordinate MoFA's open data activities. Strong GSS-MoFA partnering should be encouraged. To this end, the action plans in Chapter 7 have been set up to explore strategies, such as staff secondment and joint training to enhance knowledge exchange, collaboration, and mutual capacity development between MoFA and GSS.

3.4.2.2 National Data for Sustainable Development Roadmap

The national data roadmap process is led by GSS, in collaboration with a broad range of stakeholders to facilitate a whole-of-government, multi-stakeholder approach to data issues. A National Data Roadmap Forum in 2017 officially launched the data roadmap process and is now supported by the National Data Roadmap Advisory Committee. The roadmap is guided by three strategic objectives, each with several projects being guided by the Advisory Committee, GSS staff, and national and international experts. These include:

1. **Addressing data gaps to improve policy, planning and decision making**: Projects in this strategic objective focus on: harnessing administrative data to generate timely and disaggregated information for monitoring; exploring new sources of data, such as the African regional data cube for geospatial/big data and call details records from the telecommunication industry; working with private sector data intermediaries on the use of open data and mobile technologies to improve agricultural data access and use, and monitoring of SDGs at district level.
2. **Encouraging data use to enhance performance and inform public policy debate**: A national SDGs reporting platform to make disaggregated data available and ensure transparency and participation. This will be connected to the re-vamped GODI platform (Section 3.4.1.3)
3. **Building a policy and enabling environment to strengthen the entire data ecosystem**: GSS is partnering with National Statistics UK to develop strategic leadership, communication and data science capacity. A quality assurance framework is also being developed with CSOs, academia and the private sector to fully leverage data within the ecosystem, and this is considered in the action plans of Chapter 7.

These strategic objectives are well-aligned to MoFA's e-Agriculture programme, particularly open data, and present opportunities to leverage existing momentum around open data for agricultural transformation. Indeed, there are several agricultural projects within these objectives that are relevant to the action plans identified in Chapter 7. These include several projects to explore and implement new mobile technologies with farmers and data intermediaries, as well as a project on the African Regional Data Cube to harness the 17 years of earth observation and satellite imagery. Members of the National Data Roadmap Advisory Committee were therefore consulted in identifying priorities and conceptualizing actions in this policy discussion document.

3.4.3 ICT data intermediaries

ICT data intermediaries play an important role in the Ghana open data ecosystem, and a relatively large community has developed in response to the data needs of farmers, the constraints of extension services offered by government, and the widespread use of mobile phones. These data intermediaries use mobile phone technologies to address the need for improved extension services by rural farmers at an inexpensive cost per month, e.g. providing government data as well as real-time data on pest management. Data intermediary communities are engaged as a valuable stakeholder through the various government initiatives of MoFA, NITA and GSS, and are involved in several partner projects. The main agricultural ICT intermediaries are:

- **Esoko**, which has a public-private partnership with government for collecting survey data from farmers and at the same time providing market prices, weather forecasts, crop advice, buyer-seller networks.
- **Farmerline**, which also collects survey data from farmers and focuses on preventing low yields and post-harvest loss through access to market prices, farming techniques and weather forecasts. They also have a capacity building component for farmers on how to use and access information. Currently the App has over 200k users across West Africa.
- **Vodafone Farmers Club**, focusing mainly on pest and disease management.
- **TRACTOR** (Transforming Rural Agricultural Communities through Organic Re-engineering) - aimed at disseminating indigenous farming techniques. They have a training component on using technology for improved agricultural business management and agricultural practices.
- **GINKS** (Ghana International Network for Knowledge Sharing) is not strictly agricultural but aims at alleviating poverty with the aid of ICTs, information and knowledge sharing among stakeholders. They have a training component, e.g. evidence-informed policy making.
- **MobileWeb Ghana** is also not strictly agricultural but focusses strongly on building the ICT capacity of youth to be able to meet the demands of improving social-economic and political development.

3.5 Synthesis of national policy context

The preceding sections provide information – implicitly or explicitly – on the principles, values and objectives reflected in national, global and regional development priorities. Many of the policies and initiatives also point to challenges relevant to open data and present many opportunities on which to build. Ideally, the core principles, as well as some of the challenges and opportunities should be reflected in the principles, policy objectives and actions set out in this policy discussion document in Chapters 5 to 7.

3.5.1 Principles underpinning policies related to open data for agricultural transformation

The relevant national policies and initiatives pertaining to agriculture and open data of this chapter, align well with global and regional policy commitments and recommendations. The national development agenda is underpinned by values of economic prosperity, equity, transparency and participation, sustainable utilisation of natural resources, and peace and stability. The agenda focuses strongly on creating jobs (particularly for youths) and increasing incomes for all. Strategies to promote enabling conditions for private sector investment are emphasised as a complementary means of public investment for achieving the national development agenda. This is in response to the challenge of moving beyond 'supply-led' public sector strategies to incorporate more 'demand-led' private sector ones too. A further emphasis is placed on accountability in implementing policy towards these outcomes, with monitoring and evaluation frameworks providing an evidence base for adaptive implementation cycles.

The agricultural development agenda is very strongly aligned with the national development agenda and essentially adopts the same principles as above for transforming the agricultural sector. As with the national development agenda, the strategies to achieve this agricultural transformation have shifted from predominantly supply-led (e.g. providing government subsidies, or opening up government data) to more demand-led strategies that engage much more closely with local farmers and the private sector to catalyse innovation in the agricultural value chain (e.g. mobile technologies supply and collect information to help smallholder farmers). In addition to promoting private investment, however, the agricultural development agenda also emphasises structured and efficient public investment to at least 10% of the national budget, in line with Malabo-CAADP commitments (Sections 2.1.2 and 2.1.3) – currently there is a shortfall in investment.

The open data development agendas in Ghana focus on using ICTs to achieve the national development agenda. While there is still quite a strong, and arguably much needed, emphasis on opening up of government data, there is also a shift evident in national open data policy to move beyond only government data towards leveraging ICT innovations for collecting and disseminating open data through partnerships with private ICT information intermediaries. This is particularly relevant in the agricultural, nature, energy, health and education sectors. In addition to the national development principles (as outlined above), these agendas also emphasise the mobilisation of interoperable, accurate, relevant, reliable and timely data, and include strategies to leverage the potential of big and open data to improve equity, evidence-based decision making, efficiencies and agricultural productivity.

The aspirations for opening up data in agriculture align strongly with the core principles driving the national and agricultural development agendas, such as prosperity, equity, transparency and participation. Strategies to accomplish the effective opening up of data would undoubtedly create jobs, stimulate youths back into farming, improve efficiencies and incomes in agricultural value chains, and empower local farmers to enhance agricultural productivity. The explicit incorporation of e-Agriculture into the updated medium term national agricultural investment plan ('Investing for Food and Jobs', Section 3.2.4) and national government's flagship programme 'Planting for Food and Jobs'

(Section 3.3.5), acknowledges the potential contribution that e-Agriculture and open data hold for national development.

3.5.2 Challenges for operationalizing open data for agricultural transformation

This section summarises the key challenges specifically related to MoFA's role in open data for agricultural transformation, which were noted in documents reviewing the global, regional and national policy context (Chapters 2 and 3).

Agricultural developmental challenges that open data could address relate to:

- Low levels of agricultural productivity. Agricultural strategies have mainly focused on increasing total yield by increasing crop surface area rather than increasing productivity. While advice to farmers on crop potential in different areas, particularly in view of climate and climate change, is provided by e-Agriculture's call centres, data sets are not published online, and therefore have limited re-use capability. This limits the role that data intermediaries can play in developing demand-led advisory services and innovations. The same holds true for guidance on fertilisers and pesticides, or access to high quality seeds. Information is collected and is available if you know the networks, but it is not particularly findable or re-useable.
- Insecure land tenure, which makes agricultural investment less attractive; the national farmers database is trying to address this.
- Production inefficiencies and the high cost of production, which have negatively affected the profitability of agricultural production locally and made imports cheaper and more attractive to traders. Open data can help to guide and track public sector investment, which is critical at a time when public spending in agriculture is needing attention. Currently keeping track of public spending at district level is difficult because of lack of coordination between decentralized governments (regions and districts) and national government. This leads to a situation where MoFA is unable to track how much is spent on the sector by the decentralized governments, and whether such spending is consistent with sector plans and priorities.
- Low agricultural competitiveness and integration into domestic and international markets. Open data shared effectively across all actors in agricultural value chains could help to address this.
- Input subsidies are currently inefficient and generate low returns. Effective use of government open data to track subsidy investments and returns is a necessary point of departure for more strategic planning, which open data could address.

Operational challenges for open data in agriculture include:

- Extremely limited funding for agricultural monitoring and evaluation activities, such as data collection, analysis, and dissemination.
- Very weak coordination capacity to systematically collect, process and publish agricultural data at all levels of governance. This acts as a barrier to improving the enabling conditions for private sector investment and local farmers.
- Human capacity at all levels of governance is low and grossly inadequate to deliver on MoFA's mandate. MoFA currently operates only at a capacity of 48%, and of this staff complement 36%

are over the age of 50. There is a critical need to build capacity, with a strong focus on youths and women (who represent only 23% of the staff complement).

