GHANA'S STI FOR
SDGs
ROADMAP
2021

The Republic of **Ghana**

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SUSTAINABLE DEVELOPMENT G**O**ALS

GHANA'S **STI** FOR

SDGs

ROADMAP

2021

Contents

Abbreviations

ABBREVIATION	MEANING
1D1F	One District One Factory
ADP	Advance Digital Production
AFD	Agence Française de Développement
AfDB	African Development Bank
AGI	Association of Ghana Industries
AI	Artificial Intelligence
AIDS	Acquired Immunodeficiency Syndrome
AU	African Union
BoG	Bank of Ghana
BSTEM	Business Science Technology Engineering and Mathematics
CENDLOS	Center for National Distance Learning and Open Schooling
CEO	Chief Executive Officer
CFTA	Continental Free Trade Agreement
CIDA	Canadian International Development Agency
COVID-19	Coronavirus Disease
CPSEDP	Coordinated Programme of Economic and Social Development Policies
CSIR	Council for Scientific and Industrial Research
CSO	Civil Society Organisation
CWSA	Community Water and Sanitation Agency
DFID	Department for International Development
EPA	Environmental Protection Agency
ESIC Apps	Expanded Sanitary Inspections, Compliance Applications
ESP	Education Strategic Plan
FAO	Food and Agriculture Organisation
FARA	Forum for Agricultural Research in Africa
FM	Frequency Modulation
GBC	Ghana Broadcasting Cooperation
GDP	Gross Domestic Product
GEF	Global Environment Facility
GES	Ghana Education Service
GH	Ghana
GhAIP	Ghana Agricultural Investment Plan
GHS	Ghana Health Service
GH	Ghana Cedi
GIRC	Ghana Innovation and Research Commercialization Center
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GRATIS	Ghana Regional Appropriate Technology Industrial Service
GSGDA	Ghana Shared Growth and Development Agenda
GSS	Ghana Statistical Service
GWC	Ghana Water Company
HTA	Health technology assessment
ICT	Information Communication Technology
IDRC	International Development Research Centre
IoTs	Internet of Things
IP	Intellectual Property
JHS	Junior High School
KNUST	Kwame Nkrumah University of Science and Technology
M&E	Monitoring and Evaluation
MDG	Millennium Development Goal
MELR	Ministry of Employment and Labour Relations
MESTI	Ministry of Environment Science Technology and Innovation
MGCSP	Ministry of Gender, Children and Social Protection
MMDAs	Metropolitan and Municipal District Assemblies
MMR	Maternal Mortality Ratio
MoC	Ministry of Communications

ABBREVIATION	MEANING
MOE	Ministry of Education
MoF	Ministry of Finance
MoFA	Ministry of Food and Agriculture
MoH	Ministry of Health
MoTI	Ministry of Trade and Industry
MOYS	Ministry of Youth and Sports
MSWR	Ministry of Sanitation and Water Resources
NBA	National Biosafety Authority
NBSSI	National Board for Small Scale Industries
NCCE	National Commission for Civic Education
NDPC	National Development Planning Commission
NDWQMF	National Drinking Water Quality Management Framework for Ghana
NESSAP	National Environmental Sanitation Strategy and Action Plan
NGO	Non-Governmental Organisation
NHIS	National Health Insurance Scheme
NSC	National Steering Committee
NSS	National Service Secretariat
NVTI	National Vocational Training Institute
OER	Open Educational Resources
PEF	Private Enterprise Federation
PPP	Public Private Partnership
R&D	Research and Development
REP	Rural Enterprise Programme
RTF	Rural Technology Facility
SARS	Severe acute respiratory syndrome
SDGs	Sustainable Development Goals
SHS	Senior High School
SME	Small Medium Enterprise
STEM	Science Technology Engineering and Mathematics
STEPRI	Science and Technology Policy Research Institute
STI	Science Technology and Innovation
TB	Tuberculosis
TOR	Terms of Reference
TTT	Technical Task Team
TV	Television
TVET	Technical and Vocational Education and Training
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNEVOC	United Nations International Centre for Technical and Vocational Education and Training
UN-IAAT	United Nations Inter-Agency Task Team
UNICEF	United Nations International Children's Emergency Fund
UNIDO	United Nations Industrial Development Organization
UNOICT	United Nations Office of Information and Communication Technology
US	United States
USAID	United States Agency for International Development
USD	United States Dollars
WB	World Bank
WFP	World Food Programme
WHO	World Health Organisation
WIAD	Women in Agricultural Development Directorate
WRC	Water Resources Commission

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Foreword

Dr. Kwaku Afriyie (MP)
Ghana's Minister for Environment, Science, Technology and Innovation

Science, Technology, and Innovation (STI) have been recognized as major drivers of socio-economic advancement in many developed economies. The definitions of, "science," "technology," and "innovation" may show clear distinctions; yet, they are so connected that they are considered integrated and often referred to in the singular form – STI. The Sustainable Development Goals (SDGs) have come to highlight development gaps confronting nations and STI has been identified as the veritable tool for addressing the SDGs. This resonates with the First Ten-Year Plan of the African Union's Agenda 2063, adopted by the African Leaders as well as Ghana's own long-term development plan – (The Coordinated Programme of Economic and Social Development Policies [2017–2024]), where STI has been identified as the driver of development. Moreover, in the Addis Ababa Action Plan, Member States have committed to adopting science, technology, and innovation strategies as integral components of their national sustainable development strategies.

For STI to effectively drive the SDGs to achieve the goals of the Coordinated Programme of Economic and Social Development Policies, there must be the requisite plan to direct this application. Ghana, with the support of UNESCO, the CSIR-STEPRI under the auspices of the Ministry of Environment, Science, Technology and Innovation (MESTI), was one of the pilot countries in the Global Pilot Programme, spearheaded by the UN Inter-agency Task Team (UN-IATT) to prepare, launch and publish a RoadMap of Science, Technology, and Innovation for the achievement of the Sustainable Development Goals (STI4SDGs). The Roadmap, which was prepared through an extensive consultative process including Government Ministries, Departments and Agencies, Academia, the Private Sector, Civil Society Organizations, Development Partners and other domestic and international organizations, clearly outlines how Ghana's development partners (DPs) including UN Agencies and Development Banks can support the implementation of the Roadmap.

On behalf of the Government of Ghana, I call on all requisite stakeholders to support the implementation of the actions prescribed in the STI4SDGs RoadMap to enable us to achieve its goals and objectives. It is my expectation that the effective implementation of this roadmap, would enhance our collective efforts in the use of STI to drive societal needs in consonance with the government's overall direction to place science, technology and innovation at the center of socio-economic development as a nation.

Mr. Abdourahamane Diallo
UNESCO Representative to Ghana

Science, technology, and innovation (STI) are critical to member states achieving the United Nations Sustainable Development Goals, as STI can contribute directly or indirectly to virtually every goal and target. It is for this reason that the UN Interagency Task Team on STI for SDGs rolled out the Global Pilot Programme for STI for SDGs Roadmaps in 2019.

Ghana, Ethiopia, India, Kenya, and Serbia were assisted in developing a policy-making tool to help align national actions in science, technology, and innovation with the SDGs, while also effectively facilitating relevant regional and international efforts.

UNESCO was honoured to co-lead and support Ghana as part of the programme, and this roadmap is the result of extensive stakeholder consultations on current STI opportunities as well as how Ghana can use, manage, and govern STI to ensure the achievement of Ghana's prioritized sustainable development goals.

It is worth noting that the African Union Agenda 2063 recognizes Science, Technology, and Innovation (STI) as multifaceted enablers to accomplish and sustain the continent's development goals. This underpins the Science, Technology, and Innovation Strategy for Africa (STISA-2024), which provides overall policy directions and priority areas for investment in STI on the continent. As such, I believe the roadmap is consistent with Agenda 2063 and lays out the country's strategy to support both the implementation of the Agenda and the nation's STI policy.

Also, a key component of this roadmap is the reinforcement of partnerships and cooperation among all stakeholders to ensure synergy and cross-sectoral collaborations in the delivery of STI-related activities and projects. In accordance with this, UNESCO remains committed to supporting Ghana on this roadmap, as well as on developmental issues aligned with the Organization's mission.

I hope that this STI for SDGs roadmap will inspire scientists, technologists, innovators, and policymakers in the public, private, academic, and civil society sectors to take a more focused approach to maximize STI for national progress.

I wish to acknowledge the work of the UN-Interagency task team (World Bank, UNDESA, UNCTAD, UNESCO, UNIDO, UN-ESCAP, ESCWA, WIPO, UNU), in cooperation with the Government of Japan, the European Commission's Joint Research Centre, and OECD, which made this programme possible.

I also congratulate MESTI and CSIR-STEPRI for their leadership in the drafting and finalization of the STI for SDGs roadmap.

Acknowledgement

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Executive Summary

The Global Pilot Programme on the preparation of Science, Technology and Innovation for the achievement of the Sustainable Development Goals (STI4SDGs) roadmaps was launched in July 2019 by the UN Inter-agency Task Team (UN-IATT), with five pilot countries including Ethiopia, Ghana, India, Kenya and Serbia. In this regard, UNESCO collaborated with CSIR-Science and Technology Policy Research Institute (CSIR-STEPRI) to take technical responsibility for producing the roadmap for Ghana.

This document contains the details of the execution of the second phase of the UN-IATT project with the primary goal of formulating the STI4SDGs Roadmap for Ghana. The specific objectives are to:

(i)   Define the vision, goals and targets for the STI4SDGs Roadmap;

(ii)   Detail the strategies, programmes, projects and activities necessary for Science, Technology and Innovation (STI) to fast-track the achievement of the prioritized SDGs

(iii)   Elaborate on the budget, funding and coordination arrangement for the implementation of the STI4SDGs Roadmap

(iv)   Formulate the partnership and communication strategy to sustain stakeholder involvement and ensure inclusive governance of the roadmap.

(v)   Design the Monitoring and Evaluation system to track progress on the roadmap implementation.

A National Steering Committee (NSC) comprising representatives of the relevant sector ministries and key stakeholders was constituted for the development of Ghana's STI4SDGs Roadmap. The NSC is co-chaired by the Ministry of Environment, Science, Technology and Innovation (MESTI) and the Presidential Advisor on SDGs at the Presidency. Under the auspices of the NSC, seven SDGs were prioritized for Ghana based on the current trajectory of national development and the aspirations of the Government.

The prioritized SDGs include:
- *No poverty (SDG1)*
- *Zero hunger (SDG 2)*
- *Good Health and Well-Being (SDG3)*
- *Quality Education (SDG4)*
- *Clean Water and Sanitation (SDG6)*
- *Decent Work and Economic Growth (SDG8)*
- *Industry, Innovation and Infrastructure (SDG 9).*

The SDGs prioritized for Ghana are SDGs 1, 2, 3, 4, 6, 8 and 9. It is the assumption that the implementation of the programmes and activities elaborated in this roadmap will lead to accelerating the achievement of the prioritized SDGs, and the overall vision of the nation will be attained. The Coordinated Programme of Economic and Social Development Policies (CPESDP) in Ghana states the vision comprehensively as:

"An optimistic, self-confident and prosperous nation, through the creative exploitation of our human and natural resources, and operating within a democratic, open and fair society in which mutual trust and economic opportunities exist for all."

The situational analysis conducted before the actual preparation of the STI4SDGs Roadmap with the support of UNESCO highlights the key issues and challenges relating to all the prioritised SDGs for the roadmap. Progress made in relation to SDG 1 on the eradication of poverty in Ghana in the past years is commendable. However, the specific obligation in SDG1 currently is the eradication of poverty using STI. The roadmap draws on a range of actions including the promotion of technologies for the creation of livelihoods and enhancement of productivity in the relevant sectors of the economy.

In achieving SDG 2 to end hunger through the application of STI, the areas of concern include ensuring improved public investment in agriculture; improving production efficiency and yield; improving post-harvest management; enhancing the application of STI in agriculture; promoting agriculture as a viable business among the youth; promoting livestock and poultry development for food and nutrition security; modernizing the agriculture sector to drive private sector agribusinesses; scaling up e-extension and business advisory services; enhancing online marketing of agricultural products; promoting the adoption of productivity improvement technologies such as greenhouse production systems; and promoting biotechnology applications for improved breeding.

Despite progress made to expand access to healthcare under SDG 3, there are challenges which can be addressed effectively through the application of STI. These challenges include huge imbalances in geographical access to quality healthcare, inadequate and inequitable distribution of critical staff, increased cost of healthcare delivery, unhealthy dietary practices and nutritional disorders, poor quality of healthcare services as well as the devastating impact of COVID-19 on Ghana's healthcare delivery system.

The National Health Policy Objectives include:

(i) strengthening the healthcare delivery system to be resilient,

(ii) encouraging the adoption of healthy lifestyles,

(iii) improving the physical environment,

(iv) improving the socio-economic status of the population, and

(v) ensuring sustainable financing for health.

STI programmes will be directed at achieving these objectives.

SDG 4 focuses on one of the underpinning development areas of Ghana: Education. A major flagship education policy is the Free Senior High School (SHS) policy which makes high school education completely accessible to all irrespective of geographical location, social status, economic circumstance or physical ability or disability. The principle of inclusivity underlying the SDGs drives the flagship educational policy. It is currently being implemented at a substantial cost to the nation and yet, it is considered one of the important investments that the country has to make to create valuable human resources for the transformation of Ghana. STI applications will aim at expanding access and enhancing teaching and learning quality within and outside the educational system.

The roadmap underlines the alignment of SDG 6 targets to the policy objectives of the water and sanitation sector. Proper provision of water and sanitation is key to achieving the SDGs, including good health and gender equality. By managing water sustainably, we are also able to better manage our production of food and energy and contribute to decent work and economic growth. Despite the fact that Ghana achieved the MDG for access to improved water supply early, but not on access to improved sanitation; current statistics show that fewer than two in five Ghanaians drink safe water, two out of every five schools are without toilets, and three out of every five schools are without water supplies. Four targets of SDG 6 have been prioritized for the application of specific technologies.

The focus of SDG 8 is to "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all". In line with this, the national development agenda seeks, among others, to build a strong and resilient economy, transform agriculture and industry; and develop robust tourism and creative arts industries. Between 2017 and 2019, Ghana experienced an impressive average annual GDP growth of about 7%. However, this growth rate declined to about 0.5% in 2020 largely due to the effects of the COVID-19 pandemic. Faced with the short and long-term effects of the COVID-19 pandemic, STI provides a useful vehicle for "building back better" through economic productivity, economic diversification and ensuring decent work for all. The roadmap details the strategies for STI applications for "building back better".

Three key programmes will be vigorously pursued under the STI4SDGs roadmap to accelerate progress towards SDG9.

These include:

(i) improving the quality and access to STI in education, strengthening the linkages between academia and industry and providing citizens especially the youth with the skills required to participate in the global economy

(ii) creating an enabling environment to support private sector development, facilitating access to innovation for all businesses, increasing productivity through the adoption of technological and non-technological innovations and improving the availability of finance to aid the process and

(iii) improving infrastructure to spur economic growth and development and provide access to services for all, encouraging inclusivity.

The roadmap presents an estimated total budget of US$19,260,000.000 (Nineteen million, two hundred and Sixty thousand US dollars) covering the envisaged programmes across all the prioritized goals and targets. Various development partners have been proposed for their partnership in funding the programme. It is hoped that all the stakeholders will show commitment to successfully implement the roadmap for the achievement of the national vision.

INTRODUCTION/ BACKGROUND, OBJECTIVES OF STI4SDGS ROADMAP AND SCOPE

1

Background

The dovetailing of Science, Technology and Innovation (STI) underscores the composite role of STI as a driver of socio-economic advancement in all societies. Science is the generation of knowledge through experimentation, observation and exploration of natural phenomena. Technology is the product of the application of knowledge. Innovation is the use of new knowledge to address contextual needs for the benefit of society. These may be the clear distinctions one notes in the elements of the composite STI. Yet, despite their differences, the connectedness is so strong that Science, Technology and Innovation are considered integrated and even referred to quite often in the singular form.

