Papua New Guinea E-agriculture Strategy

"The Papua New Guinea agricultural sector transformed by innovative information and communication technologies, by 2023"

March 2018

Document Information

Document No:	DOC-01	
Document Title:	PNG E-agriculture Strategy	
Project Title:	PNG E-agriculture Strategy	
Status	Published	
	Revisions	

Table of Contents

Acknowledgement

This report was prepared following a series of national consultation workshop for the development of a PNG E-agriculture Strategy. Acknowledgment is due to the Department of Agriculture and Livestock, Department of Communication and Information, National Information and Communication Technology Authority, the Food and Agriculture Organisation, and the International Telecommunication Union for facilitating the process. Thanks also to the PNG E-agriculture Strategy Taskforce for their expertise inputs and experiences, which have formed the basis and provided a pathway for the framework. The acceptance and support of the DAL Secretary and inputs and guidance by DAL's Deputy Secretaries for Corporate Services, Planning and Policy, and Food Security is greatly acknowledged.

The taskforce comprised experts from various organisations that contributed to this strategy.

No	Name	Designation	Organisation
1	Francis Daink	Deputy Secretary - Technical Services	DAL
2	Stephen Mesa	Deputy Secretary – Corporate Services	DAL
3	Nicks Maniha	Director - Information	DAL
4	John Kendiga	Director - Planning/Policy	DAL
5	Brown Konabe	Director - Food Security	DAL
6	Peter Kaekae	Director - Management Serv.	DAL
7	Clement Victor	Snr Project Office	PPAP – DAL
8	Jackson Kariko	Manager Int'l Affairs	NICTA
9	Kila Aluvula	Manager Special Projects	NICTA
10	Paul Kill	A/Chief Training Officer	DAL
11	Elias John	Snr Technical Officer	CODEX - DAL
12	Regina Nukundj	Food Security Officer	DAL
13	Soldier Buruka	PR Media Officer	DAL
14	Matei Labun	Manager - Training & Extension	CIC
15	Brian Manny	A/Team Leader - Eco & Mkt Research	CIC
16	Joseph George Koima	Manager - Information & Comm	FPDA
17	Laso Mana	IT Manager	National Disaster Office
18	Ken Shimizu	Country Rep	FAO PNG
19	Gerard Sylvester	Knowledge Management Officer	FAO Asia Pacific RO
20	Ashish Narayan	Programme Coordinator	ITU Asia Pacific RO
21	Seniorl Anzu	Consultant	FAO PNG

Foreword

Agriculture is the foundation and heart of the rural PNG economy with over 85% of its 7.5 million people depending on the sector for their livelihoods. With a near 30% GDP contribution, the sector has the potential to improve food security, nutrition and income earning opportunities; create employment; reduce poverty; and enhance socio-economic development.

However, the sector is faced with many challenges; from climate change to lack of access to markets and capacity of rural communities as well as limited access to agriculture resources. Access to suitable and timely information and knowledge is also one of the key drawbacks of agriculture advancement in PNG.

The country requires smarter approaches and new innovations to build a modern and internationally competitive agriculture sector. The growth of technology in the last decade, especially the increase in the use of mobile phones, broadband internet and other services provide an opportunity to bridge the information and knowledge gap among rural communities.

The PNG E-agriculture Strategy (2017-2023) sets a new direction in view of the emerging opportunities in technology to bridge the information and knowledge gap. The framework embraces the Government's focus to be smarter and innovative in increasing revenue, entrepreneurship and investment in the sector.

The strategy's vision to transform PNG agriculture through innovative information and communication technologies by 2023 is something that we all look forward to in building a resilient and prosperous sector that enhances food security, income and economic growth.

The development of this framework is timely and aligns to the O'Neill-Abel Government's desire, according to Alotau Accord II of 2017, to grow the economy. It is also in line with the APEC 2018's agenda to embrace the digital future with inclusiveness.

This strategy will guide the identification, development and sustainable implementation of information and communication technology-based services and solutions to address some of the challenges in agriculture with cost effectiveness and timeliness. This is a multi-stakeholder effort that also captures key agencies from meteorology, banking, insurance and telecommunication.

I am pleased to inform all stakeholders that the strategy was developed with the guidance of key guiding policies outlined in the PNG Vision 2050; the PNG Development Strategic Plan (2010 – 2030); National Agriculture Development Plan (2007-2016) and other national and sectoral policies, strategies and plans; taking into consideration the information technology readiness of PNG.

I also share my gratitude and appreciation to all stakeholders for their insights and thoughtful inputs in ensuring this platform is established, under the leadership of the Department of Agriculture and Livestock (DAL) in partnership with the Department of Communication and Information Technology, National Information & Communications Technology Authority (NICTA) and other key actors with technical support from the United Nation's Food and Agriculture Organization (FAO) and International Telecommunication Union (ITU).

The e-agriculture agenda is a step in the right direction to improve service delivery, considering the challenges and remoteness of our farming population. It is my firm belief that our people and the sector will embrace ICT-enabled services and solutions for improved growth and socio-economic development into the future.

Hon. Benny Allan

Minister for Agriculture & Livestock

Executive Summary

The Papua New Guinea E-agriculture Strategy is aimed at harnessing the ICT potential of the country in achieving the agriculture goals and further strengthening the role of ICTs in accelerating the growth of the agriculture sector in a sustainable and equitable manner. The strategy was developed with the use of the PNG Vision 2050 (2010-2050), PNG Development Strategic Plan (2010 – 2030), National Agriculture Development Plan (2007-2016), National Broadband Policy (2013) and other sectoral policies as guiding frameworks.

This document is a result of collective inputs from an E-Agriculture Taskforce set up by the Department of Agriculture and Livestock (DAL) which had deliberated and finalised the strategy development process. The taskforce comprised representatives from various sector agencies (DAL, Coffee Industry Corporation, Fresh Produce Development Agency, National Agriculture and Quarantine Inspection Authority), the Department of Communication and Information, National Information and Communication Authority, National Disaster Centre and National Statistic Office.

Also consulted during the process were other critical stakeholders including the National Forest Authority, National Fisheries Authority, Office of Climate Change Authority, Department of National Planning and Monitoring, National Weather Service, National Development Bank, Bank South Pacific, Telikom, Digicel PNG, Bemobile Vodafone, Datec, and the media (EM TV, National Broadcasting Corporation, The National, Sunday Chronicle, PNG FM). Technical assistance and expertise were provided by FAO Country Office together with the FAO and ITU Regional Office's for Asia and the Pacific in the development of this e-agriculture strategy for PNG.

The PNG E-agriculture Strategy was developed in accordance to the framework proposed by the FAO-ITU E-agriculture Strategy Guide (http://www.fao.org/3/a-i5564e.pdf)

This strategy outlines the development of a PNG e-agriculture vision, an action plan for key ICT solutions for the sector and a monitoring and evaluation framework. In keeping with the five year planning cycle of the PNG Government, the time frame was set as 2023 (2017-2023). The plan also identifies the critical ecosystem requirements (e.g. telecom infrastructure, banking infrastructure, institutional arrangements and capacity) and also takes into consideration the existing systems/ solutions and details the plans for developing and implementing nine priority solutions.

The PNG E-agriculture Strategy is a living document and is modified to align with the PNG Vision 2050 (2010-2050), PNG Development Strategic Plan (2010 – 2030), National Agriculture Development Plan (2007-2016), National Broadband Policy (2013) and other relevant national policies/ guidelines.

Background

Agriculture is the mainstay of Papua New Guinea's rural economy with over 85% of its eight million plus people depending on it for their livelihoods. The sector has the potential to improve food security, nutrition and income earning opportunities; create employment; reduce poverty; and enhance socio-economic development. This is the sector that requires attention with appropriate policies, strategies, resources and activities to improve livelihoods and foster rural development. However, with a decline in the conventional extension system and emerging global challenges, improved access to information and knowledge and better linkages between stakeholders are crucial for agricultural development.

The emerging ICT tools and applications offer promising opportunities for increased communication, information sharing and overall national development. Many actors in the sector have taken advantage of these opportunities but cannot progress without favourable guidelines and policy directions; and appropriate infrastructure, funding support and skills.

The Food and Agriculture Organization, in consultation with the Department of Agriculture and Livestock and other key stakeholders, has initiated the development of a PNG E-agriculture Strategy. The strategy will help guide the stakeholders through a holistic approach in capturing and better utilising the vast opportunities in ICT in PNG's agricultural and national development.

What is E-agriculture?

E-agriculture is evolving in scope as new ICT applications continue to be harnessed in the agriculture sector. It is seen as an emerging field focusing on the enhancement of agricultural and rural development through improved information and communication processes. In this context, ICT is used as an umbrella term encompassing all information and communication technologies including devices, networks, services and applications; these range from innovative Internet-era technologies and sensors to other pre-existing aids such as telephones, mobiles, television, radio and satellites.
More specifically, it involves the conceptualization, design, development, evaluation and application of innovative ways to use ICTs in the rural domain, with a primary focus on agriculture, forests, fisheries and livestock. Provision of standards, norms, methodologies, tools as well as development of individual and institutional capacities, and policy support are all key components of E-agriculture.

A. Country Overview and Agriculture Policy Environment

1. Country Profile

1.1 Geography

Papua New Guinea (PNG) is the largest island nation in the South Pacific, situated 15° south of the equator and about 150 kilometres north of Australian's Queensland state. It comprises the eastern half of the island of New Guinea, sharing the border with Indonesia's West Papua province - formerly Irian Jaya (Powaseu, 2004). PNG is made up of 600 islands and atolls with a total land area of approximately 462,000 km² of which 97% is customarily owned. An estimated 27% of the total landmass is actually inhabited while the rest is covered with tropical rainforest, mangroves and dry deciduous forest. PNG's geographical landscape is mountainous with rugged terrains in the hinterlands of mainland highlands and swampy lowlands on the coast.

Figure 2. Satellite map of PNG

1.2 Demography

The PNG population is estimated around eight million (7.3 million in 2011) with a growth rate at 3.1% per year (MTDP 2016). Of this estimation, over 85% live in rural villages through subsistence agriculture with an average of 5.1 person per household (Bourke et al 2008) and a low population density of about 11 persons per km² (NADP 2007). They produce most food and cash crops from their own gardens, especially under traditional methods of minimum tillage, shifting cultivation and bush fallow.

While English is, the formal language of education and commerce, Tok Pisin (Pidgin) and Hiri Motu are two major Lingua Franca with more than 800 other local languages.

The climate is tropical monsoonal (hot and humid) with wet and dry seasons from December to March and from May to October respectively with average rainfall from 8000 mm in mountainous areas to

1000-1500 mm in low lying coastal regions. Temperatures vary from 30-32°C in the lowlands to 22-25°C in the highlands with occasional droughts and frosts.

PNG is a country with great geographical, cultural and linguistic diversity and is rich in natural resources, including agriculture, timber, fish and minerals. The major economic sectors are agriculture, forestry, fisheries, manufacturing, mineral and hydrocarbon, retail and wholesale, building and construction, transport and telecommunications, finance and business trade (NADP, 2007).

1.3 Administrative Divisions

PNG is made up of 22 provinces - the primary administrative divisions of the country. The provincial divisions form the basis for administration, resource allocation and service delivery; although they vary depending on population size and land area. Provincial governments take charge of provincial administrations as semi-autonomous authorities under a decentralised system apart from the National Government. Within provinces, there are districts and constituencies. The provinces and districts are represented by political heads (Members of Parliament), making up the National Parliament - totalling 111 - who are elected every five years. Provincial (also known as regional) MPs are political heads of provinces as Governors and are largely responsible for administering the provinces through the Provincial Executive Councils (PECs). The PECs comprise the Governor, Electorate MPs representing the districts and Presidents of Local Level Governments (constituencies).

The country is divided into four regions on a broader scale based on organisation of government services, corporate operations, community events and machinations of politics.

Table 1. PNG's four regions and distribution of provinces

No	Region	Province
1	Highlands	Eastern Highlands, Chimbu (Simbu), Jiwaka, Western Highlands, Southern Highlands, Enga and Hela
2	Islands	Autonomous Region of Bougainville, New Ireland, Manus, East New Britain and West New Britain
3	Momase	Morobe, Madang, East Sepik and Sandaun (West Sepik)
4	Southern	Central, Gulf, Milne Bay, Oro (Northern) and Western

1.4 Government

The Independent State of Papua New Guinea, as it is officially known, has a constitutional parliamentary democracy and a Commonwealth realm with Queen Elizabeth II as the Head of State, represented by the Governor General. There are three arms of Government - the Legislature, the Executive and the Judicial - established by the Constitution, various Organic Laws and enabling Acts of Parliament. The overarching government structure functions at three levels - the national, provincial and local level governments.

The Prime Minister is the head of the PNG Government under a parliamentary representative democratic multi-party system. There are over 30 ministerial portfolios headed by state ministers, representing different sectors as Government Departments (and Authorities). Among them are the Department of Agriculture and Livestock, National Forestry Authority and National Fisheries Authority.

From colonialism to post independence (1975), all functions of agriculture, livestock, forestry and fisheries came under one umbrella through the then Department of Agriculture, Livestock and Fisheries. Since the 80s, twin policies on 'decentralisation and corporatisation' saw the establishment of sub-sector or industry based corporations, institutions, agencies and boards (Table 2) through enactments with roles and functions based on legislations, gazettal and corporate plans.

Table 2: Major agricultural organisations in PNG

No	Organisation	URL
1	Department of Agriculture and Livestock	www.agriculture.org.pg
2	National Forestry Authority	www.forestry.gov.pg
3	National Fisheries Authority	www.fisheries.gov.pg
4	National Agricultural Research Institute	www.nari.org.pg
5	Fresh Produce Development Agency	www.fpda.com.pg
6	Coffee Industry Corporation	www.cic.org.pg
7	Cocoa Coconut Institute	
8	National Agriculture Inspection Authority	www.naqia.gov.pg
9	Oil Palm Research Association	www.pngopra.org.pg
10	Oil Palm Industry Corporation	
11	PNG Cocoa Board	www.cocoaboard.org.pg
12	Kokonas Industri Koporesen	
13	Livestock Development Corporation	
14	Rubber Industry /Board	
15	Spice Industry / Board	
16	PNG Forest Industries Association	www.fiapng.com
17	Forest Research Institute	
18	Fisheries College	
19	Rural Industries Council	
20	Highlands Agriculture Technical Institute	

Information Communication Technology (ICT) is essential for PNG's growth and development in this information age, which the Government has recognised with the creation of enabling environments. These include necessary reforms since 1994, and the related legislative and institutional arrangements. To date PNG has a converged ICT regulation landscape with the following institutions playing key roles in terms of sectoral regulation, licensing and development.

Table 3: Major ICT policy maker and regulators in PNG

No	Organisation	URL
1	Department of Communication and Information	www.communication.gov.pg
2	National Information and Communication Technology Authority	www.nicta.gov.pg
3	Independent Consumer Competition Commission	www.iccc.gov.pg

1.5 Policy Alignment

As a country, PNG has its macro level development aspirations, policies and plans, as well as sectoral and institutional development policies, strategies and plans with specific frameworks. They are aligned towards the long-term dream, PNG Vision 2050, and other broad policies and guiding principles. The formulation of the PNG E-agriculture Strategy takes into account key national development policies, sectoral policies, and relevant legislative framework, and the following are some of those now in effect.