- Inadequate district extension services to effectively engage local farmers, collect data and accomplish any monitoring and evaluation activities.
- Development agency initiatives on agricultural transformation often run independently of government, and further exacerbate the issues of coordination in the agricultural sector. This is particularly true when development agencies engage regional or district agricultural offices but fail to reach national ministries. This is exacerbated by MoFA's weak staff strength and coordination capacity.
- Most real-time data collected by development agencies and civil society organisations are not open, and there is no coordinating mechanism or incentive provided for these agencies to open up their data.
- There is a strong need for going beyond merely supplying data to developing an empowered receiving environment. This will require developing active, multi-stakeholder communities of practice and engaging with software developers on users' needs (e.g. through hackathons).

3.5.3 Opportunities on which to build in opening up data for agricultural transformation

The preceding sections of this chapter identified relevant policies, ministries and programmes that share interest in open data for agricultural transformation. In reviewing these, several opportunities, listed below, were noted in relation to open data. Aligning activities in this Policy Discussion Document with these initiatives can leverage additional support and momentum for accelerating the open data agenda. The main opportunities noted include:

- A strong will from national government to exchange technical expertise with other countries and organizations, offering an opportunity to engage with the open data knowledge network in West Africa and beyond through initiatives such as the Open Government Partnership, International Open Data Charter, and Godan.
- Strong coordination and leadership role played by NITA at national level in opening up data. This has led to the development of a draft National Data Sharing Policy, which allows for coordination of open data across government (through the Data Sharing Steering Committee and Data Task Teams) and between government and non-government partners (Open Government Partnership Steering Committee). It also allows for the capacity development of data champions within government ministries, departments and agencies in order to meet the national government commitments on leveraging open data.
- Alignment of the national development agenda with reporting on SDGs, which has led to the establishment of a national data roadmap process across different ministries in Ghana (Section 3.4.2.2). This presents a strong potential coordination mechanism for open data for agriculture.
- Although limited, there is good expertise in ICT and open data both in and beyond MoFA on which to build. Training in ICT technologies for agriculture is undoubtedly a means of attracting youths back into farming to re-invigorate and modernise agriculture.

- A small but vibrant suite of ICT data intermediaries already exists in Ghana. At least two of these private companies already have formalised partnerships with MoFA, and there is potential for scaling up and out.
- A strong intention by national government to promote enabling environments for private sector innovations and investment, which has enabled public-private partnerships with ICT intermediaries in the e-Agriculture and Planting for Food and Jobs programmes. It is hoped this will expand demand-led extension services, which are driven by the quality and scale demands of agro-processors, wholesalers, and exporters. If these efforts are successful, improved farmer productivity and the elaboration of agricultural value chains can offset the cost of providing extension services.

4 Stakeholder scoping: findings and synthesis

Chapters 2 and 3 provided an assessment of the global, regional and national policy context within which open data for agricultural transformation in Ghana is embedded. This chapter summarizes the perspectives and priorities of key stakeholders in the open data ecosystem in Ghana. The information from both the policy and stakeholder assessment was used to identify the principles, goals and policy objectives (Chapter 5 and 6) in this policy discussion document, and the supporting short- to medium-term actions (Chapter 7).

4.1 Stakeholders in open data for agricultural transformation

Stakeholders of open data for agriculture include those from both the agri-food system and the data ecosystem. Agri-food system stakeholders include input suppliers, farmers, processors, retailers and policymakers, who make decisions that affect each other. Stakeholders in the data ecosystem comprises data collectors, data managers, data re-users, data subjects, legal advisors and others. These stakeholders play a role in extracting, cleaning, publishing and maintaining data, as well as in strategic processes such as policy production, decision making and administrative enforcement. Broad groups of stakeholders in the agri-food and data ecosystem are shown in Table 7 together with the different capacities they need to fulfil their function.

Table 5: Stakeholders and their capacities required to fulfil their function in the agri-food data ecosystem *(adapted from OpenDataMonitor[15])*

Stakeholder	Capacity requirements
Government bodies and associations: National and subnational bodies and associations; coordinating bodies around ICT and e- government; public enterprise in charge of furthering the information society; standardisation bodies	Advocate the publication of high- value agriculture-related data sets; benchmark volume and sophistication of the published data as well as its use; understand coverage of used standards to align with these; understand what constitutes high-value agriculture-related data sets to advocate their publication; understand how open data in agriculture can be used
Policy makers: Parliament and ministry officials encouraging the use of open data in decision making; coordination bodies for e- government and ICT; governance structures for cross-level collaboration in e-government and ICT	Understanding barriers to open data publication and use; understand, develop and enforce widely used standards (e.g. data formats, structure, licenses)
Private sector: corporates; financiers; various agribusiness companies and associations (e.g. seed suppliers, pesticide manufacturers, fertiliser manufacturers, transport companies); food wholesalers and retailers; transport companies	Detect high-value agriculture-related data sets with minimal and transparent strings attached; detect mashable, harmonised data sets on a large scale
Civil Society Organisations and media outlets	Advocate publication of open data and detect existing high-value open data sets for agriculture indicator monitoring

[15] http://knowhow.opendatamonitor.eu/stakeholder/stakeholder-requirements/

The consultative process used in developing this policy discussion document is outlined in Section 1.6 and Figure 1. This included consulting stakeholders through focus group interviews and stakeholder workshops. These interviews and workshops where held with over 50 stakeholders who were drawn from the five broad stakeholder groups in Table 5, and represented departments in the Ministry of Environment; Ministry of Communications; Ministry of Environment, Science, Technology and Innovation; Ministry of Local Government and Rural Development; representatives of private sector agri-tech firms; media organisations; research and academia institutions; civil society organisations; national farmer associations and multilateral organisations.

4.2 Challenges and opportunities raised by stakeholders

The focus group interviews and workshops led to the identification of the following issues and challenges for action:

- Limited funding and human resources within government to support opening up of agri-food data. Sustaining momentum for open data in MoFA will require additional external support at least in the short- to medium-term.
- Limited human and technical skills at sub-national levels of MoFA. District officers lack both resources and skills to collect and provide timely data. Regional offices are key to mobilising district, sub-district and farmer data flows but also lack coordination capacity. There is a need to complement the traditional ways of collecting data with new ICT and remote technologies, even in scaling up the computer-assisted personal interviewing (CAPI) system compared to doing paper surveys.
- Data that are collected by MoFA are disseminated by call centres and not in online, re-usable format. This limits the innovation potential of data intermediaries in the development of applications that can support local farmers, processors and retailers. A vibrant, dynamic, open and multi-tier data ecosystem is needed, in which data is supplied in timely fashion and can be interpreted and used in decision making if open data are to make a real impact
- Lack of coordination mechanisms across the many agri-food related organisations who can supply as well as use data. It was determined that many non-governmental organisations are collecting data and are willing to share however there is no one to play the coordinating role for this to take place sustainably.
- Lack of skills in interpreting data and ensuring quality. Projects need to focus more on local capacity building within governments, insist on institutionalizing measures, and ensure that the datasets released are the ones that address needs.
- Low agricultural productivity. Open data on crop potential and production advice to farmers and extension officers would help to improve decision making from local to national scales.

Several opportunities for open data were also identified:

- There is genuine political will to open up government datasets, not only for increased transparency but also in order to achieve economic impacts, social equity and to stimulate innovation.
- There is a general appreciation and appetite for open data among the stakeholders in the data ecosystem. Many of these stakeholders also possess skills and technical capacity to fulfil their roles (Table 7) if a coordination mechanism is provided.
- MoFA is strategically placed and in a favourable position to establish strategic partnerships with global and local partners for capacity building, advocacy and possibly funding.
- Mechanisms are already in place within MoFA for the regular and frequent collection of market price data for several commodities from up to 200 markets, which is critical for farmers. These need to be opened up in re-usable format online for use by data intermediaries, amongst others.
- The Ghana Open Data Initiative has already established data infrastructure that could be leveraged by MoFA for its open data publishing.

4.3 Exploring existing open data and priorities with stakeholders

Information on existing open data sets in relation to agricultural transformation were explored in a scoping workshop (Figure 1), which was attended by approximately 50 stakeholders from a diverse range of policy perspectives and use (Table 5). The Open Up Guide for Agriculture[16] was used as a starting point to guide the stakeholder identification of existing data. The guide provides a roadmap for governments to engage with open data and develop open data strategies to support agriculture. It is based on extensive consultation with policy makers, agriculture specialists and members of the open data community from around the world. It identifies six policy areas and 14 key data categories where open data can support the agricultural sector. The policy areas include: empowering farmers; optimizing agricultural practice; stimulating rural finance; facilitating the value chain; enforcing policies; improving transparency and efficiency. For each of the 14 data categories, a description of the data and example data sets are given in Table 6.