The Sustainable Development Goals (SDGs) have come to highlight in sharp relief the global and specific development agenda confronting the world and all nations of the earth. STI is the veritable tool for addressing the SDGs, which resonates with the First Ten-Year Plan of the African Union's Agenda 2063 adopted by the African Leaders. Nevertheless, for STI to effectively drive the achievement of the SDGs, there must be the requisite plan to direct its application in respective countries. Ghana is one of the countries selected in the Global Pilot Programme for the preparation of a Roadmap for STI for SDGs.

The Global Pilot Programme on the preparation of Science, Technology and Innovation for the achievement of the Sustainable Development Goals (STI4SDGs) roadmaps was launched in July 2019 by the UN Inter-agency Task Team (UN-IATT), with five pilot countries including Ethiopia, Ghana, India, Kenya and Serbia. The programme was formulated with the recognition of the critical contributions of STI as a catalyst for achieving SDGs in the past three UN STI Fora in 2016, 2017, and 2018. The Global Pilot Programme intends to get the participating countries to formulate their roadmaps and accelerate the process of developing new or adapting existing solutions to meet the SDGs targets using STI. Following up on the launch, a joint UN guidebook was developed to support the process and to serve as a toolkit for the national roadmap development exercise. The UN-IATT agreed that UNESCO should be the UN agency to provide support and technical guidance to Ghana for the STI4SDGs Roadmap formulation. In this regard, UNESCO, in collaboration with the Ministry of Environment, Science, Technology and Innovation (MESTI), engaged CSIR-Science and Technology Policy Research Institute (CSIR-STEPRI) to conduct a situational analysis regarding the targeted SDGs, assess the STI system in Ghana, and apply these findings to formulate a roadmap for the country.

Goal and Objectives

The specific objectives are to:

(i)   Define the vision, goals and targets for the STI4SDGs Roadmap;

(ii)   Detail the strategies, programmes, projects and activities necessary for STI to fast-track the achievement of the prioritized SDGs;

(iii)   Elaborate on the budget, funding and coordination arrangement for the implementation of the STI4SDGs Roadmap;

(iv)   Formulate the partnership and communication strategy to sustain stakeholder involvement and ensure inclusive governance of the roadmap; and

(v)   Design the Monitoring and Evaluation system to track progress on the roadmap implementation.

1.3

The Development Challenges

Though Ghana's development challenges are typical of countries in Africa, peculiar challenges are coming from its history, natural resource endowments and people. Some challenges constitute the hurdles constraining the achievement of the overall vision and the respective goals in development. These are evident in the Situational Analysis Report of 2020, which set the tone for the formulation of the STI4SDGs Roadmap.

Ghana is classified as a lower middle-income country with a per capita GDP of about $2,212 in 2019, which is a decrease in the per capita GDP of 2013 of $2,437. In the national development framework document, the Coordinated Programme of Economic and Social Development Policies (CPESDP), per capita GDP is projected to increase from $1,515.6 in 2016 to at least $2,500 by 2020, rising further to at least $3,500 by 2024. The current level of per capita GDP, as determined by the Ghana Statistical Service, raises caution that unless intensive and strategic actions are taken, the goal to achieve a per capita US$3,500 by 2024, will be elusive. However, this is a challenge that a well-crafted STI4SDGs Roadmap can, all things being equal, effectively address.

Poverty remains a developmental challenge even though some strides have been made in the past to improve the poverty incidence in society. An important success story for Ghana is the reduction of the level of poverty by more than 50% between 1990 and 2013 (NDPC and GSS, 2018). In the early 1990s, 51.7% of the population of Ghana was estimated to be living in poverty and about 36.5% lived in extreme poverty. However, in 2013, it was estimated that 24.2% of the population lived in poverty and 8.4% in extreme poverty. Still, it is the millions of people in Ghana who are living in poverty that pose a major challenge to development. The disparities in regional poverty incidences are also major developmental concerns.

Regarding health and wellbeing, the challenges in the sector are captured in the National Health Policy (2020) which include:

•   Inadequate health facilities in terms of infrastructural and equipment including ICT infrastructure and AI-powered healthcare services;

•   Need for re-tooling of existing facilities;

•   Need for construction and siting of additional purpose-built facilities, promote the availability and use of high-quality assistive devices and technologies;

•   Inadequate human resources particularly medical personnel – the Doctor-patient ratio for the country stands at one doctor to 8000 patients;

•   Adoption of digital technologies for pandemic planning, surveillance, testing, contact tracing, quarantine, and health care; and

•   The institutionalisation of Comprehensive Health Technology Assessments (HTA) to inform the selection and procurement of all medical technologies required.

In Higher Education, the challenges (identified from a Policy Symposium organised by CSIR-STEPRI in 2016 and GIRC Business case studies Report in 2019) are:

- Inadequate research capacity and inequitable assets;
- Weak relationship between academia/research and Policy makers;
- Inadequate resources to transform the economy into a knowledge-based one;
- High demand for tertiary education which creates a huge supply gap situation;
- Inadequate facilities and ageing faculties;
- Imbalance between Sciences and Humanities;
- Unwillingness of the private sector to offer training in technical skills to fresh graduates;
- Differences in the meaning of Excellence for academics and the public; and
- Need for a cultural change regarding the teaching model, re-training of trainers, effective communication and constant interaction with industry.

In the water and sanitation sector, there are challenges with the following:

- Water quality monitoring and management systems;
- Inadequate facilities for water quality testing;
- Inadequate ICT infrastructure for better targeting and inefficiencies in cost recovery approaches;
- Capacity gaps in the management of water and sanitation service delivery;
- Awareness creation and behavioural initiatives on sanitation and good hygiene practices;
- Ineffective Planning of Cities and challenges with monitoring of environmental sanitation services; and
- Plastic menace and issues with sustainable plastics management.

One may further illustrate the nature of the development challenges in analysing the policy environment. There are several challenges that even directly constrain the implementation of policy. These include:

- Weak linkage between policy formulation and national development planning;
- Ineffective coordination of the STI system;
- Inadequate budget and resource allocation to STI;
- Weak linkages between various agencies and organizations in STI;
- Weak linkage between industry and the R&D system; and
- Over-reliance on the use of foreign expertise to the neglect of the use and development of local expertise.

Approach to the Formulation of the STI4SDGs Roadmap

A key principle in the formulation of the STI4SDGs Roadmap for Ghana is to aim at buy-in by the relevant stakeholder institutions. In this regard, a Technical Task Team (TTT) chaired by MESTI and the SDGs Unit at the Presidency was established to coordinate and provide strategic and substantive inputs to the development of the STI4SDGs Roadmap for Ghana. The Task Team is composed of the (i) Chief Director, MESTI as Chairperson, (ii) Head, Office of Presidency SDG Unit as Co-Chair, (iii) Director for STI, MESTI; and representatives from (iv) National Development and Planning Commission, (v) Ministry of Finance, (vi) Ministry of Food and Agriculture, (vii) Ministry of Monitoring and Evaluation, (viii) Ministry of Health, (ix) Ministry of Water and Sanitation, (x) Ministry of Business Development, (xi) Ministry of Trade and Industry, (xii) Ministry of Education, (xiii) Ghana Statistical Services, (xiv) Association of Ghana Industries and (xv) CSIR-STEPRI. A core team from among the members carried out the practical task of drafting the chapters of the Roadmap for discussion and input by the Technical Task Team. The Roadmap was then validated at a national stakeholders' consultative workshop. The list of members of the TTT is shown in Appendix 1.

The drafting of the constituent chapters follows from the conduct of the situational analysis of STI in Ghana. The report provided an empirical analysis of the state of STI in the country and defined the gaps which the roadmap should aim at addressing.

The Scope

The thrust of the STI4SDGs Roadmap is the elaboration of strategies and programmes to use STI to accelerate the achievement of the SDGs. The national context of Ghana in terms of its natural resource endowments, the social and economic attributes and the political and cultural conditions will inform the formulation of the roadmap. In the course of the work on the roadmap, certain SDGs were prioritized taking into account the present development goals of the nation. These are SDGs 1, 2, 3, 4, 6, 8 and 9. The roadmap will largely be limited to discussions of these SDGs and the strategies, programmes and activities to ensure STI accelerate the achievement of these prioritized SDGs.

SITUATIONAL ANALYSIS

2

Assessment of STI capabilities to meet Prioritized SDGs for Ghana's STI4SDGs Roadmap

Seven SDGs were prioritized for Ghana based on the current trajectory of national development and the aspirations of the Government. The prioritized SDGs include No poverty (SDG1) zero hunger (SDG 2), Good Health and Well-Being (SDG3) Quality Education (SDG4), Clean Water and Sanitation (SDG6), Decent Work and Economic Growth (SDG8) and Industry, Innovation and Infrastructure (SDG9). This presents the current situation of the prioritized SDGs and the critical contributions of STI in accelerating the achievement of SDGs in Ghana.

2.1.1

Agriculture

Addressing Zero Hunger and Employment Creation to Eradicate Poverty through Effective Application of STI

SDG 2 (with strong linkages to SDGs 1, 3,5, 8 and 9) is one of the important priority SDGs. Agriculture's contribution to GDP in 2019 is estimated to be 18.5%, with the Service and Industry sectors accounting for 47.2% and 34.2% respectively (Figure 1).

The current Ghana Agricultural Investment Plan (GhAIP 2018–2021) focuses on (i) promoting a demand-driven approach to agricultural development; (ii) ensuring improved public investment; (iii) improving production efficiency and yield; (iv) improving post-harvest management; (v) enhancing the application of STI; (vi) promoting agriculture as a viable business among the youth, and (vii) promoting livestock and poultry development for food and nutrition security and income generation. The sector, which is mainly private sector-led, plays a critical contribution to poverty reduction. An overall goal is the modernization of the sector to drive private sector agribusinesses to provide decent and rewarding jobs along the agricultural value chain, especially for the youth. In addition to the provision of food to the growing population, agriculture provides raw materials to industries. Yet, agriculture is predominantly on small scale with the majority of farm holdings less than 2 hectares per farmer.

Principal agricultural export commodities include cocoa, timber, horticultural products, and fish/sea foods. Despite the critical contribution of the agricultural sector to the socio-economic development of the country, the sector is beset with challenges including low agricultural productivity; poor construction and management of irrigation infrastructure; inadequate post-production infrastructure; limited funding of food and agricultural research and extension services; low use of improved technologies in crops, livestock and fisheries; inadequate quality feed and water standards for livestock and poultry; lack of modern housing for livestock and poultry production; inadequate disease monitoring and surveillance
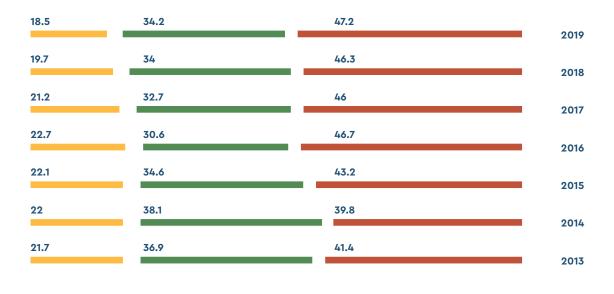
Figure 1
% Contribution to GDP by Sectors

	Agriculture	Industry	Services	Year
	18.5	34.2	47.2	2019
	19.7	34	46.3	2018
	21.2	32.7	46	2017
	22.7	30.6	46.7	2016
	22.1	34.6	43.2	2015
	22	38.1	39.8	2014
	21.7	36.9	41.4	2013

Agriculture   **Industry**   **Services**

system; low use and high-cost improved inputs; low access to mechanization services along the value chain and low use of intermediate technologies; the negative impact of climate change; and inadequate disaggregated data /statistics on the sector.

COVID-19 has opened up opportunities for innovation in agricultural value chain systems including e-extension and business advisory services, product development to meet consumer needs – increasing demand for organic products, online marketing of agricultural products, local production of import substitute commodities such as rice and poultry in Ghana, packaging convenient foods for special delivery services and taking advantage of new consumer lifestyle and new food products to build immune systems of the weak and vulnerable. Taking advantage of such opportunities, however, will come with productivity improvement technologies such as greenhouse production systems and biotechnology for improved breeding. It also calls for building capacity in e-Agriculture, innovation platforms, and strengthening the research-extension linkage system.

ASSORTED FARM HARVEST © **MARCELA LASKOSKI**

2.1.2

Health Sector

Good Health and Well-being through Effective Application of STI

The Ghana National Health Policy (2020) is aimed at ensuring universal access to health services and healthy lives for all. It is directly linked to the national efforts at achieving SDG 3. The health policy is anchored in the CPESDP (2017–2024) and aligned to global and regional policy frameworks such as the African Union (AU) Vision 2063: "The Africa We Want" and the African Health Strategy (2016–2030). The health policy objectives seek to (i) strengthen the healthcare delivery system to be resilient, (ii) encourage the adoption of healthy lifestyles, (iii) improve the physical environment, (iv) improve the socio-economic status of the population, and(v) ensure sustainable financing for health.

A 5-year National Healthcare Quality Strategy (2017–2021) to develop a robust and sustainable quality culture institutionalized in the healthcare delivery system has been launched with clear measurable standards in terms of safety, efficiency, effectiveness, timeliness, equity and patient-centredness. As a financial risk management strategy, the healthcare quality strategy seeks to strengthen the National Health Insurance Scheme (NHIS) as well as encourage the population to subscribe to the NHIS and other private insurance schemes where appropriate. The Universal Health Coverage (UHC) Roadmap (2020 -2030) for Ghana also has components on improving health financing, health services delivery systems, the health workforce and communications networks, health technologies, information systems, quality assurance mechanisms, and governance and legislation. Other policy-related documents in the health sector including National Strategic COVID-19 Response Plan (2020–2024), Private Health Sector Development Policy, Ghana E-Health Policy and Health Sector ICT Policy and Strategy provide a framework for the improvement of health delivery systems in Ghana.

Under emergency readiness and management, the policy seeks to strengthen surveillance and response systems to prevent, detect, investigate, protect against, control and provide a public health response to the spread of diseases resulting from epidemics and disasters such as COVID-19. The use of drones to augment the health commodity supply chain – blood and blood products and essential medicines has been emphasized.

Digital Health

Digital health can improve access and quality of inclusive health services, enhance diagnostics, training and better prevention of diseases. ICT and digital health solutions offer the prospect of using digital health services to accelerate the achievement of SDG 3 and make universal health coverage for all a reality by 2030. According to WHO (2018), over 63% of countries have implemented digital health policies and national strategies through the World Health Organization-International Telecommunication Union (WHO-ITU) co-created National E-Health Strategy Toolkit. The initiative is aimed at establishing the foundations in countries to sustainably implement digital health initiatives and scale up the use of digital technologies in the health sector including the use of electronic records systems, integrated electronic platforms for budgeting and planning and the use of Surveillance Outbreak Response Management and Analysis System (SORMAS). All these, to improve the quality, accessibility and affordability of health services for all and bring the impact of SDG 3 to scale.

The importance of integration and interoperability is key to allow for digital programs to transfer and retrieve information and data across systems. Capacity building in the area of software engineering, technical capacity to design systems that respond to end-user needs and adapting systems for local needs are important. Strategic direction and leadership at the highest level are required to create the enabling environment and regulatory system for the effective management of digital health care systems and ICT4D (information and communication technology for development).