1.5.1   PNG Vision 2050

PNG Vision 2050 is the country's 40-year visionary development strategy with seven key pillars and constitutional directives for socioeconomic development. Although the bulk of the population rely on agriculture for their livelihoods, the economic base centres on the mining and hydrocarbon industries at present. The Vision however focuses on shifting this economic base to one that is dominated by renewable sectors - **agriculture, forestry, fisheries and tourism** - with greater prosperity and also to be categorised among the top 50 in the UN HDI by 2050. These are targeted through effective service delivery, human resource development, wealth creation and sustainable development of our existing vast natural resources which are underpinned by our shared national interests so as to create a "*Smart, Wise, Fair, Healthy and Happy Society by 2050*".
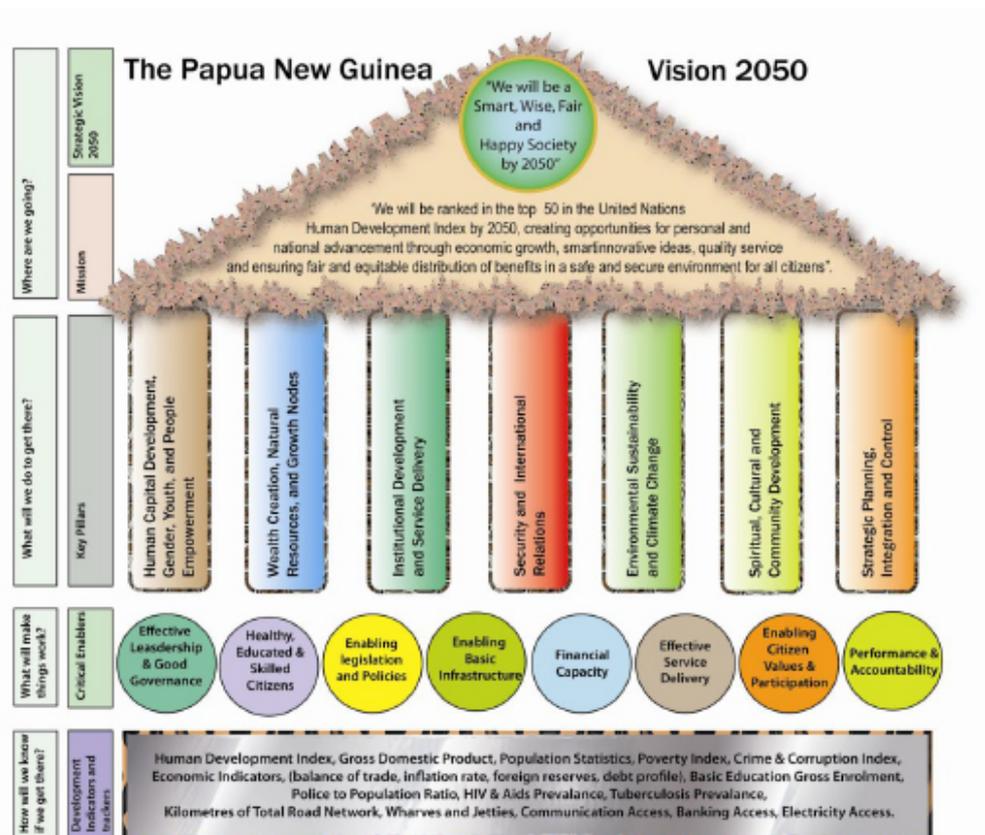

Figure 3: The PNG Vision 2050 pillars

1.5.2   PNG Development Strategic Plan 2010 – 2030

The DSP came on the back of PNG Vision 2050 in an attempt to translate the Vision into more specific programs and targets. It is largely about mapping out the pathway with strategies for PNG to reach its destiny in 40 years. In doing so, the PNGDSP should quadruple the national income, which should give all Papua New Guineans an improved quality of life by exploiting the available opportunities and enable them to become key players in the overall socioeconomic development of this country. It is designed to strategically inform and guide Papua New Guineans in all walks of life to engage in the development process of our country.

1.5.3   National Agriculture Development Plan 2007-2016

The National Agricultural Development Plan is the blueprint to stimulate economic growth through the promotion of food security, income generation and poverty alleviation by involving all stakeholders. The NADP has been PNG agriculture's overarching strategic plan developed collectively by sectoral players under leadership of DAL. The 10-year plan was intended to address issues relating to economic inequality and poverty among the rural communities by promoting smallholder agriculture development, in tandem with medium to large scale commercial agricultural enterprises which have provided the framework to mobilize the rural poor to utilize their customary lands productively and invest in income generating activities. Many other medium term plans and strategic frameworks, including those for the sub-sector agencies and corporations, incorporate NADP's vision and principles - as guiding principles and pathway to overall development goals and economic growth.

1.5.4   Medium Term Development Plan 2011-2015

The Medium Term Development Plan was the first 5-year plan to implement the PNG Development Strategic Plan 2010-2030 and the Vision 2050 in the mid-term. With the 40-year development initiatives mapped out by Vision 2050 through the seven pillars, the DSP translates the pillars into directions for economic policies, public policies, sector interventions with objectives, targets and desired deliverables for 2030. The MTDP guides the development of sector policies, plans and strategies for the first of four years with public funding and responsible implementing agencies (sector players, provinces, CBOs and other development partners).

1.5.5   Medium Term Development Plan II 2016-2017

The Medium Term Development Plan 2 (2016-2017) is a two-year plan to complete the current political cycle's planning process (a continuation from MTDP 2011-2015) and captures the intentions, priorities and activities of the present government. The new government formed after the 2017 election will be required to develop its new five-year plan for the next political cycle through the Department of Planning and Monitoring. The reasoning is to have governments responsible for their own strategic directions with political support. The MTDP 2 builds on from other policies and strategies in a smarter approach to development. It will be central to a broader planning framework described under a proposed legislation (PNG Planning Act) which in turn will give legislative effect to planning and monitoring processes and linking to the national budgets. MTDP 3 will form the next 5-year plan (2018-2022) in the next government cycle.

1.5.6   National Strategy for Responsible Sustainable Development for PNG (StaRS) 2014

The StaRS is a strategic framework that emphasise responsible planning and development of national plans. It came about in 2014 after a review of both the Vision 2050 and DSP 2030 in light of the rapidly changing global circumstances. StaRS is a policy shift in ensuring broad policies (Vision 2050 and Development Strategic Plan 2030) do not only vie for improved broad based growth outcomes but these outcomes are being truly strategic in approach. By revisiting existing policies against some of the assumptions of sustainable growth and managing the resources being exploited to sustain the PNG economy, StaRS prescribes a new development road map for a growth strategy that is truly strategic, futuristic and appropriate for the future.

1.5.7   DAL Strategic and Corporate Plan 2013-2017

The DAL Strategic & Corporate Plan (2013-2017) provides a road map and guidelines to achieve key priorities for agriculture as outlined in the Government's Alotau Accord. With the branding: 'Transforming the agriculture sector to a climate-smart and business-oriented powerhouse'; the plan positions DAL as the leading agency in the development of an overarching agricultural policy to modernise agriculture as well as provide strong and effective leadership and coordination in implementing and overseeing policies of government and the corresponding programs in the sector. It realigns DAL's role and responsibilities with national government policies, sub-sector statutory agencies, provinces, districts, and private sector together with development partners. Furthermore, it strengthens development partnership and macro-economic and inter-sectoral linkages, and aims at providing the right environment for efficient and effective agriculture and agri-business supply chains/value chains establishments and operations.

1.5.8   NADP Alignment to National Development Plans

In order to remain focused to better serve the sector and achieve higher development gains, the Agriculture Sector, through DAL, had aligned the NADP to the two higher-level plans through a consultative process in 2011. This realigned vision was documented through the publication: "Aligning the Agriculture Sector to Higher National Development Plans", in 2011.

In the same way, the different agriculture sector agencies also redeveloped their visions/missions and strategic plans, realigning them to the Vision 2050 and DSP 2030 through the realigned NADP. The process, which was based on the cascading logic and was facilitated in consultation stakeholders. Further planning thereafter at Institutional level (programs and projects) had fallen with the framework and priorities site under the realignment.

1.5.9   Forest Policy 1991

The Forest Policy 1991 is the active policy framework to date covering areas of forest management, the forest industry, forest research, forest training and education, and forest organization and administration. Its objectives are to ensure sustainability of PNG forests through proper management practices and for forest resources to benefit Papua New Guineans through income and economic growth.

1.5.10 National Information & Communication (ICT) Policy 2008

PNG's national ICT Policy sets out a strategic framework for meeting the Government's objectives for the ICT sector. Under the auspices of the Department of Communication and Information, the policy defines ICT as an important development tool in this information age and broadly captures ITC's relevance and application in different facets of development including agriculture and fisheries. It also strategizes various ICT aspects mandated under the Ministry such as mobile network, open market competition, and transformation of the state-owned Telikom in view of competition, regulatory framework and infrastructure.

1.5.10 National Information & Communication (ICT): Phase 2 Reforms 2009

Following on from the ICT Policy 2008, this is a report (Government policy) which contains 50 reforms establishing the basis for the ICT regulatory framework under open competition. It captures the pathway to open competition, future of community services, supporting arrangements, timing and implementation. Regulatory structures and processes were reviewed for the setup of much efficient arrangements. The recommended reforms were to support the development of telecommunications networks and services to Papua New Guineans.

1.5.12 National Broadband Policy 2013

The National Broadband Policy (2013) is an important policy framework to attract and sustain broadband services for the country. The Government has recognised that the country requires high-speed access services for connectivity to the internet and other ICT services. This access should be high quality and affordable broadband services that will support social and economic development of the country. This policy is a part of the overall national ICT Policy and is aligned with the broader planning commitments and national aspirations of the Government, such as those expressed in the *PNG Vision 2050* and the *Medium Term Development Strategy*. The E-agriculture services and solutions are largely dependent on the accessibility, affordability and quality of the telecommunication infrastructure. The broadband policy, consistent with PNG Vision 2050, has five development objectives:
  i.   Good governance,
  ii.   Growth in the national economy across all sectors,
  iii. Deployment and construction of physical infrastructure to support services delivery, especially in regional and rural areas,
  iv.   Private sector development and employment, and
  v.   Capacity building and human resources development.

1.5.13 Policies related to Agriculture

There are a number of other related policies and strategies that this E-agriculture strategy aligns to, which include the PNG Coffee Industry Strategic Plan 2008-2018, NARI Strategy and Results Framework 2011-2020, PNG Cocoa Coconut Institute Strategic Plan 2010-2020, PNG Forest Authority Corporate Plan 2007-2012, National Rice Policy 2015-2030, and the Cybercrime Code Bill 2016.
These policies and plans are highly relevant to PNG's agricultural growth and economic development. While different groups formulated them under different frameworks at different times, they target the same Papua New Guineans. Additionally, the sector is captured in respective contexts.

1.5.14   Intergraded Government Information System

The government efforts to integrating all departments and agencies onto a single ICT platform, referred to as the Integrated Government Information System (IGIS), forms an ideal backdrop for ease of e-agriculture adoption and implementation among stakeholders in the public service. IGIS is a system aimed at maximizing the use of ICT resources through shared ICT infrastructure and services for all government agencies and is a platform that stands to build the foundation for e-Government in PNG. IGIS is a government initiative aimed at computerising and integrating departments and State agencies using ICT as a precursor to eventual e-government.

The e-Government network platform solution covers the following aspects:
- an interconnected government network,
- a comprehensive security protection system,
- a cloud-based e-Government platform that supports data sharing and support applications,
- a collaborative government office service platform, and
- a unified and centralized management for network O&M.

IGIS provides an opportunity for improved efficiency of government performance, resulting in high productivity; and reduced costs in network construction, operation, and maintenance. The IGIS work progress in almost completed, as shown in Table 4, covering some 47 Government sites in the National Capital District and five provincial headquarters.

Table 4: Progress on IGIS achievement

No	Item	Achieved Rate (%)
1	Data Centre Implementation	100
2	Area Data Center Implementation	100
3	Offices Sites ISP (47 sites in NCD)	100
4	ISP 5 Province Offices Sites	100
5	OSP Access Fiber in NCD	100
6	TPNG IP MPLS Core	100
7	Applications (ERS2 and NCRS2)	100
8	Government Help Desk	100
9	Managed Service	100
10	Email system + Anti-virus System	100
11	OSP District Fiber	100
12	Microwave	99
13	End to End Integration NCD sites	100
14	End to End Integration Province sites	99
15	**Overall Project Progress**	99.9

The PNG IGIS will fundamentally change the way services and information is delivered to citizens and how we interact with our colleagues across government departments and agencies and also with our citizens.

IGIS Products and Services

- ✓ Internet security gateway service for communication between IGIS-NET and outside world,
- ✓ Email services for gopng domain,
- ✓ VoIP Telephony system helps to achieve the objective of cost reduction for inter-department voice communication,
- ✓ Unified Communication solution provides broaden information exchange,
- ✓ Video Conference and TelePresence System for improved government meeting efficiency and cost saving,
- ✓ Datacentre: Cloud computing, Data sharing and centralized database,
- ✓ Customized applications for E-Government e.g. e-health, e-medicine, e-procurement, e-agriculture online portal, etc.

IGIS Benefits

- o High Speed Internet Service through Fiber,
- o GovCloud,
- o Free VoIP services between departments and agencies,
- o Storage of High volumes of data,
- o Email services using Government domain name gopng.gov.pg
- o A unified collaboration application that enhances teamwork across departments and locations,
- o Improve organization knowledge management for better planning and monitoring,
- o Decrease IT costs,
- o Increase inter departments and inter locations collaboration.

1.5.15 PNG eGovernment Master Plan

The PNG eGovernment Master Plan (EGMP) shares a vision for transformative eGovernance that meets the nation's development objectives through ICT with efficiency, transparency and accountability, enhanced citizen's engagement, and effective delivery of public services. Its objective is to ensure the coherence of ICT programs and projects with each other, ensuring that there is no duplication, or overlapping of projects. E-Government are envisioned to create "a digitally empowered and integrated government that provides responsive and transparent online citizen-centred services. Through the eGovernment initiative, transformation in government service delivery will be realized through efficient, convenient and transparent services to citizens and businesses through appropriate ICTs.

Strategy for Implementing e-Government

- The EGMP adopts a whole-of-government approach to support the Government of PNG's eGovernment aspirations,
- The EGMP presents building blocks for e-Government that include an initial list of priority projects,
- The EGMP highlights the importance of collaboration, interoperability, shared services, and openness.

A key issue is the development of human resource and institutional capacity in the use of ICTs.

B. Strategic Context for E-agriculture in Papua New Guinea

1. Agriculture System Status in Papua New Guinea

1.1 Agriculture

Agriculture is the mainstay of PNG's rural economy and a vital driver for economic development. It is the source of livelihood for over 80% of Papua New Guineans as it provides food for subsistence and income generation. The sector accounted for about 19% of PNG's Gross Domestic Product with exports worth K3.7 billion (US$1.74 billion) in 2011, a 28% increase on the previous year (Business Advantage PNG 2012). The major export commodities are oil palm, coffee, cocoa, copra, rubber and tea. The important food crops are sweet potato, banana, sago, taro, Chinese taro, yams, cassava and sugarcane. Cash crops include oil palm, coffee, cocoa, copra, fresh vegetables and betel nut.