At the scoping workshop, stakeholders were asked to identify existing open data sets and their priority in relation to these policy areas. This was done in two steps. The first step was to consider the representative range of perspectives offered by the policy areas of the Open Up Guide. Workshop participants found these to be particularly appealing because they explicitly broadened the open data discourse to one that moves beyond opening up data by national government, to open data processes that include farmer perspectives and the different sectors involved in agri-food value chains. This deliberation led to aggregating the six policy areas in Open Up Guide into four similarly representative policy objectives for Ghana (Chapter 6). The second step then used these four policy objectives and 14 data categories to identify existing data sets and to prioritise these for opening up. The results of this process are described in the next two sections.

[16] https://openupguideforag.info/

Table 6: Fourteen data categories and example data sets suggested in the Open Up Guide for Agriculture (after https://openupguideforag.info/what-data/data-categories/)

Main group	Category	Description	Example datasets
Administration and legislation data	Government, agricultural law and regulations	Policy and legislation texts relevant for the agricultural sector	Subsidy schemes; animal health and welfare regulations; import/export regulations; environmental regulations; (phyto) sanitary regulations
	Official records	Lists of organisations, people or products officially registered, permitted or restricted as a result of legislation	Permitted pesticides; (import/export) tariffs; (safety) inspection results; approved permits; licensed organisations (corporations, businesses, NGOs); land registration
	Government finance data	Data on the financial management of the government, budgets, spending	Penalties given to agricultural actors; agriculture-related tax income; agricultural subsidy expenditure
	Rural development project data	Data describing rural development (RD) projects funded by a government. This may be the local government or a donor government (aid)	Rural development project documents; rural development project baseline and survey data; rural development project output, outcome and impact; general information on a rural development project
Socio-economic data	Land use data and productivity data	Data describing the land use, crop types and production of an area or region	Biomass; crop yield; cultivated crops and livestock; land use data
	Value chain data	Data describing the value chain and its activities	(Food) product data; company profiles of groups of value chain actors or organisations; (food safety) inspection results
	Infrastructure data	Data describing national networks for roads, water, ICT, including their condition and maintenance	Internet coverage; waterways; road management schedules; mobile telephone coverage; road network
	Market data	Data on the location of markets, market prices, market standards	Import/export volume; lists of markets and auctions; market prices; global food prices; location of markets; standards, grades, labelling; market management and rules
Natural resources, earth and environment data	Meteorological data	Quantitative data on weather and climate	Climate change predictions; climate zones; observations archives; real-time observations; short-term weather forecast
	Elevation data	Data describing the elevation of the terrain and its derivates	Digital elevation model; height points; slope data; aspect data
	Hydrological data	Data describing the state and dynamics of ground and surface water	Water management; water tables; water quality; real-time water levels; historical records on flooding; flood zones; water balance; location of water sources
	Soil data	Data describing soil properties	Soil classes; soil samples; soil maps
Agronomic data, agricultural technologies	Production advice	Data related to crop selection, crop and land management	Fertilizer recommendations; intercropping, relay cropping and rotations; agronomic practice recommendations; crop calendars; data on cultivars, land races and farmer varieties including new releases
	Pest and disease management data	Data on the distribution of pests and diseases and their treatment	Occurrences and distribution of plant diseases; treatment of plant diseases; recommended pesticides

4.3.1 Existing datasets related to agricultural transformation in Ghana

Guided by the 14 data categories of the Open Up Guide (Table 6), stakeholders identified existing data sets and sources within Ghana (Table 7), excluding global data sources such as satellite data.

Table 7: Important existing datasets and sources for agricultural transformation in Ghana

Data category	Dataset	Local Source
Government, agricultural law and regulations	• Subsidies • Sanitary regulations	• Directorate of Crop Services – Ministry of Food & Agriculture • Plant Protection & Regulatory Services – Ministry of Food & Agriculture
Official records	• Permitted pesticides • Land registration • Approved permits	• PPRSD • Environmental Protection Agency (EPA) • Food and Drugs Authority (FDA) • GSA • Land Commission • Registrar General
Government finance data	• Penalties • Tax exemption regulations for crops	• GSS • Environmental Protection Agency (EPA), • MoFA • Ghana Revenue Authority (GRA)
Rural development project data	• Rural development projects	• District Assemblies - www.ghanadistricts.com/districts • Ministry of Local Government & Rural Development
Land use data and productivity data	• Crop yield • Cultivated crops and livestock • Land use data	• MoFA (Statistics Research & Information) • Land Use and Spatial Planning Authority • District Assemblies • Land Commission • CSIR (Soil Research)
Value chain data	• (Food) product data • Company profiles of groups of value chain actors or organisations • (Food safety) inspection results	• Land Use and Spatial Planning Authority • Farmer Based Organisations • Directorate of Agricultural Extension Services (MoFA) • Ministry of Fisheries and Aquaculture Development (MoFAD) • Agtech companies e.g. Farmerline & Esoko • CSIR • Agro Centre - agrocenta.com • Ghana Investment Promotion Centre (GIPC) • Ghana Export Promotion Authority
Infrastructure data	• Internet coverage; mobile telephone coverage • Waterways • Road management schedules • Road network	• Ministry of Communication • TELCOS • District assemblies • Ministry of Roads and Highways • Ministry of Works and Housing • Irrigation Development Authority

Data category	Dataset	Local Source
Market data	• Import/export volume • Lists of markets and auctions • Market prices • Global food prices • Location of markets • Standards, grades, labelling • Market management and rules • Quality standards	• GEPA - Ghana Export Promotion Authority • MOFEP - Ministry of Finance • Farmerline • GCX - Ghana Commodity Exchange • GSA - Ghana Standards Authority • FDA - Ghana Food and Drugs Authority • District Assemblies
Meteorological data	• Climate change predictions • Climate zones • Observations archives • Real-time observations • Short-term weather forecast	• Ghana Met Authority • MESTI (EPA) • Private sector companies
Hydrological data	• Water management • Water tables • Water quality • Real-time water levels • Historical records on flooding • Flood zones • Water balance • Location of water sources	• Water Resources Commission of Ghana • Hydrological Services Department • Irrigation Development Authority • Water Research Institute • Environmental Protection Agency • Ministry of Sanitation and Water Resources
Soil data	• Soil classes • Soil samples • Soil maps	• CSIR, Soil Department of CSIR • MoFA • NDA • NARS
Production advice	• Fertilizer recommendations • Intercropping, relay cropping and rotations • Agronomic practice recommendations • Crop calendars • Data on cultivars, land races and farmer varieties including new releases	• MoFA Directorate of Agricultural Extension Services (DAES) • Plant Protection & Regulatory Services (MoFA) • CROPS - Directorate of Crop Services (MoFA) • Yara Ghana - https://www.yara.com.gh/ • CRI - Crops Research Institute (CSIR)
Pest and disease management data	• Occurrences and distribution of plant and animal diseases • Treatment of plant diseases • Animal diseases • Recommended pesticides	• MOFA Directorate of Agricultural • Extension Services (DAES) • Animal Production Directorate (APD) • Animal Research Institute - CSIR

4.3.2 Priority data sets identified by stakeholders

At the scoping workshop (Figure 1), stakeholders were each asked to prioritize the data categories of the Open Up Guide, both in terms of the impact opening up would have for agricultural transformation in Ghana and the ease of opening up in the Ghana data ecosystem.

The priority data selected by stakeholders is shown in Figure 3. In terms of impact, stakeholders regarded market data, meteorological data, and land use and productivity data as the having the most impact on opening up. Most selections of meteorological data (6/8 instances) were referring to short-term weather, rather than long-term climate change information. Interestingly, market data and land

use and productivity data were also regarded as being some of the easiest data sets to open up. Similar to many other countries, meteorological data was not considered as easy to open up compared to production advice, pest and disease management, and government agricultural regulations. A description of the four most impactful data sets to open up for agricultural transformation (market data, land use and productivity data, production advice data (fertiliser) and meteorological data (weather data)), together with the benefits of opening up these data from the viewpoint of farmers and other actors, is provided below.