Challenges in the health sector as captured in the National Health Policy (2020) are:
- Inadequate health facilities in terms of infrastructural and equipment including ICT infrastructure and AI-powered healthcare services;
- Need for re-tooling of existing facilities;
- Need for construction and siting of additional purpose-built facilities, promote the availability and use of high-quality assistive devices and technologies;
- Inadequate human resources particularly medical personnel – Doctor-patient ratio stands at one(1) doctor to 8000 patients;
- Adoption of digital technologies for pandemic planning, surveillance, testing, contact tracing, quarantine, and health care; and
- Institutionalization of comprehensive Health Technology Assessments (HTA) to inform the selection and procurement of all medical technologies required.

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Inclusive and Equitable Quality Education through Effective Application of STI

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2.1.3.1

Human Capital for Sustainable Development

Ghana's Educational sector has undergone various reforms over the years in an attempt to improve equity, quality, availability, accessibility and affordability of education in line with SDG4. Access to quality early development and basic education through strengthened management systems of the schools by 2030 has been the strategic policy direction. The Education Strategic Plan (ESP) 2018–2030 seeks to establish a sustainable and accountable system to improve the quality of basic education through improved quality of teaching and learning materials in the education service delivery. Ghana has formulated an Inclusive Basic Education Policy to provide a universal design for learning framework, which is free, compulsory and accessible to all school-aged children including children with special education needs. The government of Ghana initiated the free Senior High School (SHS) programme to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Some of the polytechnics have been upgraded to technical universities to respond to job market demands. There has been a steady improvement in gross enrolment at all levels of education since 2017. In particular, enrolment at the SHS level (public, private and GES TVET) for 2018/19 increased by 14.1% over the 2017/18 level. The free SHS policy contributed to this increase in enrolment.

Currently, the diversity of tertiary educational institutions is evidence of the efforts the country is making to ensure that it has the needed skills and competencies to drive the national development agenda. In the specific area of STI, the evidence of diverse tertiary institutions training STI human resources is strong. Public tertiary institutions are dominating the training of STI human resources. For example, an institution such as KNUST still addresses its fundamental mandate in Science, Technology, Engineering and Mathematics (STEM) education even though it has extended into teaching and learning in non-STEM disciplines. Other tertiary institutions have also strengthened their efforts in STEM education. For instance, the University of Ghana now runs engineering programmes.

The developmental issue has been ensuring quality education that produces problem-solvers to reduce over-reliance on foreign experts, employable skills and competence-based lifelong learning that offer opportunities for home-grown solutions to developmental challenges. There is a human resource capacity gap in emerging technologies such as biotechnology, photonics, microelectronics nanotechnology, material science and engineering. At the basic education level, there is the need for training of basic school teachers in the delivery of BSTEM and equipping basic schools with STEM equipment in line with the Government's policy of strengthening and generating interest in Mathematics, Science and Technology. There is a need for stimulating creativity at all levels of education.

Creating appropriate infrastructure for STI human resource development is vital, particularly digitalization and e-infrastructure. The central government budgetary allocation to the educational sector should be adequate for maintaining the needed professionals and workers in the sector and ensuring continuous enrolment into educational institutions at all levels. However, without the infrastructure and emphasis on practical teaching and learning, STEM education is unable to achieve the desired goal of building competencies.

Digital Education

Digital technology, ICT and mobile applications improve access to education, particularly those in remote areas. Smart learning solutions contribute to ensuring inclusive and equitable quality education and lifelong learning opportunities for all, bringing impact to SDG4 at scale. From the online survey conducted in this study, a majority (over 80%) of respondents considered ICT and digitalization as extremely relevant in delivering quality education at all levels of the educational system.

2.1.4

Clean Water and Sanitation through Effective Application of STI

The Ministry of Sanitation and Water Resources (MSWR) is responsible for ensuring that all Ghanaians have access to safe water, sanitation and hygiene practices and sustainable management of water resources. Given that SDG 6 is a key priority for Ghana, many developmental challenges that confront MSWR need to be addressed. These include limited access to safe drinking water in rural and some urban areas, poor water quality, low water-use efficiency, poor sanitation and improper hygienic practices, and barriers to the reuse of water.

Several factors contribute to the lack of safe water access in Ghana (Agyeman, 2019). For instance, most people rely on surface water sources, lack of basic training and capacity to maintain wells, hand pumps and other systems, and lack of proper sanitation and hygiene frequently compound contamination of existing water sources. To increase targets under SDG goal 6 to 100% by 2030, some policies and programmes have been put in place to ensure efficient management of water resources, accelerate the provision of safe, adequate and affordable drinking water, and speed up the provision of adequate and equitable sanitation and hygiene for all. The most recent ones include the National Drinking Water Quality Management Framework for Ghana (NDWQMF) introduced in 2015 and the new mining policy framework (2018) that seeks to regularize and reform mining activities in Ghana. Mining generally has deleterious effects on the lakes and rivers and their tributaries, which are the sources of drinking water for local communities. In the 2020 Budget Statement, expansion of a nationwide water quality monitoring network, implementation of water governance, ecosystem restoration and conservation as well as groundwater monitoring and management are some of the activities budgeted for by the Water Resources Commission of Ghana.

Sanitation is a major challenge. About 20% of the entire country's population practice open defecation. The practice is much more widespread in the three regions of Northern Ghana (Northern, Upper East and Upper West Regions) where more than 70% of the population practice open defecation. A high proportion (almost 51%) of Ghanaians use communal latrines which, according to the Joint Monitoring Programme of WHO/UNICEF, are classified as unimproved. Poor sanitation has negative implications on health, soil and water contamination, and life on land and water among others. One of the key causes of poor sanitation is poverty and low prioritization of sanitation at all levels of development planning – district, regional and national. MSWR with support from the World Bank is constructing sustainable toilets using biofill technology. For accelerated impact, the Ministry is considering the construction of central Sewage Systems, Community-led Total Sanitation and support to the poor and vulnerable including the aged, PLWDs, widows and female headed-households without adequate social-support systems.

The National Environmental Sanitation Strategy and Action Plan (NESSAP) is a response to the need to refocus attention on environmental sanitation in Ghana and provide clear strategies and action plans that will guide implementation by Metropolitan, Municipal and District Assemblies (MMDAs). The NESSAP covers awareness creation, improvements in all aspects of environmental sanitation services targeting the reduction of wastes for final disposal, effective coordination, and resource use efficiency and reduction in MMDA's cost of managing waste. Technology options considered in targeting the poor and vulnerable for basic sanitation services in Ghana include improved pit latrines, ventilated improved pit latrines, pour-flush latrines and aqua privy latrines and bio-digesters. Another area for consideration is the enforcement of sanitation-related by-laws and the use of indigenous knowledge as well as local institutions in implementing sustainable sanitation options to ensure social and community acceptance.

One of the worrying concerns in Ghana has been the issue of plastic waste, which impacts negatively on water, sanitation and the environment. The Ministry of Environment, Science, Technology and Innovation in January 2020 published the National Plastics Management Policy with the vision to ensure sustainable plastics management through Science, Technology and Innovation (STI). The document outlined the processes of creating public awareness, building management capacity, promoting the adoption of innovative practices, identifying innovative financial sources and promoting effective inter-institutional collaboration as the objectives of effective plastics management. The policy identified STI as the first important systematic pillar for achieving its objectives. There are emerging technologies to manage waste including pyrolysis, gasification and thermal hydrolysis for processing solid waste into useful and marketable products. Technologies for recycling plastic waste are particularly important.
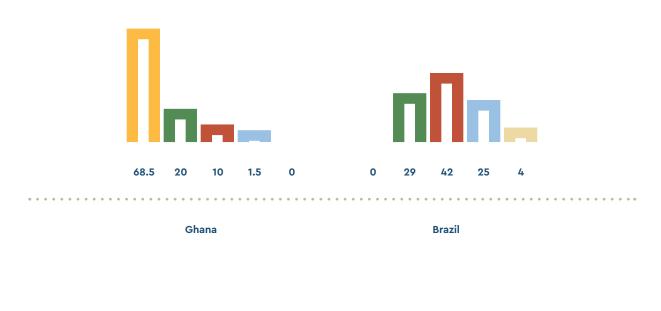
Industry, Innovation for Creation of Decent Employment through Effective Application of STI

SDG 9 aims to build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. The industrial sector is of particular importance for Ghana's socio-economic development given that it underpins sustainable job creation, import substitution and exports. The contribution of the industrial sector to Ghana's GDP was estimated at 34.2% in 2019 (GSS, 2020) with the manufacturing sub-sector contributing 11.2%, mining & quarry (14.9%) and construction (6.4%). Industrialization enables countries to build and strengthen the skills and capabilities to compete and succeed within new technological paradigms.

Figure 2
Level of Adoption of Advanced Digital Production Technologies

68.5	20	10	1.5	0

Ghana

0	29	42	25	4

Brazil

Generation 0   Generation 1.0   Generation 2.0   Generation 3.0   Generation 4.0

Considering the fact that the growth rate in the manufacturing subsector has been dwindling (from 9.5 in 2017 to 4.1 in 2018), a focus on the level of use of Advanced Digital Production Technologies such as Advanced Robotics, Artificial Intelligence, Big Data and the Internet of Things for smart manufacturing was conducted (UNIDO Industrial Survey Report 2019) in Ghana. The survey covered 200 firms in the food products and beverages, textiles, furniture and wood, metal, plastics and rubber industries in the Greater Accra and Ashanti regions of Ghana. The majority of the manufacturing firms surveyed were using industry 1.0 and 2.0 generation technologies. Globally, the firm-level data showed Ghana as a laggard in the use of Advance Digital Production (ADP) technologies. Only 1.5% of firms surveyed were using 3.0 and 4.0 generations digital technologies (Figure 2). Compared to Brazil, this is a rather poor industrial performance. In the manufacturing sector, there is the need to leverage ongoing initiatives using ADP Technologies and strengthen the uptake of R&D.

The relatively poor performance of the industrial sector and particularly the manufacturing sub-sector is attributed, but not limited, to:

- High cost of capital and electricity;
- Limited access to medium and long-term financing;
- Unreliable power supply and limited access to land for industrial activity;
- Weak logistics and weak infrastructure support for industrial development;
- Cyber security and internet fraud;
- Influx of foreign competitive products and downward pressure on prices of locally produced goods and services; and
- Bureaucratic delays in certification by regulators.

Ghana is vigorously pursuing an industrialization agenda through (i) a stimulus package/fund arrangement for selected distressed but viable local companies; (ii) one district, one factory flagship programme; (iii) strategic anchor industrial initiatives focusing on petrochemicals, iron and steel, integrated aluminium, pharmaceuticals, automotive, industrial salt, garment and textiles, among others; and (iv) industrial subcontracting exchange programme that seeks to link SMEs to feed large-scale enterprises. The implementation of the industrialization agenda is at the heart of Ghana's socio-economic growth.

Figure 3
Global Innovation Index – Ghana

The Global Innovation Index benchmarks 129 countries according to 80 indicators divided into innovation inputs and innovation output. In 2019, Ghana was ranked 106 and 11 in Global and Sub-Sahara Africa respectively (Figure 3). Clearly, more efforts at promoting innovation have to be made. MESTI will need to mobilize its agencies for a more effective cross-sectoral innovative impact, especially concerning the industrialization strategy.

Constraints and Opportunities in the STI Ecosystem

The principal thrust of Ghana's National Science, Technology and Innovation Policy is to ensure that STI drives all sectors of the economy. However, some STI-related challenges still exist that require policy attention. Some of these challenges have been flagged in the STI Policy including:

- Inadequate scientific expertise in the country and over-reliance on the use of foreign expertise
- Lack of effective advocacy for STI at the highest political and policy levels and Low science and technology culture among the populace
- Weak structures for the management of STI and ineffective coordination of the STI system
- Inadequate budget and resource allocation to STI
- Weak mechanisms for implementation, evaluation and review of STI policies, projects and initiatives
- Weak linkages between various agencies and organizations in STI. For example, Poor collaboration between CSIR and the Universities, weak linkage between industry and the R&D system
- Inadequate science teaching and learning in our pre-tertiary education system
- Poor remuneration and conditions of service for science and technology personnel of research institutions
- Lack of data on technological opportunities, and
- Difficulty with the maintenance of imported technologies and lack of local content concept in deploying ICT solutions in Ghana.

Despite the challenges, opportunities exist to leverage emerging technologies and minimize their disruptive effects. There are innovation and technology hubs to drive the generation of home-grown innovation and capacities to incubate entrepreneurs and small businesses. Other opportunities include:

- The Continental Free Trade Agreement (CFTA), offers a huge opportunity for technological capability development;
- Availability of STI Policy and National Entrepreneurial and Innovation Plan that needs resources for sustainable implement
- On-going digitization interventions and opportunity to assess impacts and possibility of up-scaling;
- Available research findings that can be transformed into commercial products;
- Opportunity to coordinate international cooperation, collaboration and partnerships;
- Opportunity for Ghanaian scientists and technologists to link up with international research centres and world-class research programmes;
- Private sector involvement in R&D to respond to demand-driven research; and
- Possibility of using Ghanaian experts in the Diaspora and other skilled persons living in foreign lands.

Concluding Remarks

A sectorial approach has been used to assess the STI capabilities available and the STI gaps for consideration in facilitating the achievement of the prioritized SDGs namely goals 1, 2, 3, 4, 6, 8 and 9. The highlighted the need for Ghana to make the necessary efforts (from both public and private sectors) to boost research and development, enhance the skills base of the current and future workforce, develop new infrastructure and create capacities in new technologies to establish the Launchpad for accelerating the achievement of the SDGs. For effective human capital formation to drive the STI agenda, especially for the accelerated achievement of the SDGs, there must be a rejuvenation of the educational system with an emphasis on stimulating curiosity and creativity and enhancing competence-building. At the tertiary level, in particular, institutions must be well-equipped to effectively deliver teaching and learning in STEM. R&D in established institutions must be enhanced with adequate human resources and infrastructure.

Recommendations:
The STI capability needs regarding human capital, infrastructural and delivery systems for fast-tracking the achievement of prioritized have been assessed and the following policy recommendations are made:
- Develop strategies to take advantage of innovations in the agri-food system, health and education delivery systems, and regulate Ghana's technological space;
- Invest in Advance Digital Production (ADP) technologies and strengthen the uptake of R&D;
- Address infrastructural gaps in irrigation, low adoption rates of climate-smart technologies and inadequate human resources;
- Invest in STEM education, scientific equipment and e-learning facilities at all levels;
- Build local capacity and workforce in industrial equipment maintenance to reduce over-reliance on foreign expertise, and initiate equity law to protect local industries; and
- Invest in water quality monitoring and management systems as well as behavioral initiatives on sanitation and good hygiene practices.

VISION, GOALS AND TARGETS OF THE ROADMAP

The situational analysis provides a logical basis for the formulation of the roadmap. However, in formulating the roadmap, there is a need to crystallize the vision and elaborate on the goals and targets in a manner that brings clarity to the connections between the STI applications and the drive to accelerate towards achieving the SDGs. This crystallizes the vision for the roadmap with the analysis of the vision statements in the requisite documents and deliberates on the developmental goals and targets with specific reference to the prioritized SDGs.

The Vision

The development vision of Ghana derives from the national socio-economic, political and cultural context of the nation. The 1992 Constitution of Ghana envisions a just and free society. This kind of vision statement however is open to wide interpretation.

The CPESDP translates the constitutional vision into more specific statements of intent for the overall development of the country: *"An optimistic, self-confident and prosperous nation, through the creative exploitation of our human and natural resources, and operating within a democratic, open and fair society in which mutual trust and economic opportunities exist for all."*

For the STI4SDGs Roadmap, the critical part of the vision statement is the "creative exploitation of our human and natural resources". Such exploitation will be on the wheels of STI taking into consideration the prioritized needs of the economy and society. STI will also drive the achievement of the specific goals set in connection with the vision, namely:

• Creating opportunities for all Ghanaians;
• Safeguarding the natural environment and ensuring a resilient built environment;
• Maintaining a stable, united and safe country; and
• Building a prosperous country.