1.2 Oil Palm

Oil palm is currently the highest producer and income earning commodity for PNG with an export value of K1 449 million (US$700 million) in 2011. This was a 44% increase over the preceding year due to high world prices and higher production. The sub-sector is largely driven by the private sector with more than 50% of the oil palm grown on estates, while the industry directly supports over 20,000 smallholder families. PNG is the world's leading producer of sustainable palm oil.

1.3 Coffee

Coffee is a major source of income for more than 50% of the PNG total population, 397,772 households, or more than 2.5 million growers. It is grown in 16 of PNG's 20 provinces and earns more than K350 million per annum of which 60-70% goes to coffee households (CIC 2008). Production in 2011 reached 1,488,752 bags, the highest ever recorded by the PNG coffee industry. This was attributed by favourable weather conditions as well as a favourable world and domestic market prices that allowed good coffee plot rehabilitation and harvesting throughout 2010 - 2011. During the period, total coffee exports reached 1,224,523 bags GBE (73,471 metric tonnes), earning some K927 million, "an increase of 78% from K520.9 million in 2010 earnings and the highest level ever recorded. It is estimated that over K500 million of the total export earnings were pass onto coffee producers and growers (CIC Website 2016).

1.4 Cocoa and Coconut

Cocoa and coconut make a significant contribution to household incomes and food security, while coconuts worth K120 million are consumed annually in domestic diets. The cocoa industry employs 31% of the national labour, while coconut provides direct and indirect employment to 36% of all rural households. Export revenue earnings from cocoa rank third after oil palm and coffee at K227 million per annum in the past five years, while those from coconut peaked at K275 million in 2008 (CCI 2009). In 2011, PNG cocoa earned K284 million kina (US$134 million) (DAL 2013) while copra earned K245 million. Approximately 70% of PNG's cocoa is exported directly to the world's largest chocolate manufacturers. Over two million people, mostly from coastal provinces, cultivate cocoa.

1.4 Forestry

PNG's forest resources support rural livelihood and the cash economy. The tropical rain forests have more than 480 commercial species. PNG exports woods in the form of logs presently. More than 2.2

cubic meters of log have been harvested already. In 2005, forestry's contribution to total real GDP was as high as 9.2%, which was estimated to be K742.2 million.

1.5 Fisheries

The average market value of PNG catch is estimated at K350 to K400 million a year however there is huge potential for increased economic value and returns to the national coffers with improved management and development programs (NFA 2016). Although earnings from exports of fisheries resources are important, the subsistence economy also means a lot the people and domestic economy due to daily reliance.

The major revenue of the fisheries sector comes from access fees from deepwater fishing. In line with the Fisheries Management Act, NFA also generates income from licence fees from other operators, assistance from donors and penalties arising from prosecutions. In April 2016, NFA made a K25 million dividend payment to the government, which came in less than a year after the authority also announced a K50 million dividend in October 14, 2015 (NFA Website 2016).

Rubber (K41 million) and tea (K14 million) are other export commodities (DAL 2013).

2. Agriculture, Development Goals and Challenges

2.1 Agriculture Sector Goals and Priorities

2.1.1 Goals

Being the major source of livelihood for the majority and its significant contribution to the economy, the renewable sector forms an integral pillar in wealth creation and national prosperity. The sector is well captured in a number of higher level strategies and development frameworks.

The PNG Vision 2050 envisages its goal for PNG to become *a Smart, Wise, Fair and Happy Society by 2050* and ranked among the top 50 in the United Nations' Human Development Index by 2050. One of its seven pillars or strategic focus areas is Wealth Creation; which specifically targets agriculture, forestry, fisheries, and tourism. Relatively its strategic direction is *"Papua New Guinea will develop and grow the manufacturing, services, agriculture, forestry, fisheries and eco-tourism sectors from 2010 to 2050"* to enable economic growth by 2050 and enhance socioeconomic performance and improvement of overall HDI ranking.

The major renewable sector players are also well captured in the PNG Development Strategic Plan (2010 – 2030) with an overall goal for "a high quality of life for all Papua New Guineans". Specific goals identified for agriculture, forestry and fisheries as well as for climate change and ICT are:

- ✓ Agriculture and Livestock Goal: A world class agricultural sector that is responsive to international and domestic markets for a diverse range of products and provides the best available income and job opportunities.
- ✓ Forest Goal: Build a forestry sector that is sustainable and highly profitable.
- ✓ Fisheries Goal: Develop a fisheries sector that is both sustainable and highly profitable for PNG, including the establishment of PNG as a world leader in the supply of tuna."
- ✓ Climate Change Goal: Adapt to the domestic impacts of climate change and contribute to global efforts to abate greenhouse gas emissions.
- ✓ Information and Communications Technology Goal: A modern and affordable information and communications technology that reaches all parts of the country.

The agricultural development blueprint, the National Agricultural Development Plan (2007-2016) has an overall goal to stimulate economic growth in the agriculture sector in all districts through the development of a well-coordinated planning and implementation that are interactive, and effective, involving the full participation of the stakeholders, which promotes food security, income generation and poverty alleviation.

2.1.2 National Agriculture Goals

The PNG E-agriculture strategy adopts or identifies seven goals from available policies, strategies and plans:
- Increase the efficiency and competitiveness of PNG's agriculture industries and government institutions
- Increase agricultural production and productivity by encouraging and supporting innovation and growth
- Generate new opportunities for employment and income for rural communities through high strategic market development both domestically and internationally

- Strengthen agricultural extension by promoting multi-sectoral integration and supporting strategic partnerships
- Enhance national food security, healthy nutrition and vibrant food trade
- Protect, conserve and ensure sustainable use of land and other natural resources
- Improved welfare of rural families and communities who depend wholly or partly on agriculture for their livelihood

2.1.3   Agriculture Priorities

The present Medium Term Development Plan II (2016-2017) envisages a "Pathway to a responsible, sustainable future. A smarter approach to development" with key strategic priorities:

Agriculture and livestock:
- o   Improvement of institutional capacity;
- o   Improvement of access to land;
- o   Development of key supply chains to link producers to markets;
- o   Provision of appropriate extension services;
- o   Development of coping and mitigation strategies for pests and diseases and climate change;
- o   Funding of research and development;
- o   Enforcement of CODEX marketing standards; and
- o   Utilization of Economic Corridors for agricultural development

Forestry and Biodiversity
- o   Banning the export of old growth logging;
- o   Processing of logs and forest products within the country to generate income and employment;
- o   Maintaining areas under forest cover through afforestation/reforestation;
- o   Increasing the income of landowners through carbon trading;
- o   Increasing areas under national parks and protected areas to protect biodiversity; and increasing the number of eco-tourists per annum.

The NADP specified eight priority areas are;
  i.   Agriculture research, extension, information and training;

  The research, extension, information and training sub-components, aim at providing appropriate technology packages, backed up by extension information and human resources capacity building for farmers to effectively participate economically in agriculture activities in their respective communities. Outcomes include; improved technology packages and delivery systems, increased knowledge and skills of farmers and extension agents, and efficient market intelligence networks.

  ii.   Food and horticultural crops development;
  iii.   Tree and industrial crops development;
  iv.   Livestock, apiculture and aquaculture development;
  v.   Spice and minor crops development;
  vi.   Gender, social and HIV/AIDS related issues;
  vii.   Regulatory and technical services; and
  viii.   NADP management and coordination.

The National Information & Communication (ICT) Policy (2008)'s vision is for "bridging the digital divide" through increased access to telecommunication services in rural areas across Papua New Guinea. The policy priorities are in:

Promoting the use of the internet for **Economic Opportunity**:
i. develop the ICT network sufficiently to encompass the maximum number of rural areas that can be reached within realistic economic parameters;
ii. foster the development of appropriate applications that make the rural adoption of ICT relevant and attractive; create a government web site for farming communities which provides
iii. information about farming practices, weather patterns, crop prices and advice about which crops to plant or animals to farm; promote or encourage this web site's adoption by the rural community;
iv. encourage other primary industries to adopt the practice of creating and sharing information through industry specific portals;
v. encourage the use of broadcast infrastructure to enhance the value of primary industry information sharing and extension service creation;
vi. encourage and promote e-commerce to the export business community;
vii. enact e-commerce supportive legislation that allows for electronic signature and electronic agreements; and
viii. adopt a government strategy to express a preference for web based supply and service delivery so as to incubate the nation's ICT sector.
ix. using ICT to effectively disseminate agricultural information on preparedness of climate change-related disasters

Promoting the use of the **internet for Agriculture,** Mining and **Fishing**:
i. establish an e-marketplace enterprise specifically providing opportunities for participants in the Agriculture, Mining and Fishing sectors to participate in the exchange of goods and services via e-commerce.

Promoting the use of the internet for **e-Government**:
i. target people groups, citizens, businesses that will have an immediate use for online services with the creation of the PNG Government Portal;
ii. refine and catalogue all government services so that they can be accessed easily via the PNG Government portal; and
iii. consider a multi-technology approach combining not only the internet but radio and newspaper columns where citizens can learn about e-Government.

The PNG E-agriculture taskforce identified a set of priorities (Table 5):

Table 5: Priority areas for PNG Agriculture identified by the taskforce

	Priority areas for PNG Agriculture Sector
1	Improve the production efficiency through adoption of modern technologies
2	Increase land area under agriculture and rationalize effective use of land for agriculture
3	Implement capacity building programs (including entrepreneurship and informal training) for rural folks for farm and non-farm enterprises, including establishing and/or strengthening of farmer organizations;
4	Organize and implement pilot investment projects to jumpstart and eventually transform the agriculture sector

5	Guidelines to access the Agriculture Development Fund to increase capacity and capability building for rural communities to achieve food security, maintain sustainable production, promote rural livelihood programs, and expand export driven projects
6	Assist the development of a private sector led agriculture diversification plan that are market-led and competitive
7	Adopt and assist local farmers in the use of appropriate technology and implementation of better marketing strategies
8	Establish and/or upgrade regional centres for training and education
9	Ensure good governance in implementing projects and help create a consistent track record to showcase the potential of the agriculture sector to the national and global communities in order to encourage public and private partnerships and direct investments
10	Establish a Community Data Centre to monitor (domestic and international) markets, guide effectively and enhance export and trade competitiveness, and support agri-business and SME's to support rural and community development
11	Establish an Agriculture and Livestock Information Network
12	Position Papua New Guinea as an "agriculture alternative" that offers and delivers food security to foreign interests
13	Review the legislative framework to support and sustain the growth of agriculture and rural development
14	Review and align government policies to promote and support agricultural export-driven growth initiatives from the rural areas
15	Encourage and support initiatives to develop commercial farming and support the growth of next generation of agri-business farmers (youth farmers)
16	Increase funding support to the sector in the areas such as extension management, land mobilization, road and transport, resource centres, ICT infrastructure and connectivity
17	Creation of necessary databases (e.g. soil, weather, pest management, irrigation, demand, seeds, supply, machinery, cold storage, transport, labour, cooperatives, farm produce, trees, import, export data, national identity, policy & regulation) and their integration
18	Development of ICT applications for farmers and livestock herders
19	Capitalize the National Development Bank with the aim to increasing support to the expansion of agri-business by our citizens
20	Rehabilitation of cash crop plantations around the country
21	Rehabilitate and support fresh food storage and distribution infrastructure
22	Support agriculture research and development
23	Restructure agriculture commodity boards
24	Undertake a promotional program to invite foreign investors to invest in the sector, in areas such as rice, corn, wheat production and downstream processing
25	Access to adequate financing (banking, credits, loans, insurance etc.)

26	Enhanced coordination between agriculture sector stakeholders (e.g. farmers, extension workers, farm organizations, trade, cooperatives, DAL organisations, ICCC, Department of Provincial and Local Level Government Agencies, telecom/ICT, banks, insurance, disaster management, lands department)
27	Availability and access to actionable information, data and statistics
28	Information on agriculture best practices, pests and diseases
29	Linking markets, market supply/demand/pricing information and associated trading
30	Access to weather information and improved disaster management for agriculture sector
31	Value addition and processing of agriculture produce to enhance revenue and profitability
32	Transparency and information dissemination relating to customs, biosecurity, taxation norms (domestic and international) etc.,
33	Improve the food safety, traceability and quality
34	Increased resilience of agriculture sector to climate change
35	Increased efficiency of government program delivery and subsidies
36	Availability of reliable and timely agriculture statistics
37	Improve the compliance, monitoring and evaluation framework for the agriculture sector (policies, legislation, regulation etc.)
38	Promote PNG as an organic farming/niche product development location to drive exports
39	Strengthen programs for disaster risk reduction and mitigation targeting agriculture sector stakeholders
40	Enhancing the participation of women (on farm and off farm) in the agriculture sector
41	Support the participation of people with special needs in the agriculture sector

2.2 Agriculture Sector Issues and Challenges

The agriculture sector is impeded with issues and challenges that the identified priorities must meet. Many of these challenges are resented in the different national and sectoral policies, plans and programs which identified by the PNG E-agriculture taskforce.

Table 6: Key agricultural challenges identified by the E-agriculture taskforce

	Major Challenges in PNG Agriculture
1	Strengthen collaboration amongst agriculture and non-agriculture sector actors (e.g., ministries, national & provincial governments, research organizations, commodity boards and private sectors)
2	Improve availability and access to real-time and credible information for policy makers
3	Improve availability and access to and credible information (e.g., policies, legislation and regulations) amongst stakeholders involved in the agriculture value chain
4	Improve the education, literacy and skills of actors involved in agriculture

5	Inadequate funding to the agriculture sector
6	Lack of adequate land tenure and ownership framework
7	Inadequate representation of farmer organisation on commodity boards
8	Lack of data and information to develop business plan (ROI)
9	Improve the legal framework/guidelines for agriculture fund access
10	Strengthening of the capacity of specialists/capacity to collect, maintain, update and process information
11	Long time-frame to create legislative frameworks
12	Lack of timely availability and accuracy in weather forecasting
13	Improve ICT infrastructure and connectivity upgrade
14	Inadequate databases and linkages for agriculture related information management
15	Lack of adoption and enforcement of data standards, sharing and interoperability
16	Inefficient market and market access for agriculture and livestock
17	Low interest amongst youth to pursue agriculture as a career
18	Lack of conducive policies/guidelines & systems for financing and credit facilities for SMEs & producers
19	Lack of affordable risk mitigation products (e.g. insurance)
20	Need to improve the compliance, monitoring of the agriculture sector policies, legislations and regulation
21	Need to improve food quality standards implementation and monitoring
22	Inadequate logistics for agriculture (cold storage, transport, roads, wharfs, electricity etc.)
23	Lack of actionable alerts relating to agriculture (e.g., disaster, pest & diseases, marketing, awareness, health-nutrition)
24	Need to strengthen the pests and disease management program
25	Inadequate customs, taxation information
26	Inadequate biosecurity policy and information systems (ENFORCEMENT?)
27	Inadequate availability and access to domestic and international trade-related information
28	Lack of universal (and affordable) access to Internet
29	Lack of online trading platforms & electronic market linkages
30	Lack of wider dissemination of content related to sustainable and agriculture best practices (e.g., GAP)
31	Lack of framework for organic farming certification
32	Limited access to land for agriculture
33	Project planning and design inhibiting people with special needs participation
34	Need for empowering women and enhance their role in agriculture

35	Lack of information and awareness on value-addition (on-farm and off-farm)
36	Lack of access to irrigation
37	Wildlife crop degradation
38	Need to strengthen agricultural extension services
39	Need for stronger political advocacy for the agriculture sector
40	Public awareness on food safety and health related issues
41	Incentives for actors in the agriculture value chain
42	Social, cultural and religious issues impacting the agricultural workforce
43	Lack of effective communication channels between information providers and intended audience
44	Impact of climate change on agriculture
45	Inadequate availability and access of quality farm inputs (seeds, fertilizers, machinery etc.,)

2.3 Agriculture Sector Opportunities

While the sector is fronted with issues and challenges, there are opportunities which offer innovativeness for growth and development which the country can explore. Some of these opportunities are unique with competitiveness which can transform the PNG agriculture sector if capitalised. Some of the key opportunities as captured by various platforms, such as:

PNG Vision 2050
Opportunities captured in the PNG Vision 2050
   i.   "Food production for the domestic market, high value export crops, developing import-competing industries and plantation forestry while preserving ancient forests. These are also opportunities in downstream agro-industry, small-scale and light manufacturing, tourism and the service industry. "
   ii.   "Artisanal and small-scale economic activities in fishing, mining and village-based forestry are also good prospects. Improving the investment environment and adopting economic corridor planning across the country will greatly promote the non-mineral sector and drive social and economic growth. In this regard, land reform will be critical. Ensuring that there is accompanying good governance and sound public financial management will ensure that there is equitable economic growth and efficient service delivery."