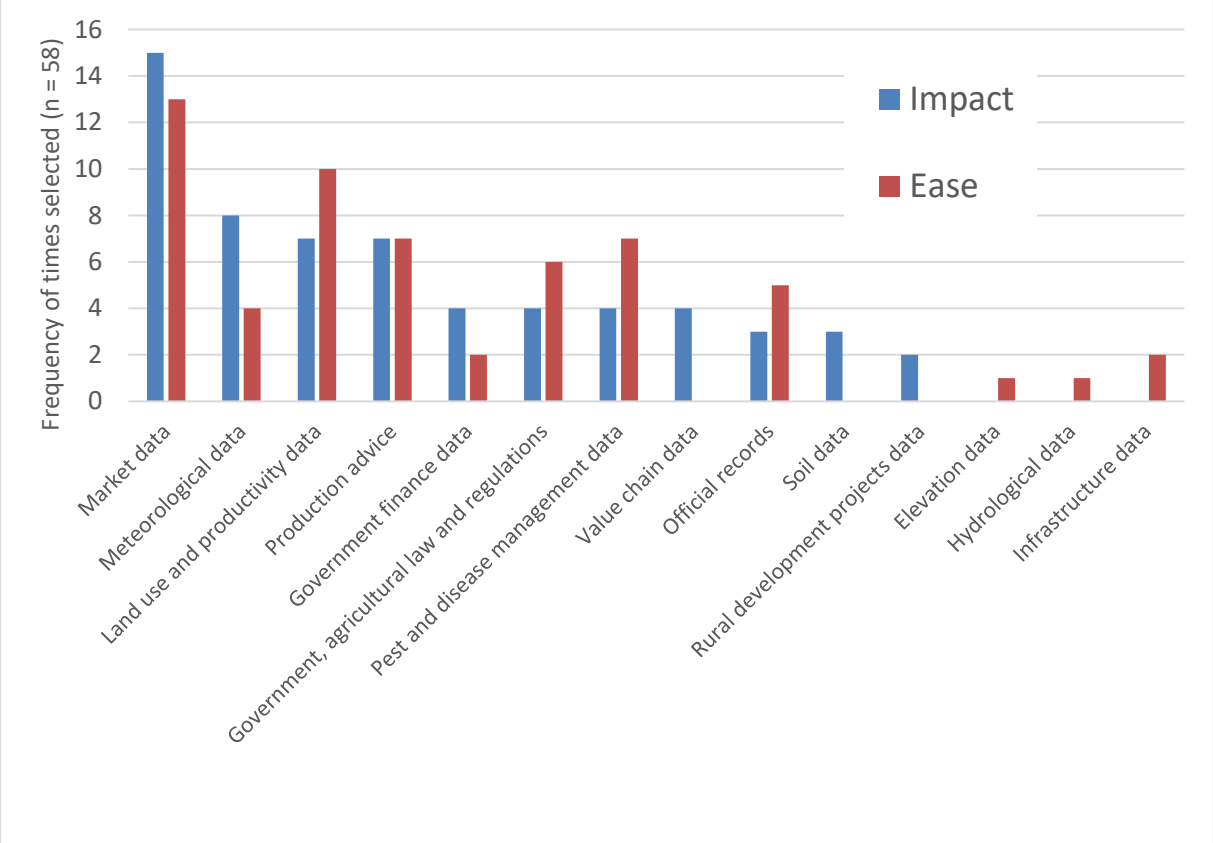

Figure 3: Priority data categories identified by stakeholders for opening up

4.3.2.1 Market Data

Market data includes data on the location of markets, market prices and market standards. In addition to these data, other information that was particularly highlighted by stakeholders included import - export tariffs, quality standards and global food prices. To create open equitable markets, price information should be shared with farmers. By providing open data on markets and market prices,

farmers will be better positioned to negotiate at the farm gate, select crops, and select a distribution channel. In Ghana, MoFA collects market price data on a weekly basis, and these are reported per quarter in aggregated format. Although the weekly prices data are potentially available to local farmers via the e-Agriculture call centres, the data are not truly open in the sense that they are not published in entirety in a re-usable, timely format online, and thus have limited use by data intermediaries intending to develop innovative products to support local farmers. Intermediary services can be built to make these lists easily accessible by the intended user groups. These lists include, for example:

- Market management and rules
- Standards, Grades, Labelling.
- Location of markets
- Global food prices
- Market prices
- Lists of Markets and Auctions
- Import/export volume

Benefits that farmers can realise from opening up market data include:

- Crop price history can help farmers make more informed decisions on what to plant.
- Improved knowledge of local and national prices improves a farmers negotiation power at the farm gate.
- Knowledge of local market prices can help farmers choose where to sell their crops.

Benefits of opening up market data to other actors include:

- Better price information can help financial services make better risk estimates about whether farmers can pay back their loans, and can determine the price of a financial product, increasing access to finance.
- Financial services, value-chain actors and governments can better forecast market developments with improved price information.

4.3.2.2 Land use and productivity data

Land use and productivity data describe the cultivated area, the crops grown and the yield in the different regions. Most governments make estimates of these measures in different regions to monitor food security and economic development. These figures have a strategic value for all value-chain actors in better planning and adapting their businesses. In the case of Ghana which has a vibrant ICT sector and increasing mobile penetration rates, sharing this data as open would encourage the development of specialised mobile services by ICT intermediaries (Section 3.4.3) who can, for example, provide tailored information on crop suitability useful for planning.

Farmers and extension agents can benefit from opening up land use and productivity data by being able to plan the crops to be planted next year in relation to the cropping pattern in the region in the previous year(s).

Benefits of opening up land use and productivity data for other actors include:

- Providing information for processors, storage facilities and traders to plan and anticipate the next harvest. By having data on the success of previous harvests or data on the (condition of) the standing crop they can plan better.
- Input suppliers are able to expand or adapt their business strategically with better understanding on the land use in different regions.
- Information on previous harvest successes allows financial service providers to make better estimates of the risk they take when providing loans or insuring farmers in a certain area and in making strategic decisions on how to develop their business.
- When used with caution, the data can help civil society to evaluate the success of agricultural policies.

4.3.2.3 Meteorological data (short-term weather data)

Meteorological data are quantitative data on surface weather variables including forecasts, local observations and historic archives. The Ghana Meteorological Agency are responsible for collecting this type of weather information in the country. Many agricultural activities (e.g. sowing, harvesting, fertilizer application) are dependent on weather conditions for planning and effectiveness, and most agricultural stakeholders are interested in some form of meteorological data. By making meteorological data open it not only becomes easier to share, but also allows the development of specialised information services by ICT intermediaries (Section 3.4.3) who provide information tailored to specific user needs. Examples of such specialized services are early warning systems for weather-related crop diseases, encouraging farmers to take preventive measures, and the prediction of suitable conditions for farm activities.

Farmers benefit from the opening up of meteorological data by having timely and accurate weather information to better plan farming activities. Other actors benefit as follows:

- By having access to weather archives, (local) climatic conditions can be objectively determined, allowing more accurate:
    - farm management advice for the farmer; and
    - investment risk investigation for financial institutions, resulting in better access to finance for farmers.
- By having access to archives of local weather variables, the weather forecast for that particular area can be improved (downscaling).
- By having access to near real-time weather observations, insurance companies are enabled to build index insurance products, reducing food security risks for the farmer and increasing the access to finance.

4.3.2.4 Production advice data

In order to provide accurate and reliable extension services, data related to crop selection, crop management and land management is critical. Important information includes data on cultivators, landraces and farmer varieties (including new releases); crop calendars; agronomic practice recommendations; intercropping, relay cropping, rotations; data related to fertiliser use (which came out as a high priority from stakeholders). The existing e-Agriculture call centre in Ghana already serve to bring this information to farmers in six different languages. However, the data are not strictly speaking open in the sense that they are not published online in a re-useable format that can be accessed by information intermediaries. Information intermediaries play a powerful role in upscaling the potential of reaching farmers with agronomic data, and opening the data supplied by the call centre into a more re-useable format will open the possibility of leveraging these benefits.

A pragmatic approach is to start with the agronomic data identified as having high priority (Figure 3), which is relatively easy to open up (it already exists) and has high value for farmers, such as information on fertilizer varieties and their specific characteristics, fertilizer recommendations per crop, pesticide management and soil type.

Farmers benefit from opening up production advice data because when it is shared in a usable and understandable manner, they can use the data to improve their farming practice, resulting in a higher yields and more sustainable systems. Other actors also benefit as follows:

- Extension officers in the field can inform farmers using timely and accurate information, including the latest insights from research, leading to higher yields and more sustainable systems.
- Input suppliers can plan their business using the latest government recommendations in agriculture.
- A strong extension system increases the confidence of financial service providers in the risks they take while lending money, providing insurance or facilitating financial inclusion.
- Knowledge of local varieties, practice and yield expectations helps financial service providers to make better risk estimates.
- Government extension information is shared more widely, and changes can be implemented more swiftly, increasing the impact.

5 Guiding principles and an open data goal for agricultural transformation

5.1 Global best practice on open data principles

There are two sets of broad principles that are often used in the open data community. The Open Data Charter[17], to which the government of Ghana subscribes, is an independent voluntary programme sponsored by the Fund for the City of New York. It provides useful principles related to the release and publication of open data, which can serve as best practice guidelines when considering open data:

1. Open by default
2. Timely and comprehensive
3. Accessible and usable
4. Comparable and interoperable
5. For improved governance and citizen engagement
6. For inclusive development and innovation

In order facilitate good data stewardship, a broad community of international stakeholders have also developed the FAIR Data principles[18] which stand for 'Findable, Accessible, Interoperable, and Reusable'. These principles overlap with open data principles but focus mostly on the term **Accessible**, which is taken to mean that data are accessible by appropriate people, at an appropriate time, in an appropriate way. This implies that data should be findable, accessible, interoperable, and reusable (FAIR) regardless where they fall on the open by default spectrum, i.e. whether they are private, used by a defined group of people, or accessible by everyone (open data).

In general, open data principles stipulate that data should be meet the following conditions:

1. **Availability and access**: The data must be available as a whole, and at no more than a reasonable reproduction cost, preferably by downloading over the internet. The data must also be available in a convenient and modifiable form.
2. **Reuse and redistribution**: The data must be provided under terms that permit reuse and redistribution including intermixing with other datasets.
3. **Universal participation**: Everyone must be able to use, reuse and redistribute – there should be no discrimination against fields of endeavour or against persons or groups.