The national vision is further elaborated by other important national documents aside from the Constitution and the Coordinated Programmes. The Ghana Beyond Aid policy is a transformation agenda based on the manufacturing and provision of high-value services from increased production of raw materials for export and local consumption. The policy is based on the premise that Ghana must grow out of aid dependency to properly reflect its status of over 60 years of political emancipation. The policy envisages creating a modernized, competitive, and resilient economy of equal opportunities for Ghanaians. The objectives target investors and donors to reorient investment streams to the productive sectors of the economy with the potential to transition the country beyond aid. The overall goal is to achieve a *"W.I.S.E.R" Ghana:*

W – Wealthy Ghana;
I – Inclusive Ghana;
S – Sustainable Ghana;
E – Empowered Ghana; and
R – Resilient Ghana.

Given the cross-cutting nature of STI, its direct impact on the efforts to achieve the respective objectives stated in the Coordinated Programme can be anticipated. However, within the broad scope of the goals spelt out in the Coordinated Programme, the formulation of the Roadmap will focus specifically on the SDGs. In this regard, an important step in the conduct of the situational analysis for the roadmap is the prioritization of the SDGs taking account of the national context. The SDGs prioritized for Ghana are SDGs 1, 2, 3, 4, 6, 8 and 9. Table 1 highlights the prioritized SDGs and the points of emphasis in the development agenda of Ghana. All of these prioritized SDGs are important for Ghana's sustainable development. For example, SDG 2 is one of the important priority SDGs. Agriculture's contribution to GDP in 2019 is estimated to be 18.5%, with the Service and Industry sectors accounting for 47.2% and 34.2% respectively. Besides contributing to GDP, the agricultural sector provides direct and indirect employment and livelihoods to about 65% of the population. The significance of agriculture stretches to other SDGs as well.

The Goals and Targets

The domestication of the SDGs and targets is in line with what member states of the UN and in particular those committed to the 2030 Agenda are expected to do. Ghana participated in the formulation of the 2030 Agenda for Sustainable Development in the inter-governmental negotiations making strong submissions on poverty, gender, climate change, food security and other development themes. The 17 SDGs came with 169 targets when they were adopted in September 2015 to guide national developments around the globe. However, the UN resolution of the adoption provides for each country to take into consideration the realistic conditions of the country, capacities, levels of development and the respective national priorities and policies. In this regard, one may expect variations among the member countries in the implementation of the SDGs and their respective targets.

The current development policies and programmes illustrate the extent to which Ghana has domesticated or localized the SDGs. Beginning with the Ghana Shared Growth and Development Agenda (GSGDA II, 2014–2017) and moving on to the CPESDP (2017–2024), the national development goals are consistent with the SDGs. There have been cases of adaptation of targets and indicators, with the amendment of the original targets made in consideration of national circumstances, data requirements, statistical capabilities and national aspirations (NDPC and GSS, 2018). The SDG targets and indicators requiring no modifications were adopted for use in national and sub-national development plans and M&E frameworks. Without dwelling too much on the details of the computation of the applicable indicators linked with the targets Ghana is focused on, some key targets are highlighted here in Table 1. The aim is to illustrate the connections with STI deployment as will be elaborated in 4 as well as provide guideposts to 7, which presents the Monitoring and Evaluation framework for the roadmap and discusses the objectives, the means and methodologies of monitoring, evaluation and reporting.

SETTING POSITIVE ACTIONABLE GOALS © GSMARTBRIEF

Table 1
Ghana's Prioritized SDGs and Targets for the Roadmap

SDG	DESCRIPTION	TARGET	REMARKS
1	No poverty – eradicate poverty in all its forms everywhere.	1.1 By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.90 a day. 1.2 By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions. 1.4 By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance 1.5 By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters 1.a Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation, in order to provide adequate and predictable means for developing countries, in particular least developed countries, to implement programmes and policies to end poverty in all its dimensions.	Achieving no poverty implies deploying STI to enhance income generation for all people everywhere; formulation and implementation of programmes and projects to improve productivity in all sectors of the economy, streamlining access to financial and other resources for businesses to thrive and for sustainable participation in economic activities.
2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture.	2.1 By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round. 2.2 By 2030, end all forms of malnutrition, including achieving by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons. 2.a Increase investment, including through enhanced international cooperation in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries.	STI impact on food and nutrition security can be enhanced; sustainable agriculture can be promoted with expanded access to appropriate technology and resources; promotion of consumption of nutritious foods and local food products with emphasis on better feeding of children and young people; promotion of agricultural research and development with strong linkages between the National Agricultural Research System and all actors in the agricultural value chain.
3	Ensure healthy lives and promote well-being for all at all ages.	3.1 By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births. 3.2 By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 to at least as low as 25 per 1,000 live births. 3.3 By 2030, end the epidemics, HIV and AIDS, tuberculosis, malaria and neglected tropical diseases; combat hepatitis, water-borne diseases and other communicable diseases.	The targets and their respective indicators illustrate the opportunities for STI intervention; enhanced health care delivery coming with increasing trained health professionals and adequate health infrastructure are necessary requisites to attain SDG3; provision of tools for diagnostics and therapeutics come with STI application.
4	Ensure inclusive and equitable education and promote lifelong learning opportunities for all.	4.1 By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes. 4.2 By 2030 ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education. 4.3 By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university. 4.a Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environment for all.	The targets can be achieved with STI-based reforms of the educational systems especially the digitalization for relevant and effective learning outcomes. STI can drive the efforts to instill a culture of curiosity, creativity and innovativeness in the graduates of educational institutions at all levels.
6	Ensure availability and sustainable management of water and sanitation for all.	6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all. 6.2 By 2030, achieve access to adequate sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations. 6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.	The solution to the challenges of sustainable management of water and sanitation management is in STI. Existing technologies for water treatment and supply can be improved, new technologies adopted and technologies for sanitation can be promoted with attendant public education.

SDG	DESCRIPTION	TARGET	REMARKS
8	Promote sustained, inclusive economic growth, full and productive employment and decent work for all.	8.1 Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 percent GDP growth per annum in the least developed countries. 8.5 By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value. 8.6 By 2030, substantially reduce the proportions of youth not in employment, education or training. 8.7 Take immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labour, including recruitment and use of child soldiers, and by 2025 end child labour in all its forms. 8.10 Strengthen the capacity of domestic financial institutions to encourage and expand access to banking insurance and financial services for all.	The government flags Agenda for Jobs as its clarion call for support. STI deployment in the economic sectors particularly agriculture, industry and services can lead to job creation to reduce unemployment.
9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.	9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all. 9.2 Promote inclusive and sustainable industrialization and gross domestic product, in line with national circumstances and double its share in least developed countries. 9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities. 9.5 Enhance scientific research, upgrade the technological capabilities of industrial sectors of all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending.	Innovation is the key for sustainable development. In building infrastructures and in industrialization, STI is becoming more and more relevant. The emerging technologies such as the ICT, Internet of Things, robotics, biotechnology, nanotechnology and big data science are determining competitiveness in the economic space. Ghana needs to strategize for the deployment of these emerging technologies.

Issues of STI deployment in achieving the SDGs

As illustrated in Table 1, the prioritized SDGs come with their particular targets as contextualized in the Ghanaian socio-economic and cultural conditions. STI adoption, promotion and deployment to achieve these targets must necessarily be relevant and appropriate to the conditions. Most technologies used in the productive sectors of the economy such as in agro-processing, manufacturing, construction and in-services are imported. There are issues regarding the type of technology, which is appropriate for the country. The operation and maintenance of the technologies need to be considered as well as the availability of trained human resources.

This chapter, and in particular Table 1, does not state the indicators. However, Ghana is tracking 70 indicators across all the adopted SDGs. In chapter 7 on the Monitoring and Evaluation framework, these indicators will be elaborated on to highlight their relevance and utility. However, the effect of these indicators beyond their particular targets needs to be emphasized. For example, the percentage of total annual public expenditure allocated to the agricultural sector goes beyond target 2.a. given in Table 1 and even beyond SDG2. The effect touches on the national efforts to eliminate poverty (SDG1) and create jobs (SDG8). The cross effects of the targets and indicators present opportunities for strategic adoption of technologies that would contribute to the achievement of multiple development goals.

This chapter elaborates on the specific strategies and programmes for each of the prioritized SDGs and their respective targets. This is at the heart of the roadmap. Each of the prioritized SDGs comes with specific targets, not only adopted from the internationally prescribed ones but also targets that have been crafted to suit the context of Ghana. Table 2 highlights the targets, the activities envisaged to address the respective targets, the expected outputs and the responsibilities of the lead and collaborating institutions.

DETAILED STI STRATEGIES/ PROGRAMMES/PROJECTS/ ACTIVITIES FOR ACHIEVING THE PRIORITIZED SDGS AND THEIR RESPECTIVE TARGETS

4

STI for achieving SDG 1
No Poverty

—

Target 1.1

By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.90 a day.

Ghana's efforts aimed at poverty eradication are in line with the SDG's focus on national definitions of poverty and reflect the local socio-economic dynamics and capabilities. Poverty incidence emanates from across sectors of production and therefore the eradication efforts have to take that into account. The proposal for the adoption and promotion of technologies will therefore cut across sectors to take advantage of the attributes of technology for income generation. Promoting technology and innovation for livelihoods will include the adoption of technologies generated by the CSIR and other R&D institutions. Innovations developed in the private sector will also be promoted. It means that a fund will be created specifically for this.

The Rural Enterprises Programme also establishes the Rural Technology Facilities (RTFs) to provide technologies for rural industries. It is envisaged that in collaboration with these facilities there will be a greater infusion of technologies in the micro and small-scale industries to improve their productivity.

Since the emergence of ICT, various businesses have been founded around ICT. In Ghana, there were communication centres, which are still operating in some communities. However, currently, mobile money transfer centres have become popular, especially in urban areas. It is an indication of the potential of ICT applications for business in the service sector. The roadmap envisages promoting ICT-based business e.g. mobile money transfer centres in 50 selected communities in 5 regions.

Target 1.2

By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions.

Ensuring gender equity and sensitivity to the needs of children and the disabled are very important in poverty eradication. The Ministry of Gender, Children and Social Protection (MGCSP) has been set up to address the issues in gender equity and to ensure an all-embracing socio-economic development in the country. In this regard, the MGCSP is expected to lead in the programme for applying STI for the achievement of target 1.2. The main effort is to create an ICT-based system for monitoring poverty-eradication programmes to ensure inclusivity. The specific features here are the capacity to track gender and children-sensitive outcomes in the execution of the programmes and inform the executors of corrective measures as may be necessary.

Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation to implement programmes and policies to end poverty in all its dimensions.

Resource mobilization is always a major challenge for developing countries. Fortunately, however, there is an international understanding of the need for richer countries to help the poorer ones. Despite the COVID-19 pandemic, which has put pressure on all countries economically, the willingness for assisting developing countries remains. What is envisaged to achieve target 1.a. is building a technological system to track and 'direct' resource mobilization for poverty eradication. The first step is convening development partners and other stakeholders to discuss with the government the specific commitments to poverty eradication. A system will be built to track the execution of these commitments and the implementation of the respective programmes, as well as provide information for review.

Table 2

SDG 1 Framework for Developing Strategies and Programmes for STI4SDGs Roadmap

TARGETS	OBJECTIVES	ACTIVITIES	OUTPUTS	RESPONSIBILITY*
1.1 By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.90 a day.	Eradicate extreme poverty in Ghana measured as people living on less than $1.90 a day; Ensure means of income for all.	Promote technology and innovation for livelihoods; Strengthen technology promotion centers e.g. Rural Technology Facility (RTF) to provide agric. technologies for rural industries Promote ICT-based business e.g. mobile money transfers in 50 selected communities in 5 regions.	Rural agric. Technologies Established ICT- based businesses	**CSIR**, Ministry of Finance, Ministry of Trade and Industry, Ministry of Local Governments, GRATIS, REP.
1.2 By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions.	Ensure inclusivity in poverty eradication programmes erasing all bias by gender, age and disability. Mobilize resources for poverty eradication.	Create an ICT-based system for monitoring poverty-eradication programmes to ensure inclusivity.	An ICT-based system for monitoring implementation of poverty eradication	**Ministry of Gender and Social Protection**, Ministry of Finance, NDPC, GSS, Ministry of Local Government.
1.a Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation to implement programmes and policies to end poverty in all its dimensions.		Convene a conference (physical and or virtual) of development partners on resource commitment for poverty eradication. Track resource contributions for poverty eradication and provide information on achievement and gaps.	Conference proceedings Information system on poverty eradication.	NDPC,

*Note – * lead institutions in bold*

STI for Achieving SDG 2
Zero Hunger

In 2, key issues and challenges relating to ending hunger (SDG2) in Ghana were outlined. However, to achieve the SDG2 using STI, the areas of concern include ensuring improved public investment in agriculture; improving production efficiency and yield; improving post-harvest management; enhancing the application of STI in agriculture; promoting agriculture as a viable business among the youth; promoting livestock and poultry development for food and nutrition security; modernizing the agriculture sector to drive private sector agribusinesses; scaling up e-extension and business advisory services; enhancing online marketing of agricultural products; promoting the adoption of productivity improvement technologies such as greenhouse production systems; and promoting biotechnology applications for improved breeding. These areas align with Ghana's agriculture sector policy objectives as follows in Table 3.

Table 3
Alignment of Policy Objectives of Ghana's Agriculture Sector with Areas of Focus

No.	AGRICULTURE SECTOR POLICY OBJECTIVES	IDENTIFIED AREAS FOR STI FOCUS (SITUATIONAL ANALYSIS)
1	Strengthen institutional and organisational capacity	Improved public investment in agriculture
2	Modernize and enhance production systems	Improving post-harvest management; Enhancing application of STI in agriculture; Improving production efficiency and yield; Modernizing the agriculture sector to drive private sector agribusinesses; Scaling up e-extension and business advisory services; Promoting adoption of productivity improvement technologies such as greenhouse production systems; Promoting biotechnology applications for improved breeding; Improved public investment in agriculture
3	Create an enabling agribusiness environment	Promoting agriculture as a viable business among the youth; Promoting livestock and poultry development for food and nutrition security; Enhancing on-line marketing of agricultural products;

In addition to the areas outlined in Table 3, there is recognition that climate change and disasters (human-made and natural) are threats that can derail or impede progress in the agriculture sector. Hence, STI must be brought to bear on efforts to mitigate climate change effects and enhance sustainable land and water resources management in Ghana. This is indeed a policy objective of the sector. Aligning the focal areas, the policy objectives, and the targets for SDG2 in the light of STI intervention, Table 4 is presented.

For SDG 2, Targets 2.1, 2.2, 2.4, and 2.a. have been prioritised as shown in table 4. Target 2.1 is to end hunger and ensure access by all people – in particular, the poor and people in vulnerable situations, including infants - to safe, nutritious and sufficient food all year round by 2030. It has been noted that hunger arises in Ghana out of limited food availability, accessibility, affordability and stability. Moreover, even though the areas planting various crops in Ghana seem to have been stagnant, production of crops has tended to increase over time but lack of market and wide price fluctuations of foodstuff continue to be constraints to farmers.[2] On this score, STI intervention in this area with activities such as technical support in the production of quality and well-packaged food products to enhance post-harvest management through the one-district-one-factory initiative; and support for the application of the Internet of Things (IoT) in agriculture to enhance online marketing of agricultural products.

SDG 2, Target 2.2 places emphasis on "the indicators of the triple burden of malnutrition, that is, Protein-Energy Malnutrition, Micronutrient Malnutrition and Overweight & Obesity." The target also aims at zero stunting and wasting in children under five and at addressing the nutritional needs of adolescent girls, pregnant and lactating women and older persons, as well as micronutrient malnutrition.[3] In light of this, therefore, STI should be employed to promote biotechnology applications for improved breeding of crops and to develop formulae for food supplementation and bio-fortification (with sound biosafety systems in place).