National Agriculture Development Plan 2007-2016
Opportunities identified in the NADP:

Favourable Environment for Agricultural Production - There are huge opportunities for improved agricultural production for food security and economic development in PNG. The agricultural diversity, immense flora and fauna, their renewal capability, much of them are untapped, and rich soil, large unoccupied land area, varied but favourable climatic conditions, human labour – all provide potential for agriculture development.

Idle Land - PNG has huge underutilised land under customary ownership which could be harnessed for agricultural production.

Entrepreneurial Attitude - The majority of rural population (85%) that depends on smallholder production system has high aptitude of entrepreneurship as shown with production expansions in fresh produce and active betel nut trade.

Disease-free Status - Despite the presence Cocoa Pod Borer and Potato Late Blight, PNG is still free from bird flu and foot-and-mouth diseases hence its livestock can be exported, provided they are of good quality.

Organic Production - PNG's crop production is largely organic as producers use rich fertile soils without any fertilizer. With the absence of insecticide sprays, there are no serious problems of pesticide residues.

NARI Strategy and Results Framework 2011-2020

  i. Huge potential to increase both the biological productivity and production capacity of most indigenous and staple crops, fruits and nuts, vegetables and livestock species through simple breeding and biotechnology methods
  ii. Enhancing supply of agricultural commodities to urban and rural markets
  iii. Domestication and commercialisation of indigenous nuts, fruits and other crop (e.g. galip, okari, pau, marita and pitpit) and livestock species and exploring niche markets for such indigenous products
  iv. Exploring value-addition and product diversification of crops and livestock to expand market demand and profitability for many commodities and enterprises
  v. Primary source for expansion of future productive employment for the large number of youths entering the workforce
  vi. Golden opportunity for investment of revenue from the LNG and other resource projects in developing the agriculture sector, in general, and innovative agriculture, in particular

PNG Forest Authority Corporate Plan 2007-2012

Forest Resources and Industry Opportunities
  i. The tropical rainforest of PNG has more than 480 commercial or potentially commercial species
  ii. There are huge investment opportunities for those intending to enter the sector either to develop forest concessions for log exports or process raw materials into finished products such as sawn timber, plywood and veneer
  iii. The PNGFA has identified a number of new natural resource concessions for development with total land areas of 4.86 million hectares. These resources contain some 75.6 million cubic meters of logs. Based on 35 years sustainable cut it is estimated that 2.2 million cubic meters of logs could be harvested annually.
  iv. The PNG Government policy is to add value to the resource before exporting and there are generous incentives to companies who engage in domestic processing of forest products.

DAL Strategic and Corporate Plan 2013-2017

Opportunities captured in the DAL S&CP
  i. Growing demand for agriculture; due to population growth, protein consumption and biofuels
  ii. Growing World Bank commitments to agriculture
  iii. New opportunities for market-driven agriculture economics

iv.   New opportunities for innovative funding arrangements for development of the renewable resources sector in PNG

Similar opportunities in the sub-sectors such coffee and cocoa are captured by responsible authorities. While many are common, some opportunities are commodity specific, ranging from research and technologies to extension, education, financing, collaborations, information and communication, and domestic and global market forces.

3 Status of ICT infrastructure, Services and Adoption

The need and use of ICT in agricultural development have become important over recent years. ICT is having great impact in the way the information and knowledge are processed, managed and shared with intended clients. This demonstrates the transition from traditional publications and face to face interactions to electronic forms such as computer-based databases and email and internet services, supported by innovations in infrastructure and networking, software, mobile technology, and smart devices, thus allowing improved management systems and instant access.

The availability and readily access and use of such ICT infrastructure and services form the core element of the PNG E-agriculture strategy. Availability of the infrastructure, the types of applications and the level of adoption by the users is important. The various ICT elements include

Public ICT networks and devices
- Telecom network reach by coverage and take up (mobile, wireless/broadband and fixed)
- Status of broadband backbone
- Affordability of devices and telecom services
- PCs, laptops, smartphones penetration
- End user terminal device - level of penetration

Private ICT networks and devices
- Deployment of e-Government and ICT networks by DCI/NICTA and agriculture agencies
- Sensing networks for information gathering
- Availability of databases
- Linkage and interoperability of these databases
- Availability of data analytics platforms

ICT applications and services
- ICT applications and services platforms
- E-Government (G2C) services and their adoption
- Mobile banking and e-banking services
- Agriculture information services

Key Statistics
• Population (2010): about 8 - 10 Mil
• Mobile penetration: 40%
• Fixed penetration: 1.2%
• Broadband penetration: around 5 %
• 3 MNOs [GSM, UMTS & LTE]
• 1 Fixed Cable Network operator

Source: NICTA

3.1 Public ICT networks and devices

Ensuring hi-speed broadband networks is the key for successful deployment of e-services and the ICT uptake at large. Recognizing that PNG's terrain is quite mountainous and difficult to navigate and that PNG's mobile industry has grown rapidly over the last decade, mobile devices will continue to be the primary way to connect people especially in remote villages and communities. Mobile devices are also going to be the primary vehicle for government and private interests to connect with civilians on a regular basis as well as during emergencies. With these connections, the government must focus on putting in place mobile/wireless broadband networks apart from optical fiber backbone which is already in place or being worked on through a number of projects.

Infrastructure in this context also includes ensuring sufficient capacity and sustainable data processing centres in the provinces and districts. These centres should serve as an ideal channel for promoting ICTs and for public service.

The government also needs to ensure necessary infrastructure used within the government itself e.g. government intranet, government data centre, and etc.

3.2 High-speed Broadband Backbone Networks

Optical Fiber Networks

A new industry structure has been approved (in 2014) and is being developed which includes the establishment of a new Government company - PNG DataCo Limited. This establishment was part of the PNG Government's plan to restructure the Telecommunication Industry. PNG DataCo is mandated to build, manage and offer wholesale transmission Services on a non-discriminatory basis in the country.
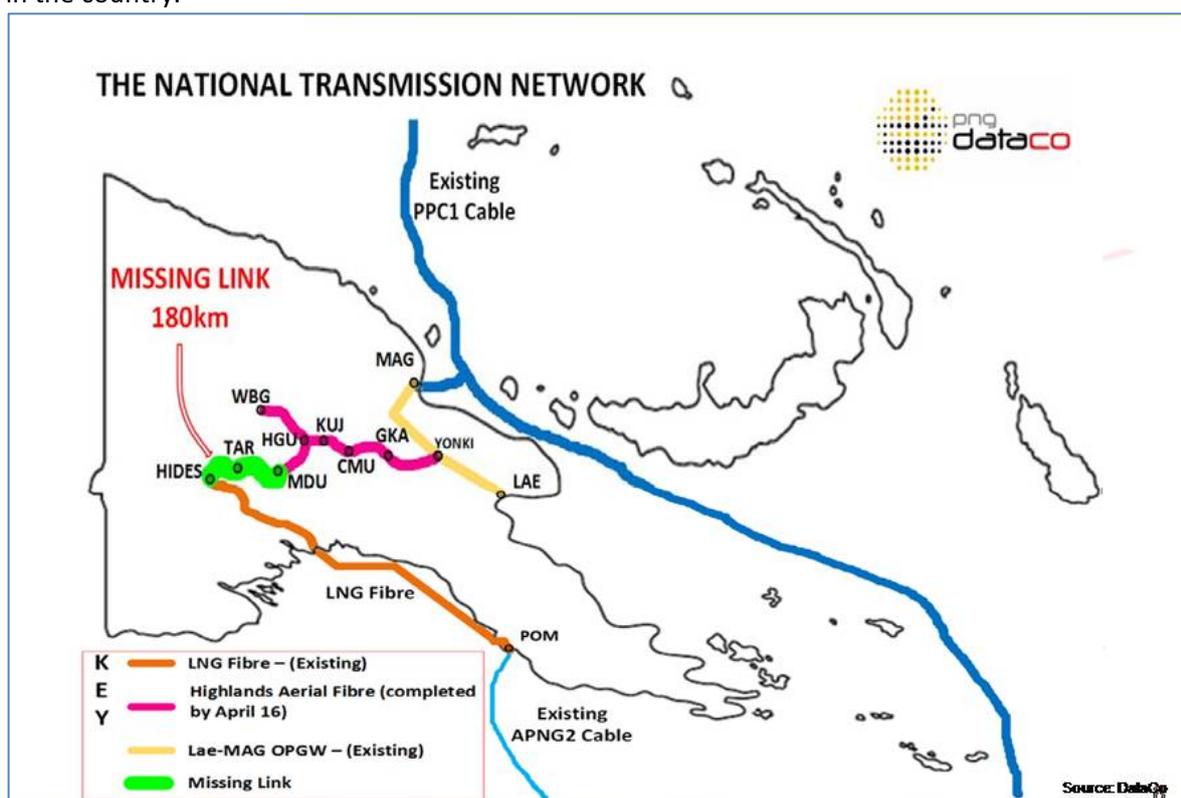
Figure 4: PNG national transmission network (Source: NICTA)

The figure below illustrates the broadband access technologies in PNG, covering fixed lines, wireless and mobile solutions.
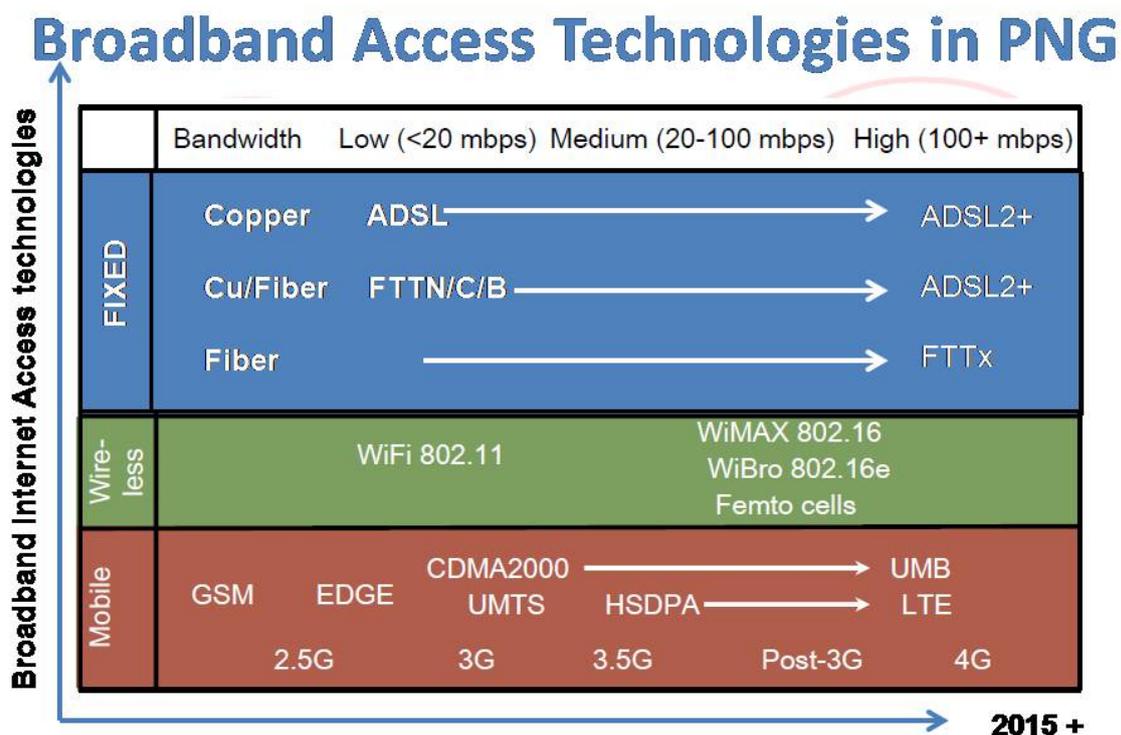
Figure 5: PNG's Broadband access technologies (Source: NICTA)

International Gateways

There are two main ways international traffic is carried to and from PNG and that is via submarine cable and satellite connectivity. However, up until March 2013, it was required by law that all international traffic be carried on the Telikom submarine cables as they had exclusive rights to the international gateway. Telikom carried voice, data and internet traffic and they continue to do so today via the two submarine cables, namely APANG 2 (1.12 Gbps) which connects Port Moresby to Sydney, Australia and PPC-1PIPE (10 Gbps) which connects Madang to Guam. Post 2013 saw the liberalisation of the international gateway market effectively ending Telikom's monopoly and allowing for new international gateway licensees. The number of ICT operators owning and maintaining international gateway of their own has grown from one in Telikom PNG to currently 12 active, as licensed by NICTA. Whilst Telikom offers capacity on its submarine cables on a wholesale basis for those operators seeking international traffic, more recently there are alternative offerings by satellite operators as well. Two major satellite operators having strong presence in the Pacific also offer satellite capacity for international traffic, namely O3b on the back of the Digicel Network and Speedcast, operating as Oceanic Broadband Solutions. They offer modern, narrow to broadband services that are becoming more and more compatible with Telikom submarine cable offerings.

3.3 Last Mile Connectivity

Mobile Communications

PNG's telecommunication is a regulated industry which has gone through several reforms with legislative and institutional developments since 1994. Telikom PNG Limited, a wholly government owned company, had been the exclusive provider of telecommunications infrastructure and services in the country until the entry of mobile communication less than 20 years ago. Mobile communication operator Bemobile entered the market in early 2000 while Digicel (PNG) Ltd began its operations in July 2007. At present Telikom PNG operates both fixed and mobile (Citifone) networks, while specialises in mobile and Digicel runs both mobile and fixed wireless as shown on Table 7.