The government of Ghana acknowledge the need to ensure access while also maintaining the appropriate rights and responsibilities for good data governance. The National Data Sharing Policy (Section 3.4.1.2) provides for a Data Sharing Steering Committee, chaired by NITA, that will ensure that best practice standards and operational expectations are consistent with global open data recommendations and guidelines. In line with national policy, MoFA recognizes that data exist on a

[17] https://opendatacharter.net/principles/

[18] https://www.go-fair.org/faq/ask-question-difference-fair-data-open-data/

spectrum, and that agricultural datasets may include sensitive information for security, personal or commercial reasons.

5.2 Guiding principles underpinning open data for agricultural transformation in Ghana

Table 8 summarises the principles underpinning the policies relating to national development, agricultural development and open data policies in Ghana. These stem from an assessment of the national policy context in Chapter 3, Section 3.5.1.

Table 8: The principles reflected in national policies related to national development, agricultural transformation and open data.

National development and agricultural policy	ICT and open data policy
• Economic prosperity • Equity • Transparency • Participation and collaboration • Efficiency and strategic deployment of public spending • Accountability and coordination in implementing policy towards these • Enabling environment for private sector investment into domestic and international markets • Sustainable utilisation of natural resources • Peace and security	Policies emphasise the first five principles articulated in national development and agricultural policies (see left column of this table), in addition to aspiring for: • Data accessibility • Data interoperability • Data accuracy • Relevant, reliable and timely data • Enabling conditions for ICT innovations

Based on the principles in Table 8, the policy discussion document proposes the following set aspirational principles, which should underpin the policy objectives and action plans identified in the subsequent chapters:

5.2.1 Accessibility

In line with privacy and protection legislation, agricultural data are disclosed in forms that Ghanaians can readily find and use without unnecessary bureaucratic or administrative barriers which may deter data users. The preference is for data to be openly accessible to all. Data will be published timeously in machine-readable formats as raw or disaggregated data under an open license subject only to considerations of state security and individuals' rights to privacy and safety. Where sharing takes place between government institutions, the data shall be in formats that allow for the integration of the

data into other databases and information management systems. Data are re-usable by information intermediaries.

5.2.2 Inclusiveness

All citizens of Ghana and government employees have access to information on programmes and services that shape and promote agricultural transformation. There is attention to diversity and inclusion. Women, the disabled, minorities and/or vulnerable are included. Attention includes the use of appropriate languages, technologies and methodologies to include minorities. This means reducing socio-economic, physical and technical barriers, and creating accessible channels for delivery of agricultural programmes and services.

5.2.3 Participation, coordination and collaboration

Government provides a coordination capacity that builds an effective enabling environment for public, private, civil society organisations and communities participation and collaboration. Community consultation provides valuable input into the co-design and delivery of agricultural programmes and services in an integrated and effective manner. Public, private partnerships are encouraged.

5.2.4 Innovation, market integration and job creation

Open data flows facilitate links across the entire data ecosystem to envision, create and foster new products and services for domestic and international markets, and drive the creation of new jobs and business models. The use of science and technology in agriculture is encouraged, and this attracts young students and entrepreneurs to the agricultural sector, who are trained in open data and ICT and engaged in finding creative ways to be more resource efficient and drive transitions toward a more sustainable and circular agri-food system.

5.2.5 Transparency and accountability

Government open data provides clear disclosure of information, rules, plans, processes and actions to facilitate understanding of how local public affairs are conducted. Such transparency helps to ensure that local representatives and officials take responsibility and are held responsible for their actions. Clear monitoring and reporting frameworks, and the investment required to maintain these, are explicitly planned for and used as a tool for monitoring government performance and refining management where needed.

5.2.6 Sustainability and circularity

Open data is used as a decision-making tool to realise high yields while making efficient use of raw materials and energy and minimising the impact on nature, environment and climate. Open data monitors the impact of agricultural development in line with SDGs, prevents waste and works towards circularity in the agri-food system.

5.3 A common open data goal for agricultural transformation in Ghana

The need for transforming and modernizing the agricultural sector in Ghana is highlighted in both national development and agricultural development policies as a key strategy for economic development and job creation. Agricultural transformation refers to a state in which agriculture is a vibrant, modern, and sustainable business that creates value for farmers, entrepreneurs, youth, and women, and produces affordable, nutritious, and healthy food for all. In line with this aspiration and the principles above, the common goal for open data is proposed in Figure 4: "To inspire all actors in the food and agricultural sector to share open data as a strategic resource for collectively promoting food and nutrition security, creating employment opportunities and eradicating poverty".

Implementation towards this open data goal would provide many benefits to local Ghanaian citizens, such as improving yields, increasing income, lowering input costs, securing land tenure, creating jobs especially for youths, catalyzing new partnerships and opportunities (yellow box, Figure 4). These in turn support the achievement of global, regional and national outcomes such as food and nutrition security, agricultural development and contribution to GDP, job creation, social inclusion, and environmental sustainability (orange box, Figure 4).

While it may be relatively easy to share common principles and a goal, little will be achieved in reality unless the goal is cascaded down into a set of common operational objectives, where all agree on what must be done, and who will take responsibility and accountability for which tasks. These objectives must be clearly understood by all, collaboratively developed, and cooperatively implemented. The open data goal is therefore underpinned by two 'application layers' (Figure 4). The first layer proposes a set of four policy objectives and associated recommendations (grey boxes, Figure 4), encompassing a diverse range of policy perspectives. These are described further in Chapter 6. To help catalyse implementation of the policy objectives, the second 'application layer' includes four short- to medium-term action plans (green boxes, Figure 4). Activities within these action plans serve to operationalize different policy objectives, as shown in Figure 4 by the positioning of the green boxes (action plan) relative to the respective grey boxes (policy objectives).

Figure 4: The open data goal (blue box) for agricultural transformation provides multiple benefits to local Ghanaian citizens (yellow box) and supports global, regional and national outcomes (orange box). The goal is underpinned by two 'application layers': the policy objectives and associated recommendations (grey boxes) and the action plans (green boxes) to catalyse their implementation. The position of the green boxes relative to grey boxes shows the association of action plans with each policy objective.

6 Policy objectives for open data for agricultural transformation

This chapter proposes a set of four policy objectives which, when considered with their associated recommendations, are intended to provide a shared agenda for cross-sector coordination and cooperation in achieving the national goal of open data for agricultural transformation (Figure 4). Each policy objective incorporates the aspirational principles identified in Section 5.2 to a varying extent as shown in Table 9.

The associated recommendations are framed over a 2 to 10 year time horizon, with the action plans in the next chapter representing short- to medium-term activities to catalyse the recommendations. In the sections that follow, each policy objective is presented in a separate section. First, the rationale and current context in Ghana is described. This is followed by a set of accompanying cross-sector policy recommendations, and an explanation of some of the open data already existing as summarized in Table 7 of Chapter 4. These recommendations were discussed and refined at meetings of cross-sector stakeholders during 21-24 October 2019.

Table 9: The extent to which each aspirational principle is incorporated into the policy objectives (+++ indicates very strong association; ++ strong; and + moderate)

	Principles					
Policy objectives	Accessibility	Inclusiveness	Participation, coordination, collaboration	Innovation, market integration, job creation	Transparency, accountability	Sustainability, circularity
Empower farmers	+++	+++	++	++	+	+
Optimize agricultural practices	+++	+++	+++	+++	++	++
Facilitate agricultural value chains	+++	+++	+++	+++	++	+++
Enhance government coordination capacity	+++	+++	+++	++	+++	++

6.1 Objective 1: Empower farmers with access to information and agri-finance

6.1.1 Rationale

The agricultural sector employs nearly half of the workforce and is the main source of livelihood among smallholder farmers in Ghana. This policy objective harnesses the agricultural sector's capacity to enhance rural economic development and livelihoods by empowering farmers, especially smallholders, with access to information and knowledge from other actors who are higher up in the agriculture value chains, such as traders or subsidy officials. Open access to information offers farmers a chance to make more informed decisions to guide their farm production and trading processes. Combining open data sources and mobile information services can help to bring information to farmers in remote rural areas and remove power imbalances that may exist from lack of access to information. Bringing such technologies to remote areas, and empowering farmers to use these can also potentially leverage more enabling environments around agri-finance. This is because open data on historical production, markets, local crop potentials and climate can help set out individualised financing strategies for farmers, and lower risks for agri-financiers.

This policy objective is acknowledged as a government priority through the explicit incorporation of e-Agriculture into the Presidency's flagship project on Planting for Food and Jobs (Section 3.3.5). The e-Agriculture system under Planting for Food and Jobs provides near real time and cloud computing services, so that data from beneficiaries can be collected and validated. The initiative has so far registered almost 700,000 local farmers. This provides an important platform to work towards a longer-term objective of stimulating agri-finance to farmers through digitalisation and open data.