Target 2.4 is to ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production; help maintain ecosystems; strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and progressively improve land and soil quality. No matter the scale of production, any food production system should aim at being sustainable. That is, "the system should get better in terms of soil improvement (or the ecosystem as a whole), be profitable (returns must exceed costs), be equitable (provide a reasonable livelihood to all involved) and have the potential of being resilient (be able to withstand climate change, disease, market and other shocks)."[4] Therefore, STI intervention activities identified developing and supplying quality seeds and improved varieties of crops, livestock, fisheries and poultry to farmers; promoting the adoption of and scaling-up of productivity improvement technologies such as greenhouse production systems; and developing a programme to implement an early warning and emergency preparedness system for agriculture.

Target 2.a. seeks to increase investment, including through enhanced international cooperation in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks to enhance agricultural productive capacity in developing countries, in particular, least developed countries. In furtherance of this target, the role of STI in SDG 2 can be amplified by intensifying advocacy and communication activities, developing a science agenda for agriculture in Ghana, and scaling up e-extension and business advisory services.

HAPPY WOMAN WITH COCOA HARVEST © TOBIAS NII KWATEI QUARTEY

[2]Matilda Steiner-Asiedu et al., "Addressing Sustainable Development Goal 2: Ghana Zero Hunger Strategic Review" (Accra, 2017), https://docs.wfp.org/api/documents/WFP-0000071730/download/?_ga=2.47054116.2038938788.1535558371–1957203229.1486643929.
[3]Steiner-Asiedu et al., 12.
[4]Steiner-Asiedu et al., 28–29.

Table 4

SDG 2 Framework for Developing Strategies and Programmes for STI4SDGs Roadmap

TARGETS	OBJECTIVES	ACTIVITIES	OUTPUTS	RESPONSIBILITY ENTITY
2.1 By 2030, end Hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food.	Promote the patronage of locally produced and processed foods and their products Develop and implement potential domestic market oriented products in the interest of the youth to encourage their interest in agribusiness	Support the adequate and efficient production of quality and well packaged/ managed food products to enhance post-harvest management Support the establishment of grain warehousing system Support the application of Innovative/Internet of Things (IoTs) in agriculture to enhance on-line marketing of agricultural produce/ products.	Improved Post harvest management.	MoFA, MESTI, MoC, MoTI, MoFAD, CSIR, DPs, NDPC, Private Sector
2.2 By 2030, end all forms of malnutrition, including achieving by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant women and older persons.	Promote the development of appropriate programmes to reduce the incidence and prevalence of nutritional disorders.	Promote biotechnology applications for improved breeding Develop formulae for food supplementation and bio-fortification (with sound biosafety systems in place).	Reduced nutritional disorders.	MoFA, MESTI, NBA, MoH/GHS, MoTI, MoFAD, CSIR, DPs, NDPC, Private Sector
2.4. By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.	Improve production efficiency and yield. Modernize the agricultural sector to drive private sector agribusinesses Establish early warning systems and emergency preparedness	Develop and supply quality seeds and improved varieties/ breeds of crops, poultry, livestock and fisheries Identify resilient indigenous food systems (agrobiodiversity systems). Promote adoption of and scaling up productivity improvement technologies such as soil management techniques/ greenhouse / mariculture/ and other efficient production systems Develop programmes to implement an early warning and emergency preparedness system.	Sustainable food production systems.	MoFA, MESTI, MoC, MoTI, MoFAD, CSIR, DPs, NDPC, Private Sector
2.a. Increase investment including through enhanced international cooperation in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries .	Improve Public investment in agriculture. Enhance application of STI in agriculture.	Intensify advocacy and communication Develop science agenda for agriculture in Ghana Scale up e-extension and business advisory services	Increased investment in STI for Agriculture.	MoFA, MESTI, MoC, MoTI, MoFAD, CSIR, DPs, NDPC, Private Sector

STI for Achieving SDG3
Good Health and Well-being

Ghana has made considerable progress in SDG3 indicators (Ghana VNR 2019 Report). Access to healthcare services improved with the proportion of the population using valid National Health Insurance Scheme (NHIS) cards estimated at 40% in 2019, an increase from 35.7% in 2018. Access to modern family methods continues to increase with the proportion of women aged between 15–49 years having their family planning needs met increased from 23.5% in 2008 to 42% in 2017. Maternal deaths declined from 580 per 100,000 live births in 2007 to 310 per 100,000 live births in 2017. Under-five and neonatal mortality rates also declined with the number of children dying within 28 days of birth dropping from 43 per 1,000 live births in 2003 to 27 deaths per 1,000 live births in 2017.

Despite progress made in access to healthcare, there are challenges which can be addressed effectively through the application of STI. These challenges include huge imbalances in geographical access to quality healthcare, inadequate and inequitable distribution of critical staff, increased cost of healthcare delivery, unhealthy dietary practices and nutritional disorders, poor quality of healthcare services as well as the devastating impact of the COVID-19 on Ghana's Healthcare delivery system. The National Health Policy Objectives include (i) strengthening the healthcare delivery system to be resilient (ii) encouraging the adoption of healthy lifestyles (iii) improving the physical environment (iv) improving the socio-economic status of the population, and (v) ensuring sustainable financing for health.

To this end, four key programmes will be vigorously pursued under the STI4SDGs Roadmap including (i) Improving the quality of healthcare delivery and public health through the application of STI, (ii) Improving emergency preparedness and management of epidemics and pandemics such as Severe Acute Respiratory Syndrome (SARS), Ebola, Lassa Fever and COVID-19 (iii) Strengthening technological capability needs and capacity building, and (iv) Improving nutrition and healthy dietary practices and lifestyles. These programmes and actionable strategies are aligned to the health sector objectives articulated in Ghana's STI Policy, CPESDP, National Health Policy, COVID-19 Response Plan and the Ghana COVID-19 Alleviation and Revitalization of Enterprises Support.

1.
Improving access to quality healthcare delivery and public health through the application of STI

Actionable Strategies
- Enhance healthcare infrastructural development including ICT infrastructure and AI-powered healthcare services;
- Improve doctor-to-patient ratio through increased enrolment, particularly at the tertiary level;
- Improve maternal and child health services, mental health and prevention of communicable and non-communicable diseases;
- Educate the general populace on the scientific basis of health issues, correct misconceptions, ignorance and superstitious beliefs and practices to reduce the national healthcare cost burden;
- Promote the development of domestic pharmaceutical production and local industrial production of some consumables in health care service delivery; and
- Establish specialized health centres to promote health tourism.

2.

Improving emergency preparedness and management of epidemics and pandemics such as Severe Acute Respiratory Syndrome (SARS), Ebola, Lassa Fever and COVID-19

Actionable Strategies

• Invest in digital technologies for epidemics and pandemic planning, surveillance, testing, contact tracing, quarantine, and health care;
• Promote e-health services delivery and technological capability through investment in ICT infrastructure and AI-powered healthcare services;
• Re-tooling of existing health facilities and construction of new ones;
• Promote research and development in the area of bio-medical engineering and instrumentation;
• Research into public health, clinical characterization and management of pandemics to inform policy; and
• Research into transmission dynamics of viruses including environmental and sociocultural conditions associated with transmission.

3.

Strengthening technological capability needs and capacity building

Actionable Strategies

• Institutionalize the Comprehensive Health Technology Assessment tool to inform the selection and procurement of needed medical technologies;
• Promote adoption and deployment at scale of selected innovation pathways and emerging technologies (AI, Blockchains, 3D Printing, telehealth platforms. Robotics and drones);
• Build the capacity of health professionals and other actors in the adoption and deployment of emerging technologies and innovations;
• Enhance access to accurate, timely and reliable data on health care delivery systems and information management; and
• Promote public-private partnerships in the healthcare delivery system.

4.

Improving nutrition and healthy dietary practices and lifestyles

Actionable Strategies

• Educate the general populace on improved nutrition and healthy dietary practices;
• Promote the development of appropriate programmes for reducing the incidence and prevalence of nutritional disorders;
• Encourage the adoption of healthy lifestyles and physical activity; and
• Promote safe and responsible sexual behavior

Table 5

SDG 3 Framework for Developing Strategies and Programmes for STI4SDGs Roadmap

TARGETS	OBJECTIVES	ACTIVITIES	OUTPUTS	RESPONSIBILITY
End the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases.	Identify technologies/ innovations in preventive measures against epidemics;	Create ICT-based systems for public education	ICT-based programmes for public education	Lead – **MOH**
	Improve early detection and diagnostics of such diseases;	Adopt electronic records and application of digital health platforms (tele-consultation, tele-radiology, m-health, big data analytics, artificial intelligence	Diagnostic tools	Others GHS, FBOs, Private Health Facilities, NGOs in Health,
Reduce maternal mortality ratio (MMR), under-five mortality and neonatal mortality rates.	Enhance therapeutics		Therapeutics	Health Regulatory Agencies,
	Strengthen human resources		Technologies and innovations (AI, Blockchains, 3D Printing, tele-health platforms. Robotics and drones)	Health Training institutions
	Strengthen M&E systems	Innovate for tests of the key diseases e.g. TB, hepatitis, AIDS,		
Increase proportion of births attended by skilled health personnel and proportion of women of reproductive age) who have their need for family planning satisfied with modern methods; and			M&E systems	
		Promote production of drugs including herbal;	R&D publications	
		Capacity building in diagnostics and therapeutics	Mass media programmes	
Reduce death rate due to road traffic injuries		Provide tools for follow-up random tests in communities	Capacity-building/ training modules	
			Trained human resources.	

STI for Achieving SDG4 Quality Education

SDG 4 focuses on one of the underpinning development areas of Ghana. A major flagship policy is the Free Senior High School (SHS) policy which makes high school education completely accessible to all irrespective of geographical location, social status, economic circumstance or physical ability or disability. The principle of inclusivity underlying the SDGs drives the flagship educational policy. It is currently being implemented at a substantial cost to the nation and yet, it is considered one of the important investments that the country has to make to create valuable human resources for the transformation of Ghana.

STI impact in the educational sector is critical to the achievement of SDG4. Table 6 highlights the key activities envisaged in addressing the targets Ghana has committed itself to.

Table 6

SDG 4 Framework for Developing Strategies and Programmes for STI4SDGs Roadmap

TARGETS	OBJECTIVES	ACTIVITIES	OUTPUTS	RESPONSIBILITY ENTITY
4.1 By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes.	Provide girls and boys with free, equitable quality education for effective learning outcomes.	Provide appropriate ICTs to girls and boys to access virtual learning programmes; Support the development of science and maths teaching and learning programmes for free electronic mass communications (radio, television and on the internet); Capacity building for science and maths teachers.	Science and maths teaching and learning programmes for mass communication. Retrained science and maths teachers	MoE, GES, Ministry of Communication, Mass media e.g. GBC radio and television.
4.2 By 2030 ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education.	Create access to quality early childhood development.	Develop STI-based programmes for all pre-primary boys and girls; Pilot the use of locally produced games to stimulate children's curiosity and creativity.	STI-based programmes for pre-primary boys and girls; Piloted locally produced games	MoE, GES, private schools, innovators in animations, cartoons and games for pre-schools (early childhood education).
4.3 By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university.	Create equal access for women and men to affordable and quality TVET.	Promote use of the internet in teaching and learning for all in technical, vocational and tertiary institutions; Organize clinics to produce audio-visual aids for STEM teaching and learning.	Internet-based TVET teaching and learning programmes Clinics to produce audio-visuals	MoE, GES, entrepreneurs, innovators in audio-visuals, animations for educational purposes.
4.a Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environment for all.	Provide inclusive and effective learning environment for pupils.	Carry out a study to assess the building, renovation and upgrading of education facilities for inclusive and effective learning environment for appropriate policy direction. Sensitize authorities in schools and universities to the importance of inclusive and effective learning environment for all.	Report of the study assessing state of educations facilities for policy direction. Sensitized authorities of educational institutions for effective learning environment for all.	MoE, GES, private school owners, Ministry of Finance.
4.4 – By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.	Upgrade skills improvement for youth and adults. Promote entrepreneurship among youth and adults on basis of upgraded skills.	Launch an internship programme in collaboration with private sector to improve identifiable skills in selected industries; Prepare entrepreneurship programme based on STI innovations. Select educational institutions and launch prepared programme.	Internship programme entrepreneurship programme Selected institutions running prepared programmes	MoE, GES, NVTI, University of Education at Winneba, AGI.

The proposed activities for the achievement of SDG 4 are derived from the broad national development context. Education is generally meant as a tool for developing the human resources of the nation from the pre-school stage through basic and secondary and through to tertiary levels. For the targets, the activities aim to create an enabling environment as well as direct or indirect impacts of STI impact on education. Further elaboration of the activities with the corresponding targets is given below.

By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes

The specific details of providing appropriate ICTs to girls and boys to access virtual learning programmes can be set in the current efforts of the Ministry of Education to promote online learning in Ghanaian schools. The Ministry of Education and the Ghana Education Service (GES) operate a Ghana Learning TV, which is a free-to-air channel solely dedicated to virtual learning for primary and junior high schools (JHS) and senior high schools (SHS). The programme is broadcasted in collaboration with the Ghana Broadcasting Corporation (GBC). The Centre for National Distance Learning and Open Schooling (CENDLOS) is one of the institutions working on virtual learning programmes. CENDLOS has currently developed an online programme on all the core contents in the senior high school curriculum and had given every student a password and access to an iCampus platform. Already an estimated SHS and TVET students of about 1.2 million students are on the iCampus system. The resources on the system include 810 notes with exercises, 20800 interactive quizzes, 600 audio-visual lessons, 540 units of interactive lessons, virtual laboratory practical sessions and simulations and over 3000 sets of notes and audio-visual Open Educational Resource (OER) materials. The key activities envisaged for the STI4SDGs Roadmap are contributing to enriching the platform and other virtual learning systems with the development of content on crucial STI topics. The following are some of the more specific activities envisaged to achieve the target:

•   Identify key informants in virtual learning and conduct interviews with them to understand the gaps to address in the STI4SDGs Roadmap;

•   Develop a programme for enhancing virtual learning with STI content;

•   Organize a stakeholders consultation workshop towards the implementation of the enhancement programme which has been developed;

•   Implement the programme with the inclusion of content in the appropriate platforms such as the iCampus.

The related activity in Table 6 is to support the development of science and mathematics teaching and learning programmes for free electronic mass communications (radio, television and the internet). It is envisaged that the pupils and students will be encouraged to use all available means including the internet to freely access the content developed towards addressing target 4.1.

There is a need for capacity building for science and maths teachers who have the responsibility to guide learning in their respective schools. The teachers, through their professional associations, will be taken through capacity-building workshops with resource persons to ensure effective teaching and learning.

By 2030 ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education

Two main activities are specified to address target 4.2. The two are strongly linked and are set in the policy context of strengthening pre-primary education of children. For example, UNICEF works in collaboration with other partners on Early Childhood Development emphasizing five main elements – health, nutrition, early stimulation, learning opportunities and protection. In Ghana, primary education starts from the age of six. Early stimulation and exploitation of learning opportunities are very important to orientate children to STI. The development of the STI-based programmes for all pre-primary boys and girls will entail the use of cartoons, games and rhymes among other things. Some pre-schools will be selected in three regions, e.g. Greater-Accra, Eastern, Central, Ashanti and Northern to pilot the STI-based games developed for preschool children. In this regard, the specific activities will include the following:

• Identify learning opportunities for pre-school children less than six years old to exploit to stimulate children's curiosity and creativity;

• Organize a stakeholder's workshop to determine innovations for stimulation of preschool children's interest in STI including games, cartoons, pictures and objects.