Table 7: Major telecommunication operators in PNG and their networks

No	Telco	Network
1	Telikom	• FIXED - ADSL, Fiber, WiMAX, Microwave, Satellite • APNG-2, PPC-1 • MOBILE – CDMA +EVDO (3G), UMTS+HDSPA (3G)
2	Bemobile	• MOBILE - GSM EDGE (2.5G) UMTS (3G)
3	Digicel PNG	• FIXED - Satellite, Microwave, WiFi • MOBILE - GSM +EDGE (2.5 G) UMTS+HSDPA (3G) LTE (4G
4	PNG Dataco	• NTN -Fibre

The mobile sector is presently dominated by the private sector - primarily the two major competitors (Bemobile and Digicel). Digicel is the dominant mobile operator having more than 80% of the total number of subscribers in the country. Bemobile subscriber base is growing steadily since embarking on a strategy to partner with the mobile giant Vodafone in 2014. From Table 7, it can be seen that they both now offer mobile broadband services with Digicel offering LTE or 4G like services in the major urban cities like Port Moresby and Lae, and Bemobile in similar locations offering HSDPA or 3G like services. Both have plans to gradually upgrade their networks eventually offering 3G to 4G services in most parts of the country where there is significant demand.

High Speed Last Mile Access

PNG has 2G, 3G and 4G (LTE) networks operational in the country. Mobile Internet (EDGE/GPRS) and mobile broadband (3G/4G) services are the most preferred mode for accessing the Internet in the country. However, close to 50% of the total land area (463 840 km²) still does not have access to mobile technology.
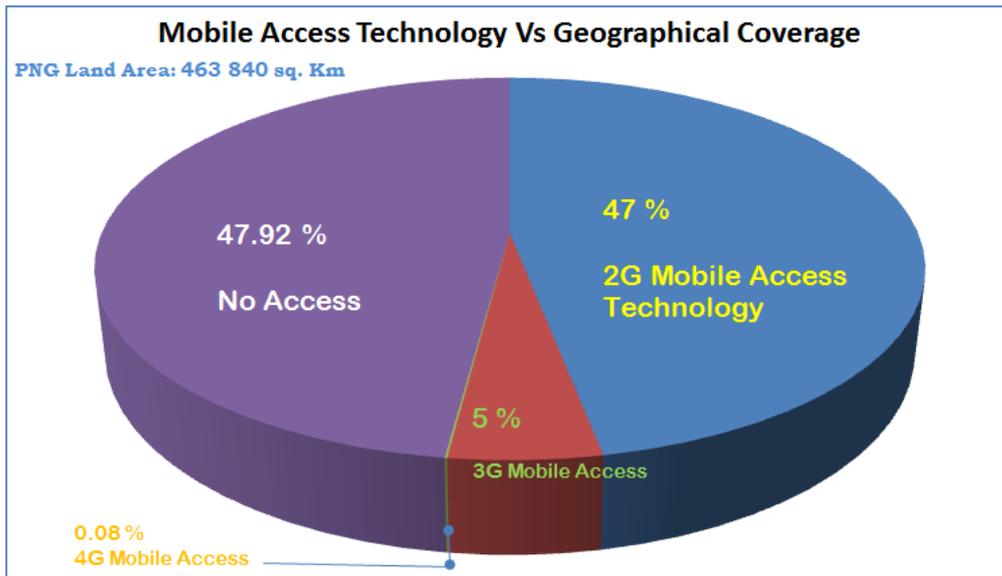
Figure 6: Mobile network access across PNG (Source: NICTA 2016)

2G is the most popular network accessed across the country including rural areas. Over two and a half million people access mobile through 2G.
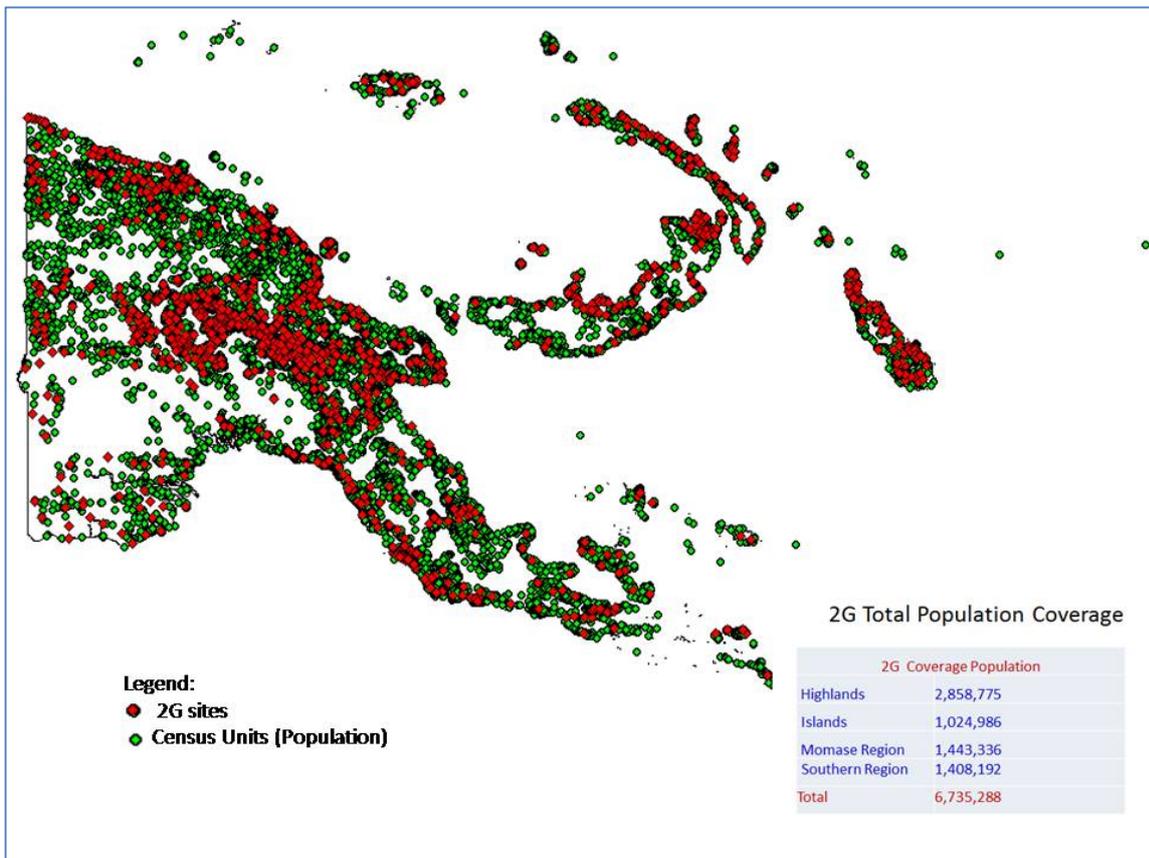
Figure 7: 2G access sites in PNG (NICTA 2016)

3.4 Alignment with e-Government Initiative

The Government of PNG recognizes the crucial role of ICT and how it can transform the public sector. As such it has undertaken an e-Government initiative. Many of the features of the e-Government initiative require alignment with E-agriculture strategy.

Government Intranet and Data Centre

PNG's Intergrated Government Information System (IGIS) has been established to integrate all departments and agencies onto a single platform to build the foundation for eGovernment in PNG. IGIS is the single biggest ICT platform for the PNG public service, managed by the Department of Communication and Information.

E-agriculture stands to define the vision and priorities of IGIS in enabling e-Government in agriculture. This is specifically identified as one of IGIS services – eAgriculture; the others are eHealth, eEducation, eMedicine, eProcurement, etc. Such services will maximise the use of ICT resources through shared ICT infrastructure and services for government agencies, reduce duplication and costs, increase employee engagement and efficiency leading to increased productivity.

e-Government Master Plan

The e-Government Governance Masterplan, endorsed by the cabinet through NEC Decision 124/2006, aims to ensure smooth implementation of eGovernment masterplan. The eGovernance mandates all eGov ICT projects to be reviewed through IGIS to prevent duplication of effort and resources, optimize & share available/existing resources wherever possible, enable system integration & interoperability, thus fostering collaboration across agencies to derive synergy.

Policy and Regulatory Measures

NICTA, since its establishment in 2010, has spearheaded a number of initiatives in view of PNG's development aspirations. Besides a couple of telephony and Internet based projects across the country, NICTA is paying considerable attention to policy and regulatory measures and the following are some of those:
   i. Cybercrime policy and legislation – PNG's Cybercrime Bill passed by Parliament in 2016, to address online criminal activities
   ii. National Broadband Policy – PNG's National Broadband Policy (2013), for high speed access to Internet and other ICT services and access
   iii. Sim Card Registration – working with operators to address abuse of mobile and other ICT services
   iv. Internet Exchange Point Project – for the localisation and protection of data
   v. Universal Access Policy – demonstration projects being considered to connect the unconnected (Rural and Isolated Communities)
   vi. Wholesale regulation – for interconnection and infrastructure sharing
   vii. Reviewing of the NICT Act 2009, in conjunction with the Department of Communication and Information

3.5 Status of E-agriculture Services in PNG

The PNG agriculture sector has undertaken several initiatives in using ICT for knowledge management, data collection, information sharing, and communication. Information requirements for E-agriculture services vary from organisation to organisation depending on the entrusted commodity or mandate and the targeted clients. While agriculture information limited to sectoral agencies, the present e-Gov efforts shall do a favour in creating an environment for greater accessibility.

Based on information needs within sub-sectors, sectoral players have collaborated on ICT solutions and below are some major, existing, E-agriculture services.

1. Melanesian Agriculture Information System (MAIS) - a bibliographic library database with over 40 000 records across the Melanesian countries (http://web.maxus.net.au/sonais/resources.html). It is a partnership involving seven major agricultural organisations which contribute to this resource, targeting researchers, agricultural planners and policy makers, extension, farmers, educationists, students, agricultural traders and private sector players.

2. Mobile market information project
Fresh Produce Development Authority (FPDA) implements a mobile market information project entitled: "Mobile Market Information Service for Fresh Produce Growers in Papua New Guinea". It is about making access market information of selected fresh produce in major centres to producers, vendors and buyers through a simple short message service. FPDA conducted weekly surveys to make available information on price, quality and supply of 12 main fresh produce in eight urban markets.

3. SMS surveillance on animal disease
NAQIA has been utilising the mobile SMS technology to share reports on sick and dead animals around the country. Quarantine officers and other provincially based livestock officers can report to NAQIA on animal disease in real time from anywhere. This mobile phone SMS platform has proved to be an innovative approach to share information and communicate in real time on quarantine matters, particularly animal disease.

4. Web 2.0 and Social Media
Web 2.0 and Social Media have emerged rapidly in Papua New Guinea in the recent past and are widely used across the country by mobile using ages. The relatively rapid emergence of laptops and smartphones have allowed organisations and individuals to store and share information, collaborate and communicate remotely using the different tools in real time.

5. E-tender
The National Fisheries Authority has encouraged e-transactions in some of its major operational activities, particularly in electronic licensing and e-tender.

6. Websites
With the growing use of internet in the country, the development and hosting of organisational websites have picked up significantly with most of the agriculture agencies now having their own dedicated websites. Websites of the main agricultural agencies and key stakeholders are given in Table 3.

7. Geographical Information System
Mapping and Geographical Information Systems (GIS) are part of program activities in many ministries, agricultural research and development organisations, territory institutions and resource developers.

GIS Units provide technical advice, produce maps and manipulate data to meet clientele information needs for research, planning, and development, and management of natural resources.

NARI has in place three GIS databases - to assist planners, researchers and individual farmers.

    i.   Papua New Guinea Resources Information System (PNGRIS)
    ii. Mapping Agricultural Systems of PNG (MASP)
    iii. Farming Systems of PNG (FARMSYST)

C. Developing the E-agriculture vision

Agriculture has been at the centre of PNG Government's development agenda over the years and will be so into the future. With unpredicted and ongoing trade deficits and global increases in the food prices, compounded by currency depreciation and impending challenges in climate change; sustainable food productivity and efficient resource utilisation for food security and improved livelihood will be paramount for the 85% of PNG population that depend on it. Agriculture is a major economic activity, a livelihood and a provider of environmental services, as well being a basis for growth, development and improvement in quality of life for the majority in PNG. It is instrumental in reducing absolute and relative poverty, help creating wealth, and improve overall welfare as emphasized by the PNG Vision 2050 and other high level strategies and plans.

The rapid emergence of ICT in PNG offer huge potential for agricultural revolution in this information age. With the increase in adoption, transformative capability of its applications and multi-sectoral institutional deployment, the PNG ICT landscape provides improved opportunities for leveraging PNG agriculture with a wide array of services. They services are in development, natural resource management, governance, education, banking, insurance, information technology, telecommunications, media, transportation and logistics with categorically important inputs by individuals, public enterprises, the private sector and international development and donor agencies. In this respect, a vision for the sector is eminent which can harness the opportunities across multiple sectors while recognizing the varying expectations and roles of different agriculture stakeholders.

The FAO-ITU framework for development (Figure 8) of vision entails –
- Establishment of E-agriculture steering committee and taskforce
- Understanding the national agriculture goals, priorities and challenges
- Development of an initial vision
- Detailing the E-agriculture outcomes to meet the vision
- Analysing the ICT solutions that can realize the E-agriculture outcomes
- Refining and finalizing the E-agriculture vision and outcomes

Figure 8: PNG E-agriculture vision development, FAO ITU Process

1 E-Agriculture Steering Committee and Taskforce

Our approach towards the development of the E-agriculture strategy has involved an inclusive process in which there were consultations and active participation by key stakeholders both in agriculture, natural resource management as well as the ICT sector. The involvement of the ICT sector players will ensure that ICT access challenges (including their costs and quality) posing hindrances to the adoption of use of these tools, notably in rural areas, are identified and tackled at higher level in a systematic manner. Such strategic alignment will result in better sustainability of solutions, cost-effectiveness and their wider adoption.

A key element of this national approach is to help improve the coordinated planning and funding of development and avoid duplication and the waste of resources as in many cases the different service providers target the same stakeholders. Systematic effort in planning and setting up a national e-agriculture approach allows for a streamlining of government efforts, ensuring the judicious use of scarce resources while providing a clear direction to the private sector, donors and other stakeholders.

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

A steering committee for the PNG e-agriculture is proposed, comprising the DAL executive management and representatives from FAO, DCI, NICTA and others.

An E-agriculture taskforce has been established comprising representatives from DAL, Coffee Industry Corporation, Fresh Produce Development Agency, DCI, NICTA, and the National Disaster Office. This is the taskforce that has developed this strategy document.

The E-agriculture taskforce recommendations can be submitted to the E-agriculture Steering Committee for decisions of strategic nature. The taskforce can form working groups involving other critical stakeholders based on identified priority services. For example, mobile banking services would require involvement of banks, banking regulators, telecom operators and community centres as critical stakeholders while an application for weather forecast would require national weather service as a critical stakeholder.

2 E-agriculture Vision for PNG

The E-agriculture taskforce after a detailed discussion considers a time framework of 5 years to set the context for the E-agriculture vision. This would enable strategic alignment with budget and planning cycles of sectoral agencies within a five-year government cycle (2017-2023). However, individual output level alignment needs to take into account the planning cycles of other stakeholders.