6.1.2 Policy recommendations

The short- to medium-term recommendations of this policy object focus on bringing access of information and digital literacy to rural areas and empowering local farmers to use these data to their benefit. This will implicitly work towards a longer-term objective of stimulating agri-finance. The following short- to medium-term recommendations support this policy objective

- Design communication initiatives that target smallholder farmers in rural areas in creating awareness of digital technologies and open data, and the e-Agricultural support platforms of MoFA.
- Provide local training of farmers to improve their digital literacy skills, and the use of the key information sources from which they can benefit.
- Train information intermediaries to develop digital innovations to meet the needs of users (demand driven approaches to design).
- Work with NITA to ensure that the necessary reach, capacity and quality of connectivity infrastructure is in place to support local users
- Provide access to key information sources, such as those suggested in the next section.

6.1.3 Overview of existing key data sets

The Open Up Guide for Agriculture lists the following relevant data for farmer empowerment: actual and historical market prices, physical infrastructure and its condition, the location of licensed organisations, permitted chemicals and land ownership (Table 6). Table 7 shows examples of the existing data sets in Ghana and their sources. Of these, market data, land registration, meteorological data (especially short-term weather) and production advice data (especially on fertiliser) were highlighted as having the most impactful benefits for this policy objective. With exception of meteorological data, these were also considered relatively easy to open up.

6.2 Objective 2: Optimize agricultural practices through digital extension services

6.2.1 Rationale

Ghana is endowed with vast areas of high agricultural production potential which can support a wide range of commodities. However, the agricultural sector in Ghana is currently characterized by low yields. Yields for both staple and cash crops are well below regional standards, and even though the country is the world's second largest producer of cocoa, cocoa yields are among the lowest in the world. Agricultural productivity currently does not meet the CAADP goal of 6% growth annually.

Closing the yield gap on staple and cash crops is a major opportunity for promoting economic development and food and nutrition security in Ghana. To date, strategies for closing these yield gaps have been driven mainly by the expansion of cultivated areas rather than by increased productivity. Adapting and modernizing farming practices and farm management is an important means to closing yield gaps through improving agricultural productivity. Open data can contribute to improved productivity in three ways. First, it provides agronomic data relevant to specific local conditions. Agronomic data is place-specific data that can be tied to a specific piece of land (e.g. planting population, hybrid selection, yield data, pesticide application, best practices). By providing agronomic data as open data and supporting access to it through ICT technologies (e.g. mobile phones, internet), many more farmers can access and benefit from the latest agronomical insights. Second, the effective flow of agronomic data supports the advisory and monitoring role of traditional extension service officers, which is critically needed given that the ratio of farmers to extension officers is currently 1 : 1,862 (Section 3.3.1.1). Third, continual demand and supply of such data by farmers provides a means of constantly and effortlessly updating agronomic insights, which ultimately informs regional and national planning to promote agricultural productivity, increase food security, and improve rural livelihoods.

6.2.2 Policy recommendations

The following short- to medium-term recommendations support this policy objective:

- Develop codes of conduct for sharing data among the actors in the value chain (e.g. licensing, ownership, privacy).
- Work with farmers associations to identify farmers' problems and high-priority needs, and opportunities that agronomic data could address.
- Capacitate extension officers and other information intermediaries to use, interpret and disseminate relevant and timely data-driven information for smallholders, and to be able to show farmers how to make best use of these digital services.
- Logistical coordination and integration of multiple data sources and flows for regional decision making.
- Provide access to key data sources, e.g. those described below (Section 6.2.3).

6.2.3 Overview of existing key data sets

The Open Up Guide for Agriculture lists the following relevant data for optimizing agricultural practices: data on crop selection, farm management, early warnings, and sustainable production methods, but also environmental data such as short-term weather forecasts, climate change predictions, soil data, altitude data and hydrological data (Table 6). Table 7 shows examples of the existing data sets in Ghana and their sources. Of these, production advice data (especially on fertiliser) and meteorological data (especially short-term weather) were highlighted as having the most impactful benefits and were also considered relatively easy to open up. In addition, mapping the potential of different crops at a fine resolution was considered as a priority by stakeholders interviewed (Section 4.2).

6.3 Objective 3: Facilitate coordination and efficiency in agricultural value chains

6.3.1 Rationale

Agricultural value chains refer to a set of actors and activities that bring a basic agricultural product from production in the field to final consumption, adding value to the product at each stage. Value chains work best when their actors cooperate to produce higher-quality products and generate more income for all participants along the chain. When actors in one part of the value chain know about performance in other parts of the value chain, they can make more informed decisions and be better linked to opportunities provided by different actors. For example, they may be able to identify new actors with mutual benefit for business, or they may be able to understand the uncertainties or quality standards in different markets, or indirectly generate new employment opportunities.

MoFA plays a critical coordinating role in the collection, processing and dissemination of open data across the agricultural value chain. Coordination capacity is required on at least two key levels. First, coordination needs to be achieved within government itself – across ministries, departments and agencies – to ensure that government opens up data to stimulate efficiencies and innovations. Second, it requires mobilising open data producers and users across the agricultural value chain, including

government, business, development agencies and civil society – at all levels from local farmers to national actors.

Achieving coordination of government open data across ministries is supported by mechanisms such as the Data Sharing Steering Committee (Section 3.4.1.2). Coordination of activities between smallholder farmers and the private sector has been somewhat stimulated by the Planting for Food and Jobs programme (Section 3.3.5), and still holds plenty of scope for further development. However, there seems to be extremely limited coordination capacity aimed at mobilising the open data collected by development partners. This lack of coordination has resulted in a growing tendency for development partner initiatives to run parallel to MoFA's efforts rather than be embedded in them, or at least align with them. It has also meant that, even when development partners are willing to share their data, there is no mechanism for doing so.

6.3.2 Policy recommendations

The following short- to medium-term recommendations support this policy objective:

- Build coordination mechanisms between farmer cooperatives and other agri-business partners. These may take the form of communities of practice, more technical infrastructure platforms, or formal and informal policy agreements.
- Promote internal collaboration between different government agencies for improved data flows. This can be facilitated by participation on the national Data Sharing Committee and effective mobilisation of the associated Data Task Team (Section 3.4.1.2).
- Coordinate the collection and dissemination of data from development partners already collecting value chain data.
- Pilot logistics management for post-harvest storage and transport in a priority value chain.
- Pilot how the opening up of data along value chains of major crops can promote efficiencies and innovation, from production (e.g. provision of quality seeds of improved varieties, fertilizers and good agronomic practices, and marketing of farm outputs), through processing to consumption.
- Provide access to key data sources, e.g. those described below (Section 6.3.3).

6.3.3 Overview of existing key data sets

The Open Up Guide for Agriculture lists the following relevant data for optimizing agricultural practices: regional production figures over time, regional farm profiles, registered companies, and the condition of transportation infrastructure (Table 6). Table 7 shows examples of the existing data sets in Ghana and their sources.

6.4 Objective 4: Enhance transparency and accountability, and policy enforcement

6.4.1 Rationale

Transparency is important to improved public services. Public reporting of data promotes higher quality and more efficient services, choice and accountability. In particular, development partners, policymakers, beneficiaries, and civil society require data on public spending in the agricultural sector to promote more efficient decision-making and equity and prevent corruption. Opening up such data facilitates evaluation of progress and adaptive management in areas that are under-performing, which in turn stimulates quality and efficiencies in the delivery of public services.

Opening up data on government regulations on what is permitted, licensed, restricted or forbidden can lower administrative costs, promote internal collaboration between different government agencies, and enable intermediaries to make this information easily accessible for actors in the agricultural value chain. Many regulations result in lists of items or organisations that are permitted, licensed, restricted or forbidden. Having this data and the related legislation openly available can lower administrative costs, promote internal collaboration between different government agencies, and enable information intermediaries to make this information easily accessible for actors in the agri-value chain to act upon.

6.4.2 Policy recommendations

- Identify priority information required from e-Agriculture to support government reporting by the Statistics Research and Information Directorate (SRID) of MoFA, and Ghana Statistical Services.
- Provide open access to key data sources concerning transparency, e.g. those described below (Section 6.4.3).
- Provide open access to key data sources concerning government regulations, e.g. those described below (Section 6.4.3).

6.4.3 Overview of existing key data sets

Relevant data supporting government transparency and accountability include: government spending, subsidy distributions, and rural development projects. Relevant datasets supporting government policy enforcement include: land registration, licensed organisations (corporations, businesses, NGOs), safety inspection results, import/export tariffs, and permitted crop protection products.

7 Short- to medium-term action plans for moving forward

7.1 Overview of the action plans

The policy objectives in Chapter 6 set out common objectives and recommendations at a relatively broad level of detail. The set of action plans below are intended to operationalise some of these objectives and recommendations in the next two to five years, using a combination of funding sources and partners. The action plans were developed based on input from stakeholders and a situation assessment on the priority needs for moving the open data agenda for agricultural transformation forward. They have been designed to align as much as possible with current initiatives, so as to leverage existing momentum and funding.

Each action plan provides a brief project concept that can be used to coordinate activities between government agencies and development partners, or as a basis of a Terms of Reference for future work. The action plans outline the rationale, aims and activities, existing relevant initiatives, and the required expertise to accomplish the work.