• Capacity-building workshops for key stakeholders such as teachers, animators and game innovators.

• Organize meetings/ workshops with policymakers in the education sector.

HAPPY FEMALE PUPILS © OBIBINI KOBBY

By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university

• Promote the use of the internet in teaching and learning for all in technical, vocational and tertiary institutions;
• Organize clinics to produce audio-visual aids for STEM teaching and learning.

Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all

• Carry out a study to assess the building, renovation and upgrading of education facilities for inclusive and effective learning environments for appropriate policy direction.
• Sensitize authorities in schools and universities to the importance of inclusive and effective learning environments for all.

By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship

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• Launch an internship programme in collaboration with the private sector to improve identifiable skills in selected industries;
• Prepare and initiate an entrepreneurship programme based on STI innovations.

FEMALE HARDWARE ENGINEER © RFSTUDIO

STI for achieving SDG 6
Clean Water and Sanitation

For SDG6, a number of key issues were identified in the situation analysis. The issues that emerged with potential for STI interventions include limited access to safe drinking water in rural and some urban areas, poor water quality, low water-use efficiency, poor sanitation and improper hygienic practices, and barriers to the reuse of water.

Accordingly, some identified interventions include the following strategic objectives:
i.   Ensure efficient management of water resources,
ii.   Accelerate the provision of safe, adequate and affordable drinking water,
iii.   Speed up the provision of adequate and equitable sanitation and hygiene for all
iv.   Expand nationwide water quality monitoring network,
v.   Implement water governance, ecosystem restoration and conservation
vi.   Monitor and manage groundwater

Table 7 illustrates the alignment of SDG 6 targets to the policy objectives of the water and sanitation sector. Proper water and sanitation are key to achieving the SDGs, including good health and gender equality. By managing our water sustainably, we are also able to better manage our production of food and energy and contribute to decent work and economic growth. Even though Ghana achieved the MDG for access to improved water supply early, but not on access to improved sanitation, statistics today show that fewer than two in five Ghanaians drink safe water, two out of every five schools are without toilets, and three out of every five schools are without water supplies.[5] Four targets of SDG 6 have been prioritized.

Target 6.1 is to achieve universal and equitable access to safe and affordable drinking water for all. The proportion of Ghana's population using improved drinking water services including piped water into dwellings, yards or plots; drinking water (bottled or in sachets) which is available when needed increased from 37.3% in 2013 to 44.3% in 2017. However, when the measurement of faecal contamination is factored in, the evidence is that only 19% of the population has access to safely managed water services.[6] Therefore, it is envisaged that STI can be deployed to provide technical assistance and guidance in the construction of water supply systems for communities and small towns to increase access to safe drinking water.

The aim of Target 6.2 is to achieve access to adequate sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations by 2030. In Ghana, improving access to adequate sanitation facilities is a priority, given that about 20% of the entire country's population practice open defecation; the practice is more widespread in the six (6) regions of northern Ghana where more than 70% of the population practices open defecation.[7] The envisaged role for STI in this regard is to provide technical assistance and guidance for the construction of latrines in communities and small towns and develop programmes to create public awareness.

Target 6.3 is to improve water quality by reducing pollution, eliminating dumping and minimising the release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally. Ghana adopted the Water Quality Index as a proxy for assessing ambient water quality. Available data shows that there has been a marginal improvement in water quality

MAN WASHING HANDS WITH SOAP UNDER RUNNING WATER © RON LACH

[5]UN Communications Group in Ghana and CSO Platform on SDGs, "The Sustainable Development Goals (SDGs) in Ghana: Why They Matter and How Can We Help?" (New York, 2017), gh.one. un.org/content/dam/unct/ghana/docs/SDGs/UNCT-GH-SDGs-in-Ghana-Avocacy-Messages-2017.pdf.
[6]NDPC, "Voluntary National Review Report on the Implementation of the 2030 Agenda for Sustainable Development" (Accra: National Development Planning Commission (NDPC), 2019), https:// ghana.un.org/sites/default/files/2019–10/23420VNR_Report_Ghana_Final_print.pdf.
[7]NDPC.

indices for the Coastal, Southwestern and Volta basins between 2017 and 2018. The Coastal and Volta basins recorded significant improvements from 51.1% and 54.3% in 2017 to 57% and 57.2% in 2018 respectively.[8] In addition to ongoing efforts to improve water quality, STI can be rolled out for water quality assessments, groundwater assessments, implementation of water governance, ecosystem restoration and conservation schemes.

Target 6.4 is to substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity by 2030. Water availability per capita in Ghana has been decreasing over the years from 1,976 m3/person in 2013 to 1,930 m3/person in 2018; however, this remains above the threshold for water stress (1700m3 per capita). In general, Ghana is not water stressed but parts of the country, particularly the Savannah and Sahel zones, experience water scarcity.[9] To contribute to the sustainable management of water resources, STI activities will include ecological monitoring, buffer zone enrichment, and strengthening transboundary cooperation.

Table 7

SDG 6 Framework for Developing Strategies and Programmes for STI4SDGs Roadmap

TARGETS	OBJECTIVES	ACTIVITIES	OUTPUTS	RESPONSIBILITY ENTITY
6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all.	Accelerate the provision of safe, adequate and affordable drinking water	Provide technical assistance and guidance in the construction of water supply systems for communities and small towns	Increased access to safe and affordable drinking.	MSWR, MESTI, MLGRD, CWSA, CSIR, GWC, NDPC, Development partners (UNICEF, USAID, etc.)
6.2 By 2030, achieve access to adequate sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.	Speed-up the provision of adequate and equitable sanitation and hygiene for all	Provide technical assistance and guidance for the construction of latrines in communities and small towns. Develop programmes to create public awareness .	Improved access to adequate sanitation and hygiene.	MSWR, MESTI, MLGRD, GWC, CWSA, CSIR, NDPC, Development partners (UNICEF, USAID, etc.)
6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.	Expand nationwide water quality monitoring network. Monitor and manage groundwater.	Water quality assessments. Groundwater assessments. Implement water governance, ecosystem restoration and conservation schemes.	Improve water quality.	MSWR, MESTI, MLGRD, GWC, CWSA, CSIR, WRC.
6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity	Ensure efficient management of water resources	Ecological monitoring Buffer zone enrichment Strengthen transboundary cooperation	Ensure sustainable management of water resources.	MSWR, MESTI, MLGRD, GWC, CWSA, CSIR, WRC.

STI for achieving SDG 8
Decent Work and Economic Growth

The focus of SDG 8 is to "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all". In line with this, the national development agenda seeks, among others, to build a strong and resilient economy, transform agriculture and industry; and develop robust tourism and creative arts industries. Various innovative initiatives by government and businesses resulted in impressive average annual GDP growth of about 7% between 2017 and 2019. Ghana's economic growth over the last decade has been driven by the services sector which contributed about 47.2% of GDP in 2019, compared to 34.2% by Industry and 18.5% by Agriculture. The national agenda is to pursue aggressive industrialization, in strategic areas, with high job creation potential to boost economic growth, while generating decent jobs and reducing the high level of unemployment among the youth.

The COVID-19 pandemic has adversely impacted all sectors of the economy with growth for 2020 declining to 0.9% as against the projected rate of 6.8%. In response to the pandemic, the government is embarking on the Ghana COVID-19 Alleviation and Revitalization of Enterprises Support (GhanaCARES) program to stabilize the economy and provide a strong foundation for accelerated economic growth and transformation. The government's emphasis is to build stronger institutions to deliver efficient services, provide the necessary infrastructure to support businesses, improve access to long-term finance, build skills to deepen the quality and impact of services and maintain financial sustainability. STI provides a useful vehicle for "building back better" through economic productivity, economic diversification and ensuring decent work for all.

Despite the disruptions occasioned by the COVID-19 pandemic, the SDGs remain relevant and serve as a practical framework for responding to the immediate effects, recovering, and building resilience. The government will therefore continue to work towards achieving its commitments under the 2030 Agenda, as well as Agenda 2063. The government's COVID-19 response and recovery are consistent with the SDGs and are guided by a careful balance of the economic, social and environmental considerations and ensuring that no one is left behind. The key STI-related activities proposed to accelerate the achievement of the selected SDG8 targets are presented in table 8 below.

Table 8

SDG 8 Framework for Developing Strategies and Programmes for STI4SDGs Roadmap

TARGETS	OBJECTIVES	ACTIVITIES	OUTPUTS	RESPONSIBILITY ENTITY
8.1 Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 percent GDP growth per annum in the least developed countries.	Increase economic diversification, productivity, and efficiency	Promote the adoption of Intelligent irrigation technologies	Intelligent irrigation systems	**MESTI**, MoFA, MoTI, MoE, MoC, PEF, academia
		Promote the use of greenhouse technology for all-year-round farming	Increase in the number greenhouse farms	
		Promote high-value addition to raw materials	Increase in the number of high value-added products	
8.2: Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labor-intensive sectors		Skills development in STI Increase use of artificial intelligence (AI)	STI skills development centers	
		Deepen the deployment of ICT in the services sector Deepen R&D partnership between research and business stakeholders.	Increased application of artificial intelligence (AI)	
		Advocate for the expansion of infrastructure to support E-work and E-commerce	Increase in the number of R&D partnerships	
8.5 By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value.		Revamp Ghana's ICT-based labour market information system	A comprehensive national labour market information system	**MELR**, MESTI MoC, academia
		Set-up an ICT-based system for reporting and tracking decent work infractions.	An ICT-based system for reporting and tracking decent work infractions	
8.6 By 2030, substantially reduce the proportions of youth not in employment, education or training	Increase access to affordable education and skills development	Modernize vocational and technical training Carryout entrepreneurial skills development programs E-learning platforms	Modern and skillful vocational and technical workforce Entrepreneurial skills development programs Widely accessible E-learning platforms	**MoE**, MELR, MESTI, MoC, MoYS, academia
8.7 Take immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labour, including recruitment and use of child soldiers, and by 2025 end child labour in all its forms.	Stop forced labour, modern slavery, child labour and other similar practices.	Create ICT-based systems for public education on forced labour, child labour; human trafficking, and modern slavery	Digital educational materials on forced labour, child labour; human trafficking, and modern slavery	**MELR**, NCCE, MoC, CSOs, academia
		Set-up an ICT-based system for reporting and tracking child labour	Awareness creation campaigns	
			ICT-based system for reporting and tracking child labour	
8.10 Strengthen the capacity of domestic financial institutions to encourage and expand access to banking, insurance and financial services for all.	Achieve universal access to financial services	Train financial institutions on new and emerging digital financial services	Increased knowledge on new and emerging digital financial services	**BoG**, Association of Bankers, Telcos
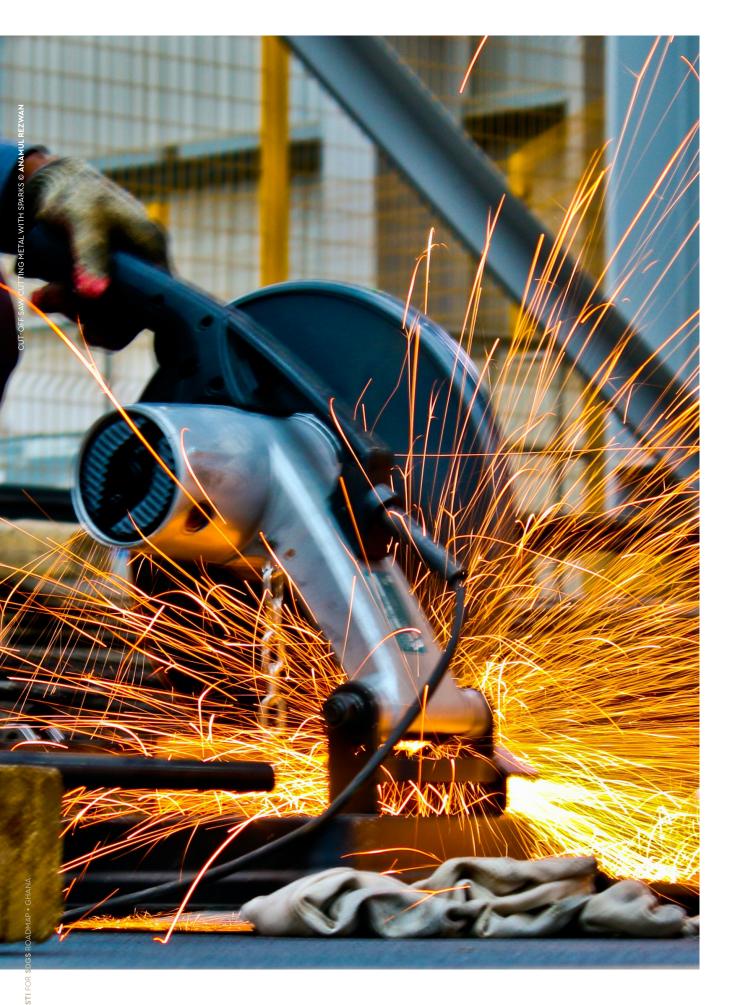
STI for achieving SDG 9
Industry, Innovation and Infrastructure

Sustained investment in infrastructure and innovation is key to economic growth and development. The continuous effort at bridging the digital divide in Ghana has been critical in ensuring access to information and knowledge which has spurred innovation and entrepreneurship. For instance, the single act of liberalizing the state-controlled telecommunication industry and the subsequent investments in the sector over the years have led to several innovations and stimulated economic growth. Access to mobile networks has led to mobile phone penetration soaring above 132.8% in 2020. Governing bodies have embraced mobile money and support the industry by providing the necessary regulatory framework. Due to the nature of its convenience and accessibility, the total value of mobile money transactions has increased from GHS20.9 billion in February 2019 to GHS30.1 billion in February 2020 while the volume of other traditional forms of payments like cheques continues to decline. This innovation has had a cascading effect on the economy through the facilitation of payments, trade, creation of jobs, and formalization of the informal economy, among others. Digital payments have opened the doors for various other innovations in financial technology, health and insurance; providing access to basic financial services for many - who in the past have been unreachable – thereby providing solutions to our developmental challenges mainly financial inclusion. Furthermore, industrialization has an impact on all areas of the economy. For a country that imports the majority of its consumable goods, industrial developments present the opportunity for economic growth. Reduction in the value of import bills is critical for development. The industry also creates jobs, and investment in the industry is the route that many countries have taken to tackle unemployment.

In light of the efforts being made to embrace innovation and support the SDG agenda, we must recognize that the done in building capabilities of the workforce of the future. Moreover, there should be a focus on strengthening the interlinkage between academia and industry. Failing to improve infrastructure and promote technological innovation could translate into a continued lack of access to health care and education, in addition to that, the quality of both could be compromised should technology not be used to advance methods However, through the application of STI, solutions can be designed to scale the achievement of SDGs 9.

Three key programmes will be vigorously pursued under the STI4SDGs roadmap to accelerate progress towards Goal 9. These include (i) Improving the quality and access to STI in education to strengthen the linkages between academia and industry and provide citizens, especially the youth, with the skills required to participate in the global economy; (ii) Creating an enabling environment to support private sector development, facilitating access to innovation for all businesses, increasing productivity through the adoption of technological and non-technological innovations and improving the availability of finance to aid the process and (iii) Improvements in infrastructure to spur economic growth and development and provide access of services to all, encouraging inclusivity.