In considering all sectoral guiding principles and strategic plans, including the PNG Vision 2050, and in consultation with key stakeholders, and the leverage potential of ICT, an E-agriculture vision was set up as follows:

> *The Papua New Guinea agricultural sector transformed by innovative information and communication technologies, by 2023*

The vision exemplifies the sustainable growth and equitable societal principles of the country while looks to mainstream ICTs in the development agenda. ICTs have the potential to meet the agricultural development goals of PNG more effectively by

- Making accurate information available in real time or near real time for the agriculture sector leveraging on smart sensing technologies and integration of required databases;
- Effective monitoring of agriculture sector using ICTs;
- Strengthening the tracking and traceability framework nationwide to protect the bio-diversity;
- Bridging the skills and knowledge gap in the agriculture sector using e-learning and networking tools;
- Improving the confidence in use of extension and advisory services through enhanced online knowledge resources,
- Facilitate education and enhance efficiency of women in agriculture sector through ICT interventions;
- Promoting research and innovation through availability of information and enhancing engagement leveraging on modern communication tools;
- Improved linkage between agriculture extensions and researchers and increased responsibility of advice;
- Increasing the efficiency of production and diversity of crops,
- Improving logistics (e.g. storage, transportation, farm inputs),
- Incorporating ICTs in agriculture financing, banking and transactions to create a vibrant commercial market;
- Utilizing ICTs to expand the reach of the PNG's agricultural produce to domestic and international markets;
- Enable new and innovative services and improving efficiency of agriculture services utilizing ICT devices & networks, platforms and connected critical databases for agriculture sector;
- Bridging the information gap and improving the efficiency of risk management tools and procedures using ICTs;
- Introducing new and improving the efficiency of existing risk management services such as micro-insurance, government subsidy, others;
- Increasing the transparency and awareness on policies and regulations
- Proactively coordinating with policy makers and regulators of various sectors to create the appropriate enabling environment;

3 E-agriculture expected outcomes

Effective deployment of ICTs in agriculture by 2023 would make a transformative impact on the sector of PNG. It is expected to deliver the following e-agriculture outcomes through a number of ICT solutions (or e-solutions).

- (**Institutional**): Enhanced communication and coordination between stakeholders, institutions and individuals using information and communication technologies.
- (**Infrastructure**): Interconnected information resources and platforms to support policy decisions, better implementation and innovative services.
- (**Data & Information**): Improved quality and timeliness of data and information availability for better decision making thereby improving livelihoods.
- (**Services**): Improved market access, risk mitigation, disaster management, logistics etc. thereby enhancing income generation and improving profitability.
- (**Processes and Mechanisms**): Increased efficiency, compliance and monitoring using information and communication technologies among various stakeholders.
- (**Capacity, Knowledge and Skills**): New and improved skills acquired by various stakeholders through the use of information and communication technologies.

4 Strategic Recommendations

4.1   Enhance communication and coordination among critical stakeholders to facilitate cross-sector collaboration.

- Creation of an e-agriculture steering committee and task force that would be responsible for updating and implementation of e-agriculture strategy in Papua New Guinea. It will also oversee and facilitate collaboration amongst stakeholder for strategic implementation of e-agriculture in the country.
- The steering committee and taskforce should consist of key sectors, as appropriate. Apart from agriculture, livestock, forestry, fisheries and ICT, it is important to consider engagement of critical stakeholders from sectors such as banking, finance, insurance, disaster management and logistics as deemed appropriate.
- The broader stakeholder consultations (farmers' organizations, cooperatives etc.,) should also be considered for individual solution/service development, pilot-testing and implementation.
- ICTs and its applications should be leveraged to improve the efficiency and effectiveness of communication amongst various e-agriculture stakeholders, domestic and international.

4.2   Strengthen policy, legislative and regulatory frameworks requirements to build sustainable and scalable ICT application.

- Policy, legislative and regulatory frameworks on addressing issues concerning data standards, interoperability, devices, networks, platform, privacy, security and data sharing.
- Universal access to broadband connectivity, access to affordable devices and enhanced digital literacy.

4.3   Identify and develop key databases, their linkage, access and interoperability to enable building of actionable information services

- Key databases related to agriculture should be identified and developed with a framework to share data between different systems and solutions.
- Interoperability frameworks and standards should be enforced in the development of information systems related to agriculture and other related applications.

4.4 Improved market access, risk mitigation, disaster management, logistics etc. thereby enhancing income generation and improving profitability

- Encourage innovation in e-agriculture services through incentives
- In areas of government to consumer interaction, the government should take the lead in establishing e-agriculture services while fostering commercial e-agriculture services.
- Strategic leverage on inter-sectoral initiatives (relevant government's e-initiatives and commercial services) and services to support and enhance e-agriculture solutions/services development and delivery should be encouraged.

4.5 Identify and improve processes and mechanisms using ICT solutions and services to enhance the effectiveness of agricultural stakeholders

- Improve the collection of reliable statistics to support decision making.
- Establish and improve processes concerning data collection, sharing, interpretation, and analytics.
- Foster mechanisms to deliver actionable information to intended stakeholders in a timely manner, based on reliable data.

4.6 Develop capacity at all levels to sustain and benefit from e-agriculture solutions and services

- Improve the capacity of people involved in farming, livestock herding, forestry and other related work to be able to use the e-agriculture services to increase their productivity and profitability.
- Improve the linkage between experts, extensions, academia and end users leveraging on ICTs.
- Incorporate distance education tools to enhance the reach and quality of capacity building.

D. National E-agriculture Action Plan for PNG

1 E-agriculture Action Plan

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

The FAO-ITU framework for development of action plan was adopted. The plan identified thirty-six outputs (E-agriculture solutions) in the context of PNG and detailed nine priority outputs for the first phase.
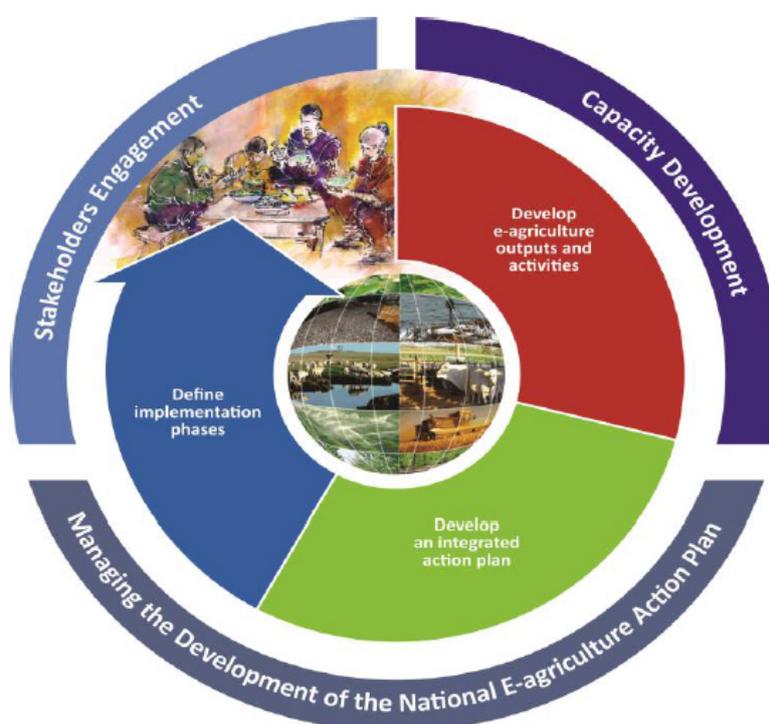
Figure 9: FAO-ITU framework for development of E-agriculture action plan

2 Agriculture Challenges and ICT Solutions

The challenges of the agricultural sector (refer Section 2.2) were discussed by the taskforce and possible solutions (both ICT and Non ICT) were identified. ICT does not have similar impact on all agriculture challenges and to gauge the impact of ICT solution on each challenge a detailed analysis was carried out. The impact of each challenge was identified and the possible e-solution was developed (Table 8).

	AGRICULTURE CHALLENGES	NON ICT SOLUTIONS	ICT SOLUTIONS	ICT SOLUTIONS	ICT SOLUTIONS	ICT SOLUTIONS	ICT SOLUTIONS
1	Strengthen collaboration amongst agriculture and non-agriculture sector actors (eg., ministries, national & provincial governments, research organizations, commodity boards and private sectors)	Policies, Guidelines, Steering Committee to create efficient collaboration	SERVICE: Communication channel (platform) amongst agriculture stakeholders	INFORMATION SYSTEM: Resources on government policies and guidelines	RESEARCH AND CAPACITY DEVELOPMENT: Linking research institutes with industry, extensions, producers and other stakeholders		
2	Improve availability and access to real-time and credible information for policy makers	Guidelines for creation of information and sharing	SERVICE: Communication channel (platform) amongst agriculture stakeholders	INFORMATION SYSTEM: Resources on government policies and guidelines	RESEARCH AND CAPACITY DEVELOPMENT: Capacity development and education using ICT		
3	Improve availability and access to and credible information (eg., policies, legislation and regulations) amongst stakeholders involved in the agriculture value chain	Guidelines for creation of information and sharing	SERVICE: Communication channel (platform) amongst agriculture stakeholders	INFORMATION SYSTEM: Resources on government policies and guidelines	RESEARCH AND CAPACITY DEVELOPMENT: Capacity development and education using ICT		
4	Improve the education, literacy and skills of actors involved in agriculture		INFRASTRUCTURE: Universal mobile broadband connectivity, deployment of low cost mobile phones, tablets	TOOLS: E-learning content creation tools	RESEARCH AND CAPACITY DEVELOPMENT: Capacity development and education using ICT		
5	Inadequate funding to the agriculture sector	Enhance viability of agri-busines	INFORMATION SYSTEM: Enabling environment and agri-business opportunities	SERVICE: Credit rating and loan availability			
6	Lack of adequate land tenure and ownership framework	Create a framework for land tenure, owner framework	INFORMATION SYSTEM: Integrated natural resource management	INFORMATION SYSTEM: Resources on government policies and guidelines			
7	Inadequate representation of farmer organisation on commodity boards	Review legislation	SERVICE: Communication channel (platform) amongst agriculture stakeholders	INFORMATION SYSTEM: Monitoring of groups/cooperatives	SERVICE: Tele-working in the agriculture sector		
8	Lack of data and information to develop business plan (ROI)		INFORMATION SYSTEM: Integrated natural resource management	SERVICE: Communication channel (platform) amongst agriculture stakeholders	SERVICE: E-market place for agriculture	INFORMATION SYSTEM: Enabling environment and agri-business opportunities	DATABASE: Agricultural statistics
9	Improve the legal framework/guidelines for agriculture fund access	Create guidelines	SERVICE: Communication channel (platform) amongst agriculture stakeholders	SERVICE: Setting up/strengthening of IVRS (call-centre)	INFORMATION SYSTEM: Monitoring of compliance to government policies, guidelines		
10	Strengthening of the capacity of specialists/capacity to collect, maintain, update and process information		INFORMATION SYSTEM: Integrated natural resource management	CONTENT/DATA: Credible GAP content aggregation and packaging	RESEARCH AND CAPACITY DEVELOPMENT: Capacity development and education	SERVICE: Agriculture workforce information	CONTENT/DATA: Climate smart technologies and climate resilient crops and

Table 8: Example of linkage between challenges and e-agriculture solution

When reclassified based on solutions, 69 independent ICT solutions were identified and detailed.

Table 9: ICT solutions for the agriculture sector in PNG

TOOLS: E-learning content creation tools
CONTENT/DATA: Credible GAP content aggregation and packaging
CONTENT/DATA: Data auditing and verification
CONTENT/DATA: Nutrition sensitive agriculture content
CONTENT/DATA: Value addition to agriculture produce
CONTENT/DATA: Climate smart technologies and climate resilient crops and breeds
DATABASE: Agricultural statistics
DATABASE: Approved chemicals, fertilizers
DATABASE: Central database of research programme
DATABASE: Farmers, fisher folks, herders and foresters
DATABASE: Fish Information
DATABASE: Fishing vessels
DATABASE: Lesser known species
DATABASE: Livestock
DATABASE: Manufacturers of agricultural machineries
DATABASE: Plant genetic resources
DATABASE: Animal genetic resources
DATABASE: Cold storage facilities
DATABASE: Transport service providers
DATABASE: Biosecurity
DATABASE: Plant protection
DATABASE: Plant production
DATABASE: Seed and planting material
INFORMATION SYSTEM: Data capture and data analysis tool(s)

INFORMATION SYSTEM: Enabling environment and agri-business opportunities
INFORMATION SYSTEM: Farm mechanization information and service
INFORMATION SYSTEM: Fertilizer history by land area
INFORMATION SYSTEM: Integrated natural resource management
INFORMATION SYSTEM: Monitoring of compliance to government policies, guidelines
INFORMATION SYSTEM: Offseason crop production technology package
INFORMATION SYSTEM: Resources on government policies and guidelines
INFORMATION SYSTEM: Agriculture early warning system
INFORMATION SYSTEM: E-agriculture extension monitoring
INFORMATION SYSTEM: Electronic pest and disease surveillance
INFORMATION SYSTEM: Food quality and safety verification and bio-safety monitoring
INFORMATION SYSTEM: Monitoring of groups/cooperatives
INFORMATION SYSTEM: Land and sea transport and traffic maps
INFORMATION SYSTEM: GIS-based wildlife tracking and alert
INFRASTRUCTURE: ICT infrastructure for data collection, storage, analysis and sharing
INFRASTRUCTURE: Interoperable and secure e/m-agriculture applications platform with content
INFRASTRUCTURE: Universal mobile broadband connectivity, deployment of low cost mobile phones, tablets
POLICY: Data collection and methodology standardization
POLICY: ICT policy on data sharing, data classification, data formats, secure e-documents
POLICY: National Emergency Telecommunication Plan
POLICY: Policy guidelines and support to agro insurance providing companies
RESEARCH AND CAPACITY DEVELOPMENT: Capacity development and education using ICT
RESEARCH AND CAPACITY DEVELOPMENT: Linking research institutes with industry, extensions, producers and other stakeholders
SERVICE: E-market place for agriculture
SERVICE: Logistics information linking agriculture service providers and markets
SERVICE: Setting up/strengthening of IVRS (call-centre)
SERVICE: Agriculture workforce information
SERVICE: Certified higher yielding seeds/planting/breeding materials verification and traceability
SERVICE: Compensation information and payout for crop and livestock

SERVICE: Actionable disaster alerts
SERVICE: Agromet data and services
SERVICE: Climate change modelling
SERVICE: Commodity and livestock outlook modelling
SERVICE: Communication channel (platform) amongst agriculture stakeholders
SERVICE: Credit rating and loan availability
SERVICE: E/m certification for GAP certification
SERVICE: E/m certification for organic produce
SERVICE: E-agriculture advisory
SERVICE: Electronic (including mobile) banking and payment
SERVICE: Food traceability
SERVICE: Integrate e-agriculture services with G2C
SERVICE: Remote video based surveillance (eg. for agriculture, wildlife and livestock monitoring)
SERVICE: Smart irrigation tools
SERVICE: Tele-working in the agriculture sector
SERVICE: Tracking and DNA barcoding of prioritized species

Each of these could address one or more challenges and would have an impact on one or more than one e-agriculture outcome.