The first two sets of action plans focus on building the open data coordination capacity of MoFA. They respond to a priority need to bring youth into agriculture and improve the MoFA staffing capacities, which are currently lower than 50% of what they should be. Capacity development for open data is required at all levels of governance, from agricultural extension officers, through to district and regional data officers, to data officers within the national ministry. Action plan 1 focuses on building the national coordinating capacity, without which, much of the open data would be fed into a black hole. Action plan 2 focuses on mobilising the open data flows from farmers and extensionists all the way through to the national portal. These action plans can be considered as cutting across all four policy objectives outlined in Chapter 6, which all require MoFA coordination capacity for their effective implementation. Action plan 3 responds to the priority need of enhancing the productivity of agriculture in Ghana and will build on existing open data initiatives in Ghana that address this need. Enhancing productivity and closing the yield gap in all major crops in Ghana is expressed strongly in both the national development plan, *the Agenda for Jobs* (Section 3.2.2), and the national agricultural investment plan, *Investing for Food and Jobs* (Section 3.2.4). Action plan 4 responds to a need to build an enabling environment for private sector and development partner investment, through coordinating the collection and dissemination of development partner data. This was strongly supported by development partner stakeholders, who expressed a desire to open up their data should a coordination mechanism exist.

The action plans address four of the seven agricultural sector policy objectives in MoFA's *Investing for Food and Jobs* (Section 3.2.4): all action plans inherently address objective 5 (Enhance the application of science, technology and innovation) and 6 (Promote agriculture as a viable business among the youth); action plan 2 also addresses objective 2 (Promote a demand driven approach to agricultural development) and action plan 3 directly contributes to objective 3 (Improve production efficiency and yield).

7.2 Action Plan 1: Capacity and training of national data officers for managing timely data flows to the national data portal

7.2.1 Background and rationale

This action plan focusses on developing the coordination capacity of national MoFA. While there is very good national government support for the aspiration of opening up data, there is a limited amount of human and technical capacities to adequately collect and manage agriculture related data to meet the increased demand from stakeholders. MoFAs current staff complement is critically low and aging rapidly – across national, regional and district levels, MoFA is currently operating at 47% of its required staffing capacity and 26% of these staff are over the age of 50 years. Open data and ICT offer an attractive career to youth, and capacity development in this field represents a means of both attracting youth into agriculture and developing the critical coordination capacity required to open up data for modernising and transforming agriculture.

This action plan works hand-in-hand with action plan 2, which serves to coordinate and mobilise the impact of data flows from sub-national levels. It is also a fundamental requirement for action plan 4, which focuses on coordinating the collection and dissemination of open data from development partners. Through developing the national capacity, this action plan also contributes to the potential for mobilising information intermediaries beyond government to assist in leveraging open data benefits across the agricultural value chain, providing a much more enabling environment for private sector investment and innovation.

7.2.2 Aim

The aim of this action plan is to develop the technical skills and capacity of national data champions in the MoFA national office, to ensure the national coordination of open data within the agricultural sector. Coordination is required across national government departments (e.g. with NITA and GSS), as well as with the district and regional offices of agriculture. The coordination capacity of national office is also seen as critical to adequately mobilise and sustain open data flows across the many actors in the agri-food value chain.

7.2.3 Suggested activities

The training programme will take a two-pronged approach. The first approach provides 'Train the Trainer' training, designed for more technically advanced local Ghanaian open data trainers, who will be responsible for ongoing assistance of national data champions within the MoFA national office. These trainers will be drawn from within government, as well as from local agencies with a track record of bridging between government and its external stakeholders. The course will include in-depth training and detailed material on how to run an open data programme or project, as well as a technical course for those deploying or maintaining open data portals. It will also include a hands-on pilot on operationalizing the agricultural component of the national portal and enhancing the timely dissemination of market data on the national data portal

The second approach will be to train promising young professionals, who have appropriate training in ICT and/or agriculture. Trainees will be drawn from existing MoFA and NITA staff, as well as from government internship programmes, which draw upon young graduates who need to fulfil their national community service obligations. The course will include topics such as:

- Basics and principles of open data
- Developing and open data management plan
- Data quality issues (e.g. duplications, errors, and inconsistencies that can lead to high error rates)
- Preparing and publishing open data
- Architecture and core functionality of a modern Open Data Management System
- Application of standards, formats, licensing and ethics
- Geospatial data and other special capabilities
- Engaging with the open data community

The course will also include practical sessions to train participants to access silos of data to get a complete view of what data is available, regardless of the source, type, or format. These practical sessions will focus on priority data for opening up as identified in Section 4.3.2, which include market price data, land use productivity data, and production advice data.

7.2.4 Existing relevant initiatives on which to build

- Build on lessons learnt through establishing data officers maintaining the energy access portal in Ghana
- Mobile Web (local company) offer some basic training, and a 'Train the Trainers' partnership with them and an international open data training company could hold potential
- Department of Science and Technology internship programme
- Explore in-kind staff secondment between MoFA and GSS
- Explore the use of interns as data champions to MoFA

7.3 Action Plan 2: Training programmes for regional and district data officers to mobilize open data flows between local, district, regional and national levels

7.3.1 Background and rationale

Agricultural capacity development is required at all three levels of government – national, regional and district levels – to leverage the benefits of open data. Action plan 1 addresses capacity development at national level. This action plan focuses on building the capacity at sub-national levels to mobilise the data flows from the very local level all the way through to national level.

At present there is a limited technical capacity to ensure data flows are developed and maintained between district, regional and national levels of MoFA. There is a need to train nominated data officers who have the responsibility of implementing sub-national data collection and data that feed the national data system. Agricultural extension officers already collect a lot of agronomic data, and district officers also collect market price data on a weekly basis. However, most of these data are not

widely accessible beyond MoFA and its call centre, and therefore are not strictly open to other value chain actors. Training on how to collect sub-national data in standardized formats and at high quality can greatly reduce the amount of time needed to prepare it for publication onto the designated national portal. Training can also capacitate sub-national officers to use data in providing extension advice.

Ideally, this action plan should be implemented at the same time, or slightly after action plan 1, to allow national data officers to first be in place who will be capacitated with the ability to advise on the data governance plan or framework to which the sub-national data officers should adhere. Such a governance framework would include: the roles, tasks, and responsibilities of each key stakeholder; mechanisms to ensure the preparation, collection, and/or processing of data that meets data standards; the application of metadata according to the standard format; and dissemination of data according to the principles of data interoperability.

7.3.2 Aim

This action plan aims to develop the technical skills on open data use and management at subnational level and will be piloted in a district and region that is at a stage of readiness for training to be effectively implemented. The intention is to not only improve access to data within government, but also to mobilise the data for use and re-use by citizens and intermediaries. The provision of open access, online and timely data to stakeholders beyond government is critical for creating an enabling environment for intermediary innovations, which could greatly upscale the ability to reach more farmers, improve yields, and facilitate more efficient value chains.

7.3.3 Suggested activities

The training programme should be piloted in at least one regional office, together with its district officers, and should include hands-on training associated with market data and production advice data. Suggested activities include:

- Selection of a region and district(s) of focus.
- Conducting a data journey analysis for selected key agricultural datasets to identify challenges and barriers in data flows from local to national government, and stakeholders beyond government.
- Using the data journey analysis to develop a training programme to address the barriers to data flows.
- Preparation of training material that includes topics such as: data collection and analysis, data management, database technology tools, adaptation and usage of mobile ICT tools e.g. Open Data Kit.
- Selection of designated data officers at regional and district level for training, and delivery of training.
- Follow-up support and assessment to ensure ongoing learning and impact.

7.3.4 Existing relevant initiatives on which to build

- NITA's open data training programme
- Africa Open Data and Internet Research Foundation – training programme for government
- Mobile Web Ghana training programme
- TransGov Ghana

Private companies offering training:

- BigData Ghana
- The Big Data Foundation

7.4 Action Plan 3: Optimizing agricultural practices with open data

7.4.1 Background and rationale

Like many African countries, agriculture in Ghana is predominantly on a smallholder basis with about 90% of the farmers cultivating less than one hectare. It is characterized by traditional methods of farming. Despite the global importance of cocoa, yields for this and other staple and cash crops in Ghana are low and below regional standards. There are still large yield gaps for many crops in Ghana, i.e. differences between potential yield and actual yield (http://www.yieldgap.org/ghana), and agricultural productivity currently does not meet the CAADP goal of 6% annually. Adapting and modernizing farming practices and farm management is an important means to closing this yield gap, increasing farmer income and ensuring food security.

Open data can contribute to this by providing agricultural practice information relevant to specific local conditions and constraints faced by farmers in their day-to-day decision making. Good agricultural practice is highly dependent on local circumstances. Factors like soil, climate, elevation, and availability of water are crucial for decisions on which crops to grow and which farming systems and techniques are suitable at a specific location. Insight into the spatial and temporal variability and possible ways to improve farming provide opportunities to adapt agricultural policies, agricultural planning and farm management. At the national and regional scales, such information can improve the policy development process, resulting in policy measures that encourage or subsidize effective farming systems to improve food security. At the local level, the insights can inform agricultural planning and extension, advising local farmers on how better to adapt to local circumstances, and providing insights into broader system level and market drivers. Finally, the information can be one of the basic sources of input into operational farm management advice to individual farmers at the field level.