TARGETS	OBJECTIVES	ACTIVITIES	OUTPUTS	RESPONSIBILITY
9.b Support domestic technology development and industrial diversification. 9.c Universal access to information and communications technology.	Improve the quality and access to STI in education, with the objective of strengthening the linkages between academia and industry, providing both the youth and citizens with the skills required to participate in the global economy.	Reform of education systems/ curriculum. Revise curriculum to develop critical thinking skills, to spur innovation and entrepreneurial behavior. Incorporation of technology into delivery mechanisms, digital access to course materials and increased availability of hardware. Emphasis on the importance of arts, creativity and science and technology, through communication and awareness campaigns. Better preparation of students for the workplace through structured National Service scheme – continual learning workplace readiness program. Increased collaboration between private sector training providers and public sector educational institutions, developing new business and delivery models to increase access to STI education. An annual platform should be created where stakeholders will converge to assess the progress made in their collaboration strategy.	5G services spectrum availability, 100% broadband & internet penetration. STI incorporated into mainstream education. Use of technology such as the use of digital and interactive e-learning platforms, whiteboards and tablets. Increased hands-on science education by using low-cost and locally produced materials for practical. National STEM campaigns which encourages youth to choose STEM options at secondary level, STEM internships and apprenticeship programs. Collaborative platforms which promotes, and assesses collaboration between private, public sectors and academia. Future-ready youth who are globally competitive and prepared for the future of work.	MOE, GES, NSS, MOC, Public & Private Schools, tertiary and training institutions, Edtech Entrepreneurs
9.2 Promote inclusive and sustainable industrialization. 9.3 Increase access to financial services and markets. 9.4 Upgrade all industries and infrastructures for sustainability. 9.5 Enhance research and upgrade industrial technologies.	Creating an enabling environment to support private sector development, facilitating access to innovation for all businesses, increasing productivity through the adoption of technological and non-technological innovations and improving the availability of finance to aid the process.	**Ecosystem Development** Improve or establish Innovation systems, increasing the opportunity for knowledge transfer between multiple actors. Deepening of Entrepreneurial Culture and Mindset. Foster collaboration between private sector, universities and other research institutions. Introduction of a Startup Act to encourage and promote innovation and entrepreneurship . Strengthen IP laws to protect innovators and their innovations and encourage collaboration. **Financing Innovation** Build the capacity of local fund managers to enable them to support early-stage innovations – patient capital. Tax reform allowing for taxes generated from private sector activity to support R&D and Innovation at a country level. Re-introduce policies to encourage private sector finance to flow to innovation and entrepreneurship relating to Act 680. Regulatory amendments to allow for the allocation of pension funds into medium to long term investments – Patient Capital. **Improved Productivity for Industry** Policy reform/incentives for businesses that wish to adopt technologies that promote sustainability -renewable energy waste management systems, reduction of plastic consumption. Policy reform that encourages the adoption of technology within industry. Lowering the cost of the acquisition of technologies.	Stronger ecosystem, increased collaboration resulting in increased efficiencies. Entrepreneurial-minded youth. Increased access to quality entrepreneurial support services. Improved access to innovation. Protection of intellectual property of innovators. Increase access to affordable finance for small scale businesses (9.3.2) Financial services that use AI for SME creditworthiness assessment. Retail management tools such as software developed by Kudigo which allows businesses owners with basic literacy to keep sufficient records. Fintech solutions that enhances the efficiency of SMEs. Geometric Economic growth. Blockchain-enabled technology public systems. Blockchain offers permanent and tamper-evident record keeping, real-time transaction transparency and auditability features. Increased access of small-scale industries and other enterprises, to value chains and markets via the use of commerce platforms (9.3.1).	MOT, NBSSI, MOF, Exim Bank, 1D1F, Venture Capital Trust Fund, Office of Attorney General and Ministry of Justice, Entrepreneurial Ecosystem Enablers (Investors, Service Providers)

TARGETS	OBJECTIVES	ACTIVITIES	OUTPUTS	RESPONSIBILITY
9.1 Develop sustainable, resilient and inclusive infrastructures. 9.4 Upgrade all industries and infrastructures for sustainability.	Improvements in infrastructure to spur economic growth and development and provide access of services to all, encouraging inclusivity.	Introduction and promotion of PPP law to stimulate the interest in Public Private Partnerships. PPPs to improve telecommunications infrastructure, enabling access to wider groups and reducing the cost of access to services. Develop the framework for Ghana to sell Green & Blue bonds. Investment into feasibility studies, project preparatory fund.	Equitable economic development due to provision of infrastructure to the citizens. Increased access to more diverse sources of finance for development. Government and Corporates issue green and blue bonds to facilitate development and growth. Provide impact investors with attractive investment opportunities ICT platforms which supports access to investment opportunities	MOF, Ghana Venture Capital Trust Fund, Development Bank of Ghana and other Development Finance Institutions, Development Agencies (GIZ, AFD etc.)

This provides the estimated budget, funding and coordination arrangement for the Implementation of the STI4SDGs Roadmap in line with the prioritized SDGs. The key to the effective implementation of the roadmap is funding. Although the government of Ghana will be investing in the implementation of the envisaged activities, funding from development partners and other stakeholders is crucial. This outlines the budget and related expectations from possible development partners. The amounts are estimated in US dollars.

BUDGET, FUNDING AND COORDINATION ARRANGEMENT FOR THE IMPLEMENTATION OF THE STI4SDGS ROADMAP

5

Implementation of STI for SDG1 "No Poverty" Roadmap Activities

Table 10
Proposed Budget for Implementation of **SDG 1** Roadmap Activities

SDG TARGETS	KEY ACTIVITIES*	ESTIMATED BUDGET (US $)	PROPOSED DONOR PARTNERS
1.1 By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.90 a day.	Promote technology and innovation for livelihoods;	100,000	World Bank, DfID, UNDP.
	Strengthen technology promotion centres e.g. Rural Technology Facility (RTF) to provide agric. technologies for rural industries.		
	Promote ICT-based business e.g. mobile money transfers in 50 selected communities in 5 regions.	100,000	
Sub-total		**200,000**	
1.2 By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions.	Create an ICT-based system for monitoring poverty-eradication programmes to ensure inclusivity.	40,000	UNDP, World Bank, IDRC
Sub-total		**40,000**	
1.a Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation to implement programmes and policies to end poverty in all its dimensions.	Convene a conference (physical and or virtual) of development partners on resource commitment for poverty eradication.	25,000	UNDP, UNESCO, Sida, DANIDA
	Track resource contributions for poverty eradication and provide information on achievement and gaps.	40,000	
Sub-total		**65,000**	
TOTAL		**305,000**	

Implementation of STI for SDG2 "Zero Hunger" Roadmap Activities

Table 11
Proposed Budget for Implementation of **SDG 2** Roadmap Activities

SDG TARGETS	KEY ACTIVITIES*	ESTIMATED BUDGET (US $)	PROPOSED DONOR PARTNERS
2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture	Support in the production of quality and well-packaged food products to enhance post-harvest management	1,500,000	GoG (MoFA, MESTI, MoC, MoTI), WB, GIZ, Master Card Foundation, UNICEF, WFP, Canada, USAID
	Support the application of the Internet of Things (IoT) in agriculture to enhance the online marketing of agricultural products	600,000	
	Promote biotechnology applications for improved breeding	1,500,000	
	Develop formulae for food supplementation and biofortification (with sound biosafety systems in place)	300,000	
	Develop and supply quality seeds and improved varieties of crops, livestock, fisheries and poultry	600,000	
	Identify resilient indigenous food systems (agro-biodiversity systems)	250,000	
	Promote seed security and agro-biodiversity	300,000	
	Promote adoption of and scaling-up productivity improvement technologies such as greenhouse production systems	1,000,000	
	Develop programmes to implement an early warning and emergency preparedness systems	250,000	
	Intensify advocacy and communication	200,000	
	Develop science agenda for agriculture in Ghana	200,000	
	Scale-up e-extension and business advisory services	200,000	
TOTAL		**6,900,000**	

Implementation of STI for SDG3 "Good Health and Well-Being" Roadmap Activities

Table 12
Proposed Budget for Implementation of **SDG 3** Roadmap Activities

SDG TARGETS	KEY ACTIVITIES*	ESTIMATED BUDGET (US $)	PROPOSED DONOR PARTNERS
3.3 By 2030, end epidemics of AIDS, TB, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases.	Improve early detection and diagnostics of such diseases;	250,000	World Health Organization, B&MGF, Governments of e.g. India, China and Japan.
	Enhance therapeutics.	200,000	
	Strengthen human resources.	200,000	
	Strengthen M&E systems.	50,000	
TOTAL		**700,000**	

Implementation of STI for SDG4 "Quality Education" Roadmap Activities

Table 13
Proposed Budget for Implementation of **SDG 4** Roadmap Activities

SDG TARGETS	KEY ACTIVITIES*	ESTIMATED BUDGET (US $)	PROPOSED DONOR PARTNERS
4.1 By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes.	•Provide appropriate ICTs to girls and boys to access virtual learning programmes; •Support the development of science and maths teaching and learning programmes for free electronic mass communications (radio, television and on the internet); •Capacity building for science and maths teachers.	100,000 80,000 50,000	Governments of Korea, UK, India, China, Germany, Russia, US and EU and the key UN agencies e.g. UNESCO, UNDP and UN Office of Information and Communications Technology (UNOICT).
Sub-total		**230,000**	
4.2 By 2030 ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education.	•Develop STI-based programmes for all pre-primary boys and girls; •Pilot the use of locally produced games to stimulate children's curiosity and creativity.	50,000 50,000	UNICEF and other UN agencies and Governments of Australia and EU.
Sub-total		**100,000**	
4.3 By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university.	•Promote use of the internet in teaching and learning for all in technical, vocational and tertiary institutions; •Organize clinics to produce audio-visual aids for STEM teaching and learning.	40,000 120,000	UNOICT, UNESCO, UN Women and other UN agencies and governments of Japan, The Netherlands, EU, Norway, Sweden and Finland.
Sub-total		**160,000**	
4.a Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environment for all.	•Carry out a study to assess the building, renovation and upgrading of education facilities for inclusive and effective learning environment for appropriate policy direction. •Sensitize authorities in schools and universities to the importance of inclusive and effective learning environment for all.	45,000 40,000	UNESCO, UNDP, WHO, DfID, DANIDA and governments of France, UK and The Netherlands.
Sub-total		**85,000**	
4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship	•Launch an internship programme in collaboration with private sector to improve identifiable skills in selected industries; •Prepare and initiate an entrepreneurship programme based on STI innovations.	120,000 150,000	UN International Center for Technical and Vocational Education and training (UNEVOC), UNESCO, the governments of Germany and Canada (CIDA).
Sub-total		**270,000**	
TOTAL		**845,000**	

Implementation of STI for SDG6 "Clean Water and Sanitation" Roadmap Activities

Table 14
Proposed Budget for Implementation of **SDG 6** Roadmap Activities

SDG TARGETS	KEY ACTIVITIES*	ESTIMATED BUDGET (US $)	PROPOSED DONOR PARTNERS
6 Ensure availability and sustainable management of water and sanitation for all.	Provide technical assistance and guidance in the construction of water supply systems for communities and small towns.	250,000	GoG (MSWR, MESTI), WB, USAID, Canada, UNICEF, UNEP (GEF)
	Provide technical assistance and guidance for the construction of latrines in communities and small towns.	250,000	
	Develop programmes to create public awareness.	50,000	
	Water quality assessments.	1,000,000	
	Groundwater assessments.	1,000,000	
	Implement water governance, ecosystem restoration and conservation schemes.	200,000	
	Ecological monitoring	2,000,000	
	Buffer zone enrichment	1,000,000	
	Strengthen transboundary cooperation	500,000	
TOTAL		**6,250,000**	

Implementation of STI for SDG8 "Decent Work and Economic Growth" Roadmap Activities

Table 15
Proposed Budget for Implementation of **SDG 8** Roadmap Activities

SDG TARGETS	KEY ACTIVITIES*	ESTIMATED BUDGET (US $)	PROPOSED DONOR PARTNERS
8.1 Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 percent GDP growth per annum in the least developed countries.	•Promote the Intelligent irrigation technologies.	50,000	Governments of Korea, UK, India, China, Germany, Russia, US and EU and the key UN agencies e.g. UNESCO, UNDP and UN Office of Information and Communications Technology (UNOICT).
	•Promote the use of greenhouse technology for all-year-round farming.	50,000	
	•Promote high-value addition to raw materials.	100,000	
	•Undertake skills development in STI.	300,000	
8.2 Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors.	•Promote use of artificial intelligence (AI) in industry and service sectors.	350,000	
	•Deepen R&D partnership between research and business stakeholders.	350,000	
	•Promote the expansion of infrastructure to support E-work and E-commerce.	100,000	
8.5 By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value.	•Revamp Ghana's labour market information system.	150,000	UNICEF and other UN agencies and Governments of Australia and EU.
	•Set-up an ICT-based system for reporting and tracking decent work infractions, including public education.	250,000	
8.6 By 2030, substantially reduce the proportions of youth not in employment, education or training.	•Modernise vocational and technical training.	350,000	UNOICT, UNESCO, UN Women and other UN agencies and governments of Japan, The Netherlands, EU, Norway, Sweden and Finland.
	•Carryout entrepreneurial skills development programmes.	200,000	
	•Develop innovative E-learning platforms.		
8.7 Take immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labour, including recruitment and use of child soldiers, and by 2025 end child labour in all its forms.	•Create ICT-based systems for public education on forced labour, child labour; human trafficking, and modern slavery.	250,000	UNESCO, UNDP, WHO, DfID, DANIDA and governments of France, UK and The Netherlands.
	•Set-up an ICT-based system for reporting and tracking child labour.	250,000	
8.10 Strengthen the capacity of domestic financial institutions to encourage and expand access to banking, insurance and financial services for all.	•Train financial institutions on new and emerging digital financial services	80,000	UN International Center for Technical and Vocational Education and training (UNEVOC), UNESCO, the governmentS of Germany and Canada (CIDA).
TOTAL		**2,830,000**	

Implementation of STI for SDG9 "Industry, Innovation and Infrastructure" Roadmap Activities

Table 16
Proposed Budget for Implementation of **SDG 9** Roadmap Activities

SDG TARGETS	KEY ACTIVITIES*	ESTIMATED BUDGET (US $)	PROPOSED DONOR PARTNERS
9.b Support domestic technology development and industrial diversification	•Reform of education systems/ curriculum. •Revise curriculum to develop critical thinking skills, to spur innovation and entrepreneurial behavior. •Incorporation of technology into delivery mechanisms, digital access to course materials and increased availability of hardware. •Emphasis on the importance of arts, creativity and science and technology, through communication and awareness campaigns. •Better preparation of students for the workplace through structured National Service scheme – continual learning workplace readiness program.	125,000	The World Bank, African Development Bank, UN agencies
9.c Universal access to information and communications technology	•Increased collaboration between private sector training providers and public sector educational institutions, developing new business and delivery models to increase access to STI education. An annual platform should be created where stakeholders will converge to assess the progress made in their collaboration strategy.	150,000	
9.2 Promote inclusive and sustainable industrialization	**Ecosystem Development** •Improve or establish Innovation systems, increasing the opportunity for knowledge transfer between multiple actors. •Deepening of Entrepreneurial Culture and Mindset. •Foster collaboration between private sector, universities and other research institutions.	100,000	The World Bank, African Development Bank, UN agencies
9.3 Increase access to financial services and markets	•Introduction of a Startup Act to encourage and promote innovation and entrepreneurship. Strengthen IP laws to protect innovators and their innovations and encourage collaboration.	25,000	
9.4 Upgrade all industries and infrastructures for sustainability	**Financing Innovation** •Build the capacity of local fund managers to enable them to support early-stage innovations – patient capital. •Tax reform allowing for taxes generated from private sector activity to support R&D and Innovation at a country level. •Re-introduce policies to encourage private sector finance to flow to innovation and entrepreneurship relating to Act 680.	200,000	
9.5 Enhance research and upgrade industrial technologies	•Regulatory amendments to allow for the allocation of pension funds into medium to long term investments – Patient Capital. **Improved Productivity for Industry** •Policy reform/incentives for businesses that wish to adopt technologies that promote sustainability -renewable energy waste management systems, reduction of plastic consumption. •Policy reform that encourages the adoption of technology within industry. Lowering the cost of the acquisition of technologies.	80,000	
9.1 Develop sustainable, resilient and inclusive infrastructures	•Introduction and promotion of PPP law to stimulate the interest in Public Private Partnerships. •PPPs to improve telecommunications infrastructure, enabling access to wider groups and reducing the cost of access to services. •Develop the framework for Ghana to sell Green & Blue bonds. Investment into feasibility studies, project preparatory fund.	15,000	The World Bank, African Development Bank, UN agencies
9.4 Upgrade all industries and infrastructure for sustainability		695,000	
TOTAL		**1,390,000**	

The Target Audience for the partnership and communication strategy to sustain the STI4SDGs Roadmap consists of the stakeholders including the National Task Team, Government Ministries, Educational Institutions, Public sector, Private sector, UN Agencies, Financial Institutions, and NGOs. The table below explains the implementation and activities of the strategy.