2.1 E-agriculture Outcomes and Solutions

The e-agriculture solutions were prioritized based on the impact, existence and dependency and the feasibility of their implementation in the required time frame.
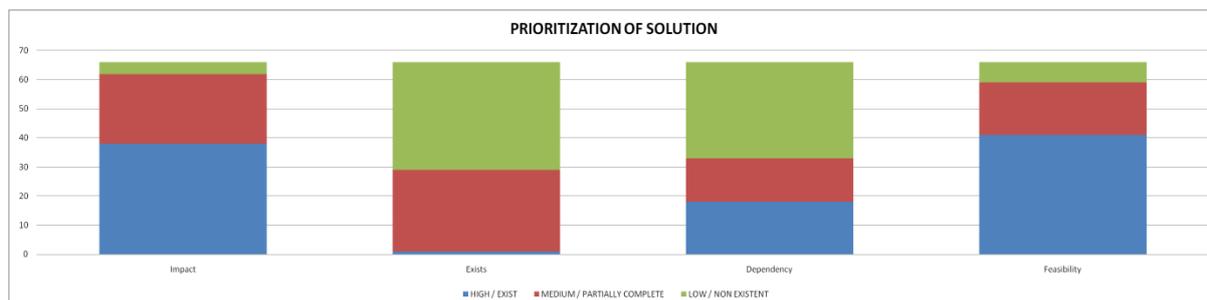
The mapping exercise was carried out to validate whether the solutions addressed all e-agriculture outcomes and were not skewed towards a few of them.

2.2 E-agriculture Action Plan

An e-agriculture action plan was developed for the period 2017-2023 (Table 10). The solutions were prioritized taking into consideration the following factors:

- **Continuing and strengthening the existing E-agriculture services**: Some of the E-agriculture services have already been developed such as plant genetic resource database, electronic pest and disease (livestock) surveillance system;

- **Development of ICT infrastructure:** ICT infrastructure roll out is key to the delivery of E-agriculture services but are governed by other government plans and operators' business considerations. However, providing connectivity to agriculture extensions is of critical nature and is required to be accorded a priority by the Ministry of Agriculture.

- **Development and Interoperability of databases**: Development and alignment of critical databases to e-Government framework and their interoperability with the framework is a time-consuming task. Also, capacity building and preparation is required to convert the existing data to the e-GIF format.

- **Continuing nature of some solutions**: Some of the solutions are of continuing nature e.g. Skill development and awareness, information availability online.

- **Scope of MTDP 3**: The budgetary cycle under the MTDP 3 (2018-2022). It is important that the activities to be undertaken be aligned with the expectations and a scope of the next five-year plan.

- **Approval process**: Development of ICT solutions requires e-Government framework approval. It is important to consider this timeline.

It is also important to note that the action plan has the flexibility to adjust based on changing priorities and development in other sectors.

#	Name of solution	Impact HIGH (H) / MEDIUM (M) / LOW (L)	Exists EXIST (E) / PARTIALLY EXIST (P) / DOES NOT EXIST (N)	Dependency HIGH (H) / MEDIUM (M) / LOW (L)	Feasibility HIGH (H) / MEDIUM (M) / LOW (L)	2017	2018	2019	2020	2021	2022
1	SERVICE: Actionable disaster alerts	H	N	M	H						
2	CONTENT/DATA: Value addition to agriculture produce	M	P	L	H						
3	CONTENT/DATA: Credible GAP content aggregation and packaging	L	P	L	M						
4	SERVICE: E/m certification for GAP certification	M	P	M	M						
5	SERVICE: E/m certification for organic produce										
6	SERVICE: Electronic (including mobile) banking and payment	H	E	L	H	Exists					
7	INFORMATION SYSTEM: Farm mechanization information and service	H	P	L	H						
8	SERVICE: Integrate e-agriculture services with G2C	H	N	H	M						
9	INFORMATION SYSTEM: Monitoring of compliance to government policies, guidelines	H	N	H	H						
10	INFORMATION SYSTEM: Monitoring of groups/cooperatives	M	N	M	M						
11	POLICY: National Emergency Telecommunication Plan	H	N	H	H						
12	POLICY: Policy guidelines and support to agro insurance providing companies	L	N	L	M						
13	RESEARCH AND CAPACITY DEVELOPMENT: Capacity development and education using ICT	H	N	M	H						
14	SERVICE: Credit rating and loan availability	H	N	H	H						
15	RESEARCH AND CAPACITY DEVELOPMENT: Linking research institutes with industry, extensions, producers and other stakeholders	H	P	M	H						
16	SERVICE: Logistics information linking agriculture service providers and markets	H	N	M	H						
17	SERVICE: Tele-working in the agriculture sector	M	N	L	H						
18	SERVICE: E-agriculture advisory	H	P	H	M						
19	INFRASTRUCTURE: ICT infrastructure for data collection, storage, analysis and sharing	H	P	L	H						
20	POLICY: ICT policy on data sharing, data classification, data formats, secure e-documents	H	N	L	H						
21	INFRASTRUCTURE: Interoperable and secure e/m-agriculture applications platform with content	H	P	H	M						
22	SERVICE: Setting up/strengthening of IVRS (call-centre)	M	N	M	L						
23	INFRASTRUCTURE: Universal mobile broadband connectivity, deployment of low cost mobile phones, tablets	H	P	L	M						
24	SERVICE: Communication channel (platform) amongst agriculture stakeholders	H	N	M	H						
25	POLICY: Data collection and methodology standardization	H	P	L	H						
26	INFORMATION SYSTEM: Agriculture early warning system	M	N	H	M						
27	SERVICE: Agromet data and services	M	P	L	H						
28	SERVICE: Climate change modelling	H	P	H	H						
29	SERVICE: Commodity and livestock outlook modelling	M	N	H	M						
30	CONTENT/DATA: Data auditing and verification	H	N	M	H						

Figure 10: PNG E-agriculture action plan [part of]

3 Priority E-agriculture Solutions

Amongst the identified solutions in the action plan, nine new solutions have been accorded high priority and are considered for start of implementation from 2016/2017. These include:

1. Upgradation of the DAL website

2. E-agriculture Extension Advisory and Monitoring System

3. Integrated Natural Resource Management Information System

4. Communication Channel (platform) amongst agriculture stakeholders

5. Creditable GAP content aggregation and packaging

6. Capacity Development and Education using ICT

7. Smart Water Management

8. E-market place for agriculture and information systems

9. Actionable weather information and alert systems

Note: Among these priority solutions, developing and upgrading the Department of Agriculture and Livestock (DAL) website has begun in 2017 with the support of the Food and Agriculture Organization of the United Nations (FAO) and is expected to be completed and launched in 2018.

3.1 E-agriculture Extension Advisory and Monitoring System

Advisory services offered by extension workers, consultants, researchers in country or abroad through electronic media (phone, Internet, email, video chat), face to face meetings or paper reports. Recognizing that the lack of credibility may deter agriculturists to deploy good agriculture practices, credible advisory services with consumer protection can be created. These can be paid or reused and would complement availability of content in open mode. The dissemination can be through computers, telecom, Internet or broadcasting network. Creation of systems to capture data, monitoring and feedback on extension service, service request and linkage with complaint redress system. It will also include monitoring of cooperatives and other groups.

E-agriculture Extension Advisory							
Outputs							
Brief description	Advisory services offered by extension workers, consultants and researchers in country or abroad through electronic media (phone, Internet, email, video chat), face to face meetings or paper reports. Recognizing that the lack of credibility may deter agriculturists to deploy good agriculture practices, credible advisory services with consumer protection can be created. These can be paid or reused and would complement availability of content in open mode. The dissemination can be through computers, telecom, Internet or broadcasting network. Creation of systems to capture data, monitoring and feedback on extension service , service request and linkage with complaint redressal system. It will also include monitoring of cooperatives and other groups.						
FPDA	Market Survey, upload on mobile network every week, quality and pricing						
Coming up	Radios and leafelets,						
	starting Android application development, call centre,						
	agriculture disaster alert						
	Input database (seeds)						
Extension support services	Copra logistics						
	ADB project extension (Smallholder Support Service Contract Facility)						
	Morobe (cocoa), Eastern Highlands (coffee & vegetables)						
	Monitoring of extensions						
	Government monitoring for systems						

Stakeholder engagement	Lead facilitator (s): DAL, All Commodity Boards								
	Critical Stakeholders: Commodity boards, district and provincial governments, NGOs, farmer organizations, cooperatives, church based organizations, agro-based industry, telecom service providers, DCI, NICTA								
Linkage with strategy	Linkage with E-agriculture Goal (s)								
	Strengthen agricultural extension by promoting multi-sectoral integration and supporting strategic partnerships								
	Linkage with Strategic Recommendation (s) / Expected Outcomes								
	Approval in ICT for fishery and agriculture sector as part of broadband policy 2013								
Identifying dependencies	Critical pre-requisite activities (activity number and title)								
	ICT and Agriculture policy level approval								
	Coordination with critical stakeholders								
	Financial resources								
	Requires network connectivity and device to agriculture extension agents and centres								
	Availability of aggregated and packaged GAP and local content								
	Human resources and skill development								
	Requires implementation of agriculture expert desk (for complaint redressal)								

		Strengthen agricultural extension by promoting multi-sectoral integration and supporting str				0			
		Year 0	Year 1	Year 2	Year 3	Year 0	Year 1	Year 2	Year 3
		This can also be done Quarterly or Monthly				This can also be done Quarterly or Monthly			
Approximate budget	Human resources (Salary)								
	Technical resources (Software & Hardware) including technical support								
	Coordination activities (Meetings, Workshops etc.)								
	Agriculture content creation and management								
	Promotion and adoption activities (Awareness, Training etc.)								
	Travel and other related operational costs								
	Recurring operational costs of ICT equipment maintenance (if any)								
	ICT usage costs (Cost of bandwidth, Telecom resources, Licenses etc.)								
	Administration, monitoring and evaluation costs								
	Others								
	Total Budget (By Output)								

Implementation plan		2018 June-Sep	2018 Oct-Dec	2019 Jan-Mar	2019 Apr-Jun	2019 Jul-Sep	2019 Oct-Dec	2020 Jan-Mar	2020 Apr-Jun	2020 Jul-Sep	2020 Oct-Dec
	Start and End of activity	Start		Complete							
	Identify necessary databases, status of availability and owner	▓									
	Finalize data sharing and format guidelines		▓								
	Creation of database schematic and formats		▓	▓							
	Populating of databases with available data		▓	▓	▓						
	Financial resources			▓							
	Network connectivity and device to agriculture extension agents and centres				▓	▓	▓				
	Linking with content and GAP information				▓						
	Human resources and skill development		▓	▓	▓	▓					
	Promotion and adoption activities (Awareness, Training etc.)					▓	▓	▓	▓	▓	▓
	Requires implementation of agriculture expert desk (for complaint redressal)										
			Review								
Key Risks Associated											

Figure 11: PNG Extension Advisory and Monitoring solution activity plan

3.2 Integrated Natural Resource Management Information System

Information system that includes GIS data (incl. high resolution satellite image) and other information on land use / land cover / land degradation, soil map / soil fertility, management history, forest cover / forest resource use, Geo portal and geo morphology, irrigation and water management, bio-diversity, invasive alien species, disaster management, weather forecasting, fire history, forest preservation.

Integrated Natural Resource Management Information System				
	Outputs			
Brief description	Information system that includes GIS data (incl. high resolution satellite image) and other information on land use / land cover / land degradation, soil map / soil ferlity, management history, forest cover / forest resource use, Geo portal and geo morphology, irrigation and water management, bio-diversity, invasive alien species, disaster management, weather forecasting, fire history, forest preservation.			
Stakeholder engagement	Lead facilitator (s): Development by DAL and implementation by all departments and boards			
	Critical Stakeholders: Research organisations, universities, commodity boards, district and provincial governments, NGOs, farmer organizations, cooperatives, church based organizations, agro-based industry, telecom service provides, DCI			
Linkage with strategy	Linkage with E-agriculture Goal (s)			
	Protect, conserve and ensure sustainable use of land and other natural resources			
	Linkage with Strategic Recommendation (s) / Expected Outcomes			
Identifying dependencies	Critical pre-requisite activities (activity number and title)			
	ICT and Agriculture policy approval			
	Coordination with critical stakeholders			
	Financial resources			
	Requires network connectivity and device to agriculture extension agents and centres			
	Availability of local content			
	Human resources and skill development			
	Requires implementation of agriculture expert desk (for complaint redressal)			

Approximate budget		Protect, conserve and ensure sustainable use of land				0					
		Year 0	Year 1	Year 2	Year 3	Year 0	Year 1	Year 2	Year 3		
		This can also be done Quarterly or Monthly				This can also be done Quarterly or Monthly					
	Human resources (Salary)										
	Technical resources (Software & Hardware) including technical support										
	Coordination activities (Meetings, Workshops etc.)										
	Agriculture content creation and management										
	Promotion and adoption activities (Awareness, Training etc.)										
	Travel and other related operational costs										
	Recurring operational costs of ICT equipment maintenance (if any)										
	ICT usage costs (Cost of bandwidth, Telecom resources, Licenses etc.)										
	Administration, monitoring and evaluation costs										
	Others										
	Total Budget (By Output)										

Implementation plan		2018	2018	2018	2019	2019	2019	2019	2020	2020	2020	2020
		Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
	Start and End of activity	Start		Complete								
	ICT and Agriculture policy approval	■										
	Coordination with critical stakeholders		■									
	Financial resources			■								
	Requires network connectivity and device to agriculture extension agents and centres											
	Availability of local content			■				■				■
	Human resources and skill development				■	■	■		■	■	■	■
	Requires implementation of agriculture expert desk (for complaint redressal)					■	■	■	■	■		
	Please prepare detailed implementation plan (if the activity is complex)											
			Review									

Figure 12: PNG INRM solution activity plan

3.3 Communication Channel (platform) amongst agriculture stakeholders

To create a network of agriculture sector stakeholders (producers, marketers, extension workers, policy makers, etc.) to distribute information (informal & formal) and enhance engagement.

Communication Channel (platform) amongst agriculture stakeholders	
Outputs	
Brief description	To create a network of agriculture sector stakeholders (producers, marketers, extension workers, policy makers, etc.) to distribute information (informal & formal) and enhance engagement.
Stakeholder engagement	Lead facilitator (s): Development by DAL and implementation by all departments and boards
	Critical Stakeholders: Commodity boards, district and provincial governments, NGOs, farmer organizations, cooperatives, church based organizations, agro-based industry, telecom service provides, DCI
Linkage with strategy	Linkage with E-agriculture Goal (s)
	Increase the efficiency and competitiveness of PNG's agriculture industries and government institutions.
	Strengthen agricultural extension by promoting multi-sectoral integration and supporting strategic partnerships.
	Linkage with Strategic Recommendation (s) / Expected Outcomes
	Processes and machanisms (outcome): Increased efficiency, compliance and monitoring using information and communication technologies among various stakeholders.
Identifying dependencies	Critical pre-requisite activities (activity number and title)
	ICT and Agriculture policy approval
	Coordination with critical stakeholders
	Financial resources
	Requires network connectivity and device to agriculture extension agents and centres
	Availability of local content
	Human resources and skill development
	Requires implementation of agriculture expert desk (for complaint redressal)

Approximate budget		Increase the efficiency and competitiveness of PNG's agriculture industries and government institutions.								
		Year 0	Year 1	Year 2	Year 3	Year 0	Year 1	Year 2	Year 3	
		This can also be done Quarterly or Monthly				This can also be done Quarterly or Monthly				
	Human resources (Salary)									
	Technical resources (Software & Hardware) including technical support									
	Coordination activities (Meetings, Workshops etc.)									
	Agriculture content creation and management									
	Promotion and adoption activities (Awareness, Training etc.)									
	Travel and other related operational costs									
	Recurring operational costs of ICT equipment maintenance (if any)									
	ICT usage costs (Cost of bandwidth, Telecom resources, Licenses etc.)									
	Administration, monitoring and evaluation costs									
	Others									
	Total Budget (By Output)									

Implementation plan		2018	2018	2018	2019	2019	2019	2019	2020	2020	2020	2020
		Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
	Start and End of activity	Start		Complete								
	ICT and Agriculture policy approval											
	Create a network of agriculture sector stakeholders											
	Identify existing social network tools											
	Identify technology applications											
	Classify communication platforms											
	Best practice communication guidelines											
	Financial resources											
	Human resources and skill development											
	Develop communication management system											
	Facilitate communication among stakeholders											
	Please prepare detailed implementation plan (if the activity is complex)											
			Review									

Figure 13: PNG Stakeholder Communication Channel solution activity plan

3.4 Creditable GAP content aggregation and packaging

Creation of agricultural content, protocol and processes which fit the local context. It is packaged for information (video, audio, website, text) or capacity building.

Creditable GAP content aggregation and packaging						
Outputs						
Brief description	Creation of agricultural content, protocol and processes which fit the local context. GAP codes, standards and regulations for safety and quality, niche market requirements, improving natural resource use, workers health and working conditions. It is packaged for information (video, audio, website, text) or capacity building.					
Stakeholder engagement	Lead facilitator (s): Development by DAL and implementation by all departments and boards					
	Critical Stakeholders: Commodity boards, statutory agencies, district and provincial governments, NGOs, farmer organizations, cooperatives, church based organizations, agro-based industry, telecom service provides, DCI					
Linkage with strategy	Linkage with E-agriculture Goal (s)					
	Increase the efficiency and competitiveness of PNG's agriculture industries and government institutions					
	Strengthen agricultural extension by promoting multi-sectoral integration and supporting strategic partnerships					
	Linkage with Strategic Recommendation (s) / Expected Outcomes					
	Processess and mechanisms (Outcome): Increased efficiency, compliance and monitoring using information and communication technologies among various stakeholders					
Identifying dependencies	Critical pre-requisite activities (activity number and title)					
	ICT and Agriculture policy approval					
	Coordination with critical stakeholders					
	Financial resources					
	Requires network connectivity and device to agriculture extension agents and centres					
	Availability of local content					
	Human resources and skill development					

		Strengthen agricultural extension by promoting multi-sectoral integration and supporting strategic partnerships								
		Year 0	Year 1	Year 2	Year 3		Year 0	Year 1	Year 2	Year 3
		This can also be done Quarterly or Monthly					This can also be done Quarterly or Monthly			
Approximate budget	Human resources (Salary)									
	Technical resources (Software & Hardware) including technical support									
	Coordination activities (Meetings, Workshops etc.)									
	Agriculture content creation and management									
	Promotion and adoption activities (Awareness, Training etc.)									
	Travel and other related operational costs									
	Recurring operational costs of ICT equipment maintenance (if any)									
	ICT usage costs (Cost of bandwidth, Telecom resources, Licenses etc.)									
	Administration, monitoring and evaluation costs									
	Others									
	Total Budget (By Output)									

		2018	2018	2019	2019	2019	2019	2020	2020	2020
		June-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep
Implementation plan	Start and End of activity	Start		Complete						
	Identification of existing content, availability, ownership									
	Finalize GAP principles, data sharing guidelines, tools									
	Creation of GAP content management and communication systems									
	Financial resources									
	Linking GAP aggregated content with other solutions									
	Human resources and skill development									
	Promotion and adoption activities (Awareness, Training etc.)									
	Please prepare detailed implementation plan (if the activity is complex)									
			Review							
Key Risks Associated										

Figure 14: PNG Credible GAP Content solution activity plan

3.5 Capacity Development and Education using ICT

Use of video, audio, text, brochure on good agriculture practices and their dissemination through web based, mobile based, print and broadcasting networks. Using multimedia tools to build skills and offer distance education. It also includes vocational and skill based courses.

	Capacity Development and Education using ICT
	Outputs
Brief description	Use of video, audio, text, brochure on good agriculture practices and their dissemination through web based, mobile based, print and broadcasting networks. Using multimedia tools to build skills and offer distance education. It also includes vocational and skill based courses.
Stakeholder engagement	Lead facilitator (s): Development by NARI and implementation by all departments and boards
	Critical Stakeholders: Commodity boards, NARS, Universities, skill building organisations, district and provincial governments, NGOs, farmer organizations, cooperatives, church based organizations, agro-based industry, telecom service provides, ISPs, DCI
Linkage with strategy	Linkage with E-agriculture Goal (s)
	Increase the efficiency and competitiveness of PNG's agriculture industries and government institutions.
	Increase agricultural production and productivity by encouraging and supporting innovation and growth.
	Strengthen agricultural extension by promoting multi-sectoral integration and supporting strategic partnerships
	Linkage with Strategic Recommendation (s) / Expected Outcomes
	Capacity, knowledge & skills (output): New and improved knowledge and skills acquired through the use of ICTs
Identifying dependencies	Critical pre-requisite activities (activity number and title)
	ICT and Agriculture policy approval
	Coordination with critical stakeholders
	Financial resources
	Requires network connectivity and device to agriculture extension agents and centres
	Availability of local content
	Human resources and skill development
	Requires implementation of agriculture expert desk (for complaint redressal)

Approximate budget		Increase the efficiency and competitiveness of PNG's agriculture industries and government institutions.								
		Year 0	Year 1	Year 2	Year 3		Year 0	Year 1	Year 2	Year 3
		This can also be done Quarterly or Monthly					This can also be done Quarterly or Monthly			
	Human resources (Salary)									
	Technical resources (Software & Hardware) including technical support									
	Coordination activities (Meetings, Workshops etc.)									
	Agriculture content creation and management									
	Promotion and adoption activities (Awareness, Training etc.)									
	Travel and other related operational costs									
	Recurring operational costs of ICT equipment maintenance (if any)									
	ICT usage costs (Cost of bandwidth, Telecom resources, Licenses etc.)									
	Administration, monitoring and evaluation costs									
	Others									
	Total Budget (By Output)									

Implementation plan		2018	2018	2019	2019	2019	2019	2020	2020	2020	2020
		Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
	Start and End of activity	Start		Complete							
	ICT and Agriculture policy approval										
	Identify capacity gap (human and skills)										
	Develop Course outline on capacity gap										
	Identify ICT systems, tools and processes										
	Learning standards and academic protocols										
	Finalize data sharing formats and guidelines										
	Financial resources										
	Human resources and skill development										
	Availability of content										
	Develop course content management and communication systems										
	Requires network connectivity and device to agriculture extension agents and centres										
	Promotion and awareness)										
	Requires implementation of agriculture expert desk (for complaint redressal)										
	Please prepare detailed implementation plan (if the activity is complex)										
			Review								

Figure 15: PNG Capacity Development and Education solution activity plan

3.6 Smart Irrigation Tools

Deployment of sensors, GIS maps to manage information around water and manage their smart utilisation. Knowledge sharing, access to weather data online, Geo-referenced (map) water source identification (ground water, river, etc.), sub-surface moisture sensors.

Smart Irrigation Tools				
	Outputs			
Brief description	Deployment of sensors, GIS maps to manage information around water and manage their smart utilisation. Knowledge sharing, access to weather data online, Geo-referenced (map) water source identification (ground water, river, ect), sub-surface moisture sensors			
Stakeholder engagement	Lead facilitator (s): Development by DAL and implementation by all departments and boards			
	Critical Stakeholders: Commodity boards, district and provincial governments, NGOs, farmer organizations, cooperatives, church based organizations, agro-based industry, telecom service provides, DCI			
Linkage with strategy	Linkage with E-agriculture Goal (s)			
	Strengthen agricultural extension by promoting multi-sectoral integration and supporting strategic partnerships			
	Linkage with Strategic Recommendation (s) / Expected Outcomes			
	Approval in ICT for fishery and agriculture sector as part of broadband policy 2013			
Identifying dependencies	Critical pre-requisite activities (activity number and title)			
	ICT and Agriculture policy approval			
	Coordination with critical stakeholders			
	Financial resources			
	Requires network connectivity and device to agriculture extension agents and centres			
	Availability of local content			
	Human resources and skill development			
	Requires implementation of agriculture expert desk (for complaint redressal)			

Approximate budget		Strengthen agricultural extension by promoting m			0				
		Year 0	Year 1	Year 2	Year 3	Year 0	Year 1	Year 2	Year 3
		This can also be done Quarterly or Monthly				This can also be done Quarterly or Monthly			
	Human resources (Salary)								
	Technical resources (Software & Hardware) including technical support								
	Coordination activities (Meetings, Workshops etc.)								
	Agriculture content creation and management								
	Promotion and adoption activities (Awareness, Training etc.)								
	Travel and other related operational costs								
	Recurring operational costs of ICT equipment maintenance (if any)								
	ICT usage costs (Cost of bandwidth, Telecom resources, Licenses etc.)								
	Administration, monitoring and evaluation costs								
	Others								
	Total Budget (By Output)								

Implementation plan		2018	2018	2018	2019	2019	2019	2019	2020	2020	2020	2020
		Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
	Start and End of activity	Start		Complete								
	ICT and Agriculture policy approval											
	Coordination with critical stakeholders											
	Financial resources											
	Requires network connectivity and device to agriculture extension agents and centres											
	Availability of local content											
	Human resources and skill development											
	Requires implementation of agriculture expert desk (for complaint redressal)											
	Please prepare detailed implementation plan (if the activity is complex)											
			Review									

Figure 16: PNG Smart Irrigation tools solution activity plan

3.7 E-market place for agriculture and information systems

Creation of e/m-market place, market information and scalable payment systems for national and international, promotion and awareness raising on use of e/m-services.

E-market place for agriculture	
Outputs	
Brief description	Creation of e/m-market place, market information and scalable payment systems for national and international e-agriculture services. Promotion and awareness rasing on use of e/m-services. It will inlcude web based and mobile based applications. It would be a modular approach involving market information system, trading facilities and linking with mobile devices
Stakeholder engageme	Lead facilitator (s): Development by DAL and implementation by all departments and boards
	Critical Stakeholders: Central Bank, Banks, Commodity boards, district and provincial governments, NGOs, farmer organizations, cooperatives, church based organizations, agro-based industry, telecom service providers (fixed, mobile, ISPs etc.), Datec, IT system Integrtaers, DCI, NICTA, NSO, IPA, Department of Transport, Manufacturing Council, Chamber of Commerce, Online shopping provider (e.g. fortuner online), Post PNG. Exporters and importers, insurance, Provincial administration
Linkage with strategy	Linkage with E-agriculture Goal (s)
	Strengthen agricultural extension by promoting multi-sectoral integration and supporting strategic partnerships
	Linkage with Strategic Recommendation (s) / Expected Outcomes
	Approval in ICT for fishery and agriculture sector as part of broadband policy 2013

	Critical pre-requisite activities (activity number and title)								
Identifying dependenc	*Policy and regulatory needs*								
	e/m banking platform								

		Strengthen agricultural extension by promoting multi-se			0				
		Year 0	Year 1	Year 2	Year 3	Year 0	Year 1	Year 2	Year 3
		This can also be done Quarterly or Monthly				This can also be done Quarterly or Monthly			
Approximate budget	Human resources (Salary)								
	Technical resources (Software & Hardware) including technical support								
	Coordination activities (Meetings, Workshops etc.)								
	Agriculture content creation and management								
	Promotion and adoption activities (Awareness, Training etc.)								
	Travel and other related operational costs								
	Recurring operational costs of ICT equipment maintenance (if any)								
	ICT usage costs (Cost of bandwidth, Telecom resources, Licenses etc.)								
	Administration, monitoring and evaluation costs								
	Others								
	Total Budget (By Output)								

		2018	2018	2019	2019	2019	2019	2020	2020	2020	2020
		Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
Implementation plan	Start and End of activity	Start		Complete							
	Invitation to form the Working Group	June									
	DAL to form a working group on e-market place for agriculture	▓									
	Develop detailed implementation plan including business requirements and functional requirements	▓									
	Guideline and regulatory requirments		▓	▓							
	Stakeholder role identification	▓									
	Financial Requirements	▓	▓								
	Launch of DAL website	▓									
	Preparation, launch and upgradation of e-agriculture market place		▓	▓	▓	▓	▓	▓	▓	▓	▓
	Please prepare detailed implementation plan (if the activity is complex)										
			Review								
Key Risks Associated											

Figure17: PNG E-market place for agriculture and information solution activity plan

E. Monitoring and Evaluation for E-agriculture services

The E-agriculture monitoring framework includes monitoring of outcomes and outputs.

1 Monitoring of Outcome

The E-agriculture outcomes for the master plan include;

- Enhanced communication and coordination between stakeholders, institutions and individuals using information and communication technologies,
- Interconnected information resources and platforms to support policy decisions, better implementation and innovative services,
- New and improved skills acquired by various stakeholders through the use of information and communication technologies,
- Improved the quality and timeliness of data and information availability for better decision making thereby improving livelihoods,
- Improved market access, risk mitigation, disaster management, logistics etc. thereby enhancing income generation and improving profitability, and
- Increased efficiency, compliance and monitoring using information and communication technologies among various stakeholders.

The suggested KPIs for the outcomes include.

E-agriculture Outcome	KPI
• Enhance communication and coordination between stakeholders, institutions and individuals using information and communication technologies	- Number of Institutions and individuals engaged - Number and type of information and communication technologies used - Number and type of engagement
• Interconnected information resources and platforms to support policy decisions, better implementation and innovative services	- Number and type of Interconnected information resources and platforms - Number of actions and services
• New and improved skills acquired by various stakeholders through the use of information and communication technologies	- Number of people skilled - Type of skills and knowledge acquired
• Improved the quality and timeliness of data and information availability for better decision making thereby improving livelihoods	- Number and type of data and actionable information processed - Number of stakeholders involved/affected
• Improved market access, risk mitigation, disaster management, logistics etc. thereby enhancing income generation and improving profitability	- Number and type of services developed - Number of stakeholders involved
• Increased efficiency, compliance and monitoring using information and communication technologies among various stakeholders	- Number and type of processes and mechanisms improved - Number of technologies adopted - Number of stakeholders involved/benefited

A detailed M&E plan would need to be developed after adoption of the action plan and priority services.

REFERENCES

Bourke et al (2008). *Food and agriculture in Papua New Guinea.* The Australian National University Press. Canberra, Australia.

CCI (2010). *Papua New Guinea Cocoa Coconut Institute Limited Strategic Plan 2010-2020.* PNG CCI. July 2009. Rabaul, Papua New Guinea.

CIC (2008). *Papua New Guinea Coffee Industry Strategic Plan 2008 - 2018.* PNG Coffee Industry Corporation. Goroka, Papua New Guinea.

DAL (2013). *Strategic and Corporate Plan 2013-2017.* Department of Agriculture and Livestock. Port Moresby, Papua New Guinea.

DAL (2011). *Aligning the Agriculture