7.4.2 Aim

This action plan focuses specifically on improving crop productivity through agricultural regional policy and regional to local farm management advice, and aligns strongly with Policy Objective 2: Optimize agricultural practices through digital extension services (Section 6.2). It focusses on generating and

disseminating information and advice on agricultural practices to local farmers, nested within a regional planning framework. The aim is to apply Innovation Recommendation Mapping (IRM), using open data as an important driver, to pilot the provision of regional and location-specific information that can enhance agricultural best practice and productivity. IRM is essentially a learning instrument that provides information about farming circumstances (biophysical, socio-economic) to help actors across the value chain co-design, plan, implement, monitor and evaluate interventions. It is a tool to support both the regional scaling of innovation and to provide local level agricultural planning and management information. An example of innovation may be information on a new crop variety, or a farming technology or practice, such as optimizing the application of fertilizers or a bundle of fertilizers.

Open data shall be used here as a powerful instrument to make both the process and its outputs available and affordable to as many as possible. This demands strong data-driven policies and directions with regard to the grounding rules of projects that are defined in the frame of the action plan. A general guideline should be “open by default”, unless there are strong reasons to protect specific data. This does not mean that all data should always be provided without costs. Added value service providers should be able to (re)cover the costs of generating data and maintaining data services. At the same time, such data should as much as possible become available under an open license.

In this action plan, we focus on two levels of application of IRM, one that focuses more on supporting innovation at the regional and district level and one that aims towards the operational, farm level management advice. The latter can benefit from the results of the first, for example because it provides directions towards the specific types of advice that are most needed at the local level.

The first level focuses mainly on planning information at the regional to district level, and aims to ‘modernize’ traditional agricultural productivity approaches by providing spatial information such as land capability and land evaluation in combination with a range of data enhancement techniques. These include data enhancement techniques such as using traditional land capability mapping in combination with:

- Other data mapping techniques, e.g. e-Agriculture data, GIS data, Earth Observation data, proximal sensor data, crowdsourced data, and modelling and multi-criteria analysis methodologies.
- Participatory elicitation of data with users interacting with data and models.
- Narrowing the scope from generic crop suitability to varieties or specific farming technologies.
- Spatially explicit mapping to the finest possible spatial granularity.

The second level will provide a more ‘dynamic’ perspective, connecting, for example, to near-real time monitoring systems that generate farm advisory information and alerts based on available, often dynamic data resources and where possible the exploitation of state-of-the-art data science and big data technologies. This approach will focus on using partially automated e-Agriculture systems to reach extensionists or farmers. The emphasis will in this case be on generation, delivery, and feedback

mechanisms to the final recipients via ICT tools and mechanisms, e.g. SMS, IVR, dashboards and multimedia platforms. It will make use of a multitude of available, often dynamic data resources combining and processing these with different ICT technologies, like:

- Spatial data infrastructures for processing and analysis of geospatial data at different spatial and temporal resolutions.
- State of the art data science, like artificial intelligence and machine learning algorithms.
- Big data technologies, to cope with large amounts of heterogeneous data and the velocity of real-time data streams.

7.4.3 Suggested activities

IRM cannot be performed without sufficient and good quality data to inform the process. Open data, feeding into IRM provide powerful opportunities for government, farmer organisations, NGOs and agro-industry to exploit this for collective innovation. This action plan will set up a project that pilots IRM with open data.

The pilot will focus on a specific agricultural region in Ghana, and on two or three important crops for Ghanaian agriculture. Efforts could go into mapping localized information such as data on fertilizers, pesticides or crop varieties to assess optimal farming strategies. The pilot will provide a proof of concept to demonstrate that, if the right data are available, targeted regional and local actions can be developed. These regional and local actions can help, for example, to inform extensionists and farmer organisations on new or adapted technologies for optimizing farm management and improving yields under specific local circumstances. The action plan will carry out the following activities:

- Analysis of the regional situation - which parameters are most critical for crop yields, what farm management and farming techniques are currently in place, which data methods and tools can support existing and future crop potential.
- Collection of existing data resources, making these available to the project and (where possible) publishing these as open data.
- Application of IRM as a method to determine how and where adapting agricultural practice can lead to higher yields and incomes. This is ideally a participatory process, where stakeholders co-develop strategies, based on the analysis of the available data and where ICT tools and expert knowledge are used to spatially map agricultural innovations and assess the potential effects on yields and income.
- Provide recommendations to feed the results into localized operational services, e.g. local extension work and development of digital farm management services.
- Select and execute one or more feasible pilots that develop an infrastructure and monitoring services that provide near real-time, localized advice to extension workers and individual farmers. Ideally these are partially based on the outputs of the regional mapping, e.g. in selecting their domains for advice (which might be customized to regions, crops, farming systems etc.) and the mechanisms to deliver advice.

7.4.4 Existing relevant initiatives on which to build

- Yield gap atlas (http://www.yieldgap.org/ghana).
- Ghana open data portal (https://data.gov.gh/, http://ghana.opendataforafrica.org)
- ISRIC World Soil Database https://www.isric.org/explore/isric-soil-data-hub
- Examples of evolving near real-time services, preferably (partly) based on open data, within and outside the African continent

7.5 Action Plan 4: Coordinating the collection and dissemination of data from development partners already collecting agricultural value chain data

7.5.1 Background and rationale

Ghana needs a vibrant, dynamic, open and multi-tier data ecosystem if the datasets are to make a real impact. From discussions with MoFA stakeholders, particularly development partners in the country, there is a strong willingness to share and release open datasets to MoFA and other stakeholders – however there is no one to play the coordinating role for these types of exchanges.

The open data landscape in Ghana consists of different actors and users with different needs, challenges, problems, expectations, roles and envisaged opportunities. A strategy to coordinate all internal and external actors, stakeholders and interested parties, is needed. This will facilitate the sharing of data and information, making them available for re-use. It also makes explicit the needs of every stakeholder, in order to realize innovation efforts and new products and deliver appropriate services for food and agriculture.

In addition to facilitating other organisations to share their data with MoFA, there is need for maintaining interaction, communication and contact with users of the data (e.g. private sector, the media) to understand what data these users need and the gaps in skills that are required to foster the development of new innovative products and services, and thereby achieve national and global benefits of open data.

7.5.2 Aim

This action plan primarily explores:

i. Creating an online community of practice online platform (with offline sessions) for agriculture data community to promote data sharing best practices

ii. Creating an online platform to channel the submission of open data by development partners in Ghana.

iii. Working together with Ghana Statistical Services to ensure the use of a quality assurance methods and tools used for the open data collected and exchanged among development partners and with MoFA.

iv. Strengthening the skills for responsible data use and data ethics.

7.5.3 Suggested activities

i. Form an initial steering committee with representatives of agriculture stakeholders.
ii. Create a data ecosystem map for Ghana for either general agricultural data or a specific value chain e.g. mapping the data ecosystem for the cocoa value chain. This helps to identify the data, data stewards and data users; the different roles they play; and the relationships between them and importantly understand how data creates value.
    a. The steering committee can use the map as a practical tool to plan and visualise a data ecosystem or show opportunities for increasing value to parts of a data ecosystem.
    b. This process will help identify the organisations with data to share and begin the process to coordinate the submission of datasets.
iii. On MoFA data portal (pre-requisite) create a user registration system for verified external partners to provide data submissions.
iv. Prepare and deliver training in collaboration with GSS on data quality assurance for data collectors and providers.
v. Prepare and deliver training on data responsibility, codes of conduct and ethics for the community of practice members.
vi. Conduct monthly online meetings with the steering committee to plan data upload sprints.
vii. Coordinate annual or semi-annual forums for the community to discuss progress, gaps and future activities.

7.5.4 Existing relevant initiatives on which to build

- Africa Open Data and Internet Research Foundation (AODIRF) – training programmes for government
- GSS data quality assurance programme
- Mobile Web Ghana open data programme
- TransGov Ghana
- BigData Ghana
- The Big Data Foundation
- GODAN Trainer network - Ghana locals

8 Conclusions

Agricultural transformation in Ghana will require the coordination and cooperation of a diverse spectrum of actors across the whole agri-food value chain. This policy discussion document is intended to stimulate a common goal and policy objectives around which the agri-food sector can cooperate to advance open data for agricultural transformation. MoFA, as lead agent for implementing the agricultural sector policy, plays an important role in realising this goal and its policy objectives. The action plans are not an exhaustive suite of actions to realise the policy objectives but are rather intended to catalyse some of the priorities and enabling conditions necessary for advancing open data for agricultural transformation in the short- to medium-term. The intended way forward would now be to work with government, business and Civil Society Organizations in Ghana together with relevant development partners to adequately resource the action plans, building on and leveraging existing initiatives as much as possible. To this end, a regional workshop is suggested in early 2020 to consider the options for leveraging public, private and development partner investment in the action plans.

Appendix 1: Assessment of global and regional tools that help to evaluate and advance open data for agriculture