PARTNERSHIP AND COMMUNICATION STRATEGY TO SUSTAIN STAKEHOLDER INVOLVEMENT AND ENSURE AN INCLUSIVE GOVERNANCE OF THE ROADMAP

6

Table 17
Partnership and Communication Strategy

OBJECTIVES	ACTIVITIES	CHANNELS	TARGET AUDIENCE	UNIT COST/ DESCRIPTIVE	BUDGET (US $)
1 To create an online presence and social media outreach.	Develop a central interactive portal to share information on the STI4SDG roadmap. Providing key stakeholders with information pertaining to policies, services and opportunities.	A Central Internet portal for STI4SDG	All Stakeholders	Design and Development of online portal	**1,800**
				Maintenance of online portal	**4,200 p/a**
	Social Media accounts can be created to engage with stakeholders in conversations on STI4SDGs, the importance of dialogue and continual learning and iteration must be fostered.	Social Media; LinkedIn, Twitter, Instagram	Business Professionals, The Youth, Ambassadors, Activists, Key industry players	Creation and management of social media platforms	**4,200 per annum**
	Informational videos maybe uploaded and could be used as a tool for education.	YouTube, Facebook	Educational Institutions, The Youth, Private Sector, General public, Public Sector	Content Creation, 800 per video Minimum of 12 per year	**1,700**
2 Develop a visual representation of the STI4SDG Roadmap	Develop an official Logo for the STI4SDG Roadmap. This logo will be used on all STI4SDG related communication materials. Creating a strong brand will create a reference point for the roadmap.	Print Media e.g., Daily Graphic, B&FT Television (TV); GBC, Joy News, Citi TV etc. Social Media; LinkedIn, Twitter, Instagram	All Stakeholders	Design	**500**
	Visual representation to highlight the goals and gaps and how STI can support. These visuals will highlight the deficiency in the prioritized SDGs.	Info graphics Social Media; LinkedIn, Twitter, Instagram Videos	All Stakeholders		**900**
	Branding at events such as conferences, workshops and media soirees.	Pull up Banners, Flags, Branded Materials	All Stakeholders		**1,100**
3 Engage main stream media to promote and create awareness of the STI4SDG roadmap.	Press/Media soirees will be organized to launch the roadmap.	TV e.g.,GBC, Joy News etc. Radio; Citi FM, Joy FM etc Newspapers eg; Daily Graphic, B&FT	All Stakeholders	Travel expenses @250 for 10 stations	**500**
	Interviews will be conducted with key stakeholder groups across selected media houses to educate the public and stakeholders and demonstrate that this is a collaborative initiative which requires the participation of all.	TV e.g., GBC, Joy News etc. Radio; Citi FM, Joy FM etc.		2,500 per interview	**1,800**
	Periodic Thought leadership pieces published in main stream press and online news portals to promote the agenda for the STI4SDGs.	TV e.g., GBC, Joy News etc. Radio; Citi FM, Joy FM		1,000 per article	**700**
	Continual engagement of selected media houses to cover STI4SDG related events.	Newspapers; Daily Graphic, B&FT		1,000 per month	**2,100**

OBJECTIVES	ACTIVITIES	CHANNELS	TARGET AUDIENCE	UNIT COST/ DESCRIPTIVE	BUDGET (US $)
4 Develop strategies to promote specific STI4SDG roadmap events.	A launch event to outdoor the roadmap to key stakeholders.	Main stream media; TV, Radio, Newspaper Online streaming platforms; YouTube, Facebook	Public Sector Private Sector	100 participants	11,000
	Identify upcoming events locally and globally that could present opportunities to further communicate around the roadmap, speaking engagements etc.	Main stream media; TV, radio, Newspaper Social media (LinkedIn, Twitter, Instagram			
	Stakeholder specific engagements that can support the dissemination and onboarding of the roadmap into organizational strategies.	Social media platforms. Scheduled meetings.		6,000 per meeting	4,200
	Develop partnerships with stakeholders to catalyze the onboarding of the roadmap.	Using Social media platforms to engage in conversations.			1,100
5 Strategic partnerships and repurposing content.	Develop a partnership with the High Level Ministerial Committee appointed by the President on the SDGs, positioning them as ambassadors of the roadmap.	Quarterly Round table discussions	All Stakeholders	4 meetings @ 6000	4,200
6 Global outreach in the promotion of STI4SDG Roadmap.	Engage Agencies, Development Partners and donors globally.	Online Platforms Social media Platforms Representation at Industry Specific Events / Speaking engagements	UN agencies International NGO's Development Partners		
					40,000

TOTAL

The total financial commitment for the implementation of Ghana's STI4SDGs Roadmap is quite modest. Across all the prioritized goals and targets as detailed in 5 and 6, a total amount of *US$19,260,000.000* is required. The Government of Ghana must necessarily bear part of this commitment. However, the nation will be grateful for substantial support from development partners.

M&E PLAN/FRAMEWORK – MONITORING AND EVALUATION SYSTEM TO TRACK PROGRESS ON THE ROADMAP IMPLEMENTATION

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7

Introduction

Monitoring and Evaluation (M&E) is an essential management tool that provides incentives for the pursuit of agreed targets, as well as ensuring accountability, responsiveness, and transparency in the allocation of resources. This section outlines the arrangement that will be put in place to guide the continuous tracking, periodic review, and evaluation of the implementation of the roadmap. It provides a set of agreed indicators, linked to the key activities, outcomes, outputs, and impact that must be tracked. Also indicated, are the roles of specific institutions in the monitoring and evaluation of the implementation of the roadmap.

7.2

How will monitoring be done?

Per the requirement of the National Development Planning Systems Act, MDAs and MMDAs prepare and submit quarterly and annual progress reports (APRs) to NDPC. These reports track the implementation of policy initiatives in the sectors' and districts' four-year medium-term development plans, based on agreed sets of indicators and targets. Lessons from the APRs informs the Annual Action Plans of MDAs and MMDAs. The system for preparing the APRs is well tested and has the legal basis to involve all the MDAs and MMDAs to track the implementation of policy initiatives in their medium-term plans.

Monitoring of the STI4SDGs Roadmap will be anchored on the existing national and sub-national monitoring arrangement. MESTI, with support from NDPC, will liaise with relevant MDAs and MMDAs to include indicators for tracking the implementation of the STI4SDGs Roadmap in their respective M&E plans. This will ensure that the APRs contain information on the agreed set of indicators for tracking the implementation of the roadmap. In addition, private sector organizations, academia and other non-state actors that play important roles in the implementation of the roadmap will be supported to generate data and report on the relevant STI4SDGs Roadmap indicators.

The sector and district APRs, together with reports from relevant non-state actors will constitute the primary source of data for preparing annual reports to track the implementation of the roadmap. The data will be complemented with information from key informant interviews, focus group discussions, and field visits as appropriate. The annual progress reports on the implementation of the roadmap will be discussed at stakeholder fora and lessons therein will form the basis of revising the roadmap, where necessary. A set of indicators and targets for tracking the implementation of the STI4SDGs Roadmap is shown in Appendix 2.

7.3

How will Evaluation be done?

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The purpose of the evaluation process is to answer more in-depth questions about how and why interventions are achieving or not achieving the expected results. It will also identify changes in internal and external conditions (social, political, technological, economic and environmental) that may affect the successful achievement of the targets in the STI4SDGs Roadmap. The evaluation activities will not attempt to establish direct attribution of implementation actions to outcomes and impact but will rather seek to provide robust information on the contribution intermediate outcomes are making toward the objectives of the Roadmap. The evaluations will therefore serve as a learning purpose for MESTI and other stakeholders. The evaluations will be based on five criteria; namely:

a.

Relevance

The extent to which the STI4SDGs Roadmap is suited to the priorities and policies of the key sectors.

b.

Effectiveness

A measure of the extent to which actions in the STI4SDGs Roadmap achieved their intended objectives.

c.

Efficiency

This measures the qualitative and quantitative outputs in relation to the input efforts. It provides a value-for-money assessment of the implementation actions.

d.

Impact

The positive and negative changes produced directly or indirectly by the implementation actions in the STI4SDGs Roadmap. The changes could be intended or unintended and related to social, economic, environmental, and other development indicators.

e.

Sustainability

This is concerned with measuring whether the benefits of the implementation actions are likely to continue after the initial support has been completed.

A mid-term evaluation is proposed by 2024. The feedback will be used to inform the medium-term development plans for 2025 to 2028. Lessons from this evaluation will influence the revision of the roadmap to ensure the achievement of the targets and objectives. A terminal evaluation is scheduled for 2030 to examine the overall impact of the STI4SDGs Roadmap in contributing to the achievement of the SDGs. It is anticipated that the findings from the terminal evaluation will significantly shape the use of STI in Ghana's development pursuit.

A proposed set of evaluation questions is shown in Appendix 3.

Roles and responsibilities

Ministry of Environment Science Technology and Innovation (MESTI)

The Ministry of Environment, Science, Technology and Innovation is the ministry responsible for the development of the environment and science in the country. The Science, Technology and Innovation Directorate is the technical wing charged to formulate STI policies and communicate and coordinate STI programmes and activities. As part of its duties, STI Directorate coordinates, monitor and evaluate Science, Technology, and Innovation policies and programmes being implemented by MDAs in support of the government's development agenda.

The STI directorate will oversee the implementation, monitoring and evaluation of the roadmap. It will approve the workplan of the STI4SDGs Roadmap Committee and mobilize resources for preparing the annual monitoring reports, as well as the mid-term and terminal evaluation reports. The directorate will also ensure that findings from the reports are discussed with key policymakers and influencers at national and sub-national levels.

STI Roadmap committee

The STI4SDGs Roadmap committee will coordinate and supervise the preparation of the annual reports, as well as mid-term and terminal evaluation reports. The committee shall develop the Terms of Reference (TOR) for the preparation of these reports and engage the services of a competent team(s) to carry out the assignment. Furthermore, the committee shall see to the dissemination of the report to key stakeholders and ensure that the lessons and proposed actions are followed through.

National Development Planning Commission (NDPC)

The National Development Planning Commission (NDPC) is mandated to advise the President on national development policies and strategies and is responsible for coordinating the decentralized planning system. It is also responsible for formulating, coordinating the implementation, monitoring and evaluation of national development policies and plans. NDPC will provide technical support to MDAs and MMDAs in integrating activities from the STI4SDGs Roadmap into their development plans, as well as M&E plans.

Ministries, Departments and Agencies (MDAS)

The MDAs are mandated to undertake development planning functions based on the prevailing national development agenda. Against this background, the MDAs will prepare and execute their respective sector medium-term development plans which will include the assigned STI Roadmap initiatives. The MDAs based on the sectoral medium-term development plans will also design a monitoring and evaluation framework, including an agreed set of objectively verifiable indicators to track the progress of programmes, outcomes, outputs, objectives, targets and activities. The MDAs will prepare and submit their APRs which contains information on the STI4SDGs Roadmap to NDPC.

7.4.5

Metropolitan, Municipal and District Assemblies (MMDAs)

Per the decentralised approach to governance and development planning, the MMDAs are the basic planning units in Ghana. They form the administrative and the political authority at the local levels and therefore, to realise the national development agenda, the MMDAs drawing from the medium-term national development policy framework by the NDPC will ensure the preparation and implementation of development plans. The MMDAs using a set of agreed indicators will implement an M&E plan to track the results of their development initiative against an agreed set of targets.

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APPENDICES

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Appendix 1
Members of the Technical Task Team

NAME	POSITION/ INSTITUTION/ ADDRESS
Mrs. Cynthia Asare	Chief Director, MESTI
Dr. Eugene Owusu	Head, Office of the Presidential Advisor on SDGs
Dr. Felix Addo-Yobo	Director, National Development Planning Commission
Mrs. Gladys Mamtee Osabutey	Director, Ministry of Finance
Dr. Simon Sovoe	Deputy Director, EPA, Office of Research, Technology and Innovation
Ms. Paulina Addy	Director of Women in Agricultural Development (WIAD), MOFA
Dr. George Owusu Essegbey	CEO, CSIR – Technology Development and Transfer Centre
Dr. (Mrs) Wilhemina Quaye	Director, CSIR – Science and Technology Policy Research Institute
Mr. Bernard Ayensu	Ministry of Education, Accra
Mr. Apollonius Osei-Akoto Asare	Ghana National Commission for UNESCO
Dr. Emmanuel Newman	National Council for Tertiary Education
Mr. Raymond Mensah	Ministry of Monitoring and Evaluation
Mr. Ben Anin Adjei	Association of Ghana Industries (AGI)
Mr. Victor Owusu Boateng	Ghana Statistical Service, Accra

Appendix 2
Proposed List of Indicators

NAME	PROPOSED LIST OF INDICATORS	DATA SOURCE
1	Number of new rural agriculture technologies developed by technology type	MoTI, MoFA, MSWR
2	Number of ICT-based businesses established by the sector	MoCD, NCA, MoTI
3	Number of greenhouse farms by crop type	MoFA, MoTI
4	Annual investment in STI	Min. of Finance, MESTI, GIPC
5	Status of ICT-based system for public education	MoCD, MoE, GES
6	Number of R&D publications	MESTI and its Agencies
7	Number of free electronic platforms for teaching and learning science and mathematics	MoE and GES
8	Number of STI-based programmes for pre-primary boys and girls	MoE and GES
9	Number of Internet-based TVET teaching and learning programmes	MoE, GES, MELR
10	Number of Entrepreneurial skills development programmes established	MELR and MESTI
11	Number of intelligent irrigation systems by type and region	MoFA, MoTI and EPA
12	Number of high-value-added products produced locally by region	MoFA, MoTI and EPA
13	Number of STI skills development centres by region and district	MELR and MoTI
14	Number of R&D partnerships by Sector	MESTI and its Agencies
15	Number of patent applications by sector	MESTI and its Agencies
16	Status of National Labour Market Information System	MELR, GSS and Fair Wages
17	Status of ICT-based system for reporting and tracking decent work infractions by Sector	MELR and MoCD
18	Number of awareness creation events organized by region by Sector	MESTI
19	Status of ICT-based system for reporting and tracking child labour by Sector	MELR and MoCD.
20	Number of training events on new and emerging digital financial services organised by sector	MoF and BoG

Appendix 3
Evaluation Questions

EVALUATION CRITERIA	EVALUATION QUESTIONS
Relevance	How relevant is the STI4SDGs Roadmap to the development priorities of the country?
	To what extent do the programme and activities meet social, economic, and environmental development needs?
Effectiveness	Is the STI4SDGs Roadmap accomplishing its intended objectives and planned results?
	What are the challenges and opportunities?
Efficiency	How well are the implementing agencies using their human and financial resources to achieve the intended results?
Impact	What can be done to ensure more efficient use of resources and information? What impact has the implementation of the STI4SDGs Roadmap had on the progress towards achieving the selected SDGs?
Sustainability	To what extent can the benefits and activities in the Roadmap be sustained?

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ROADMAP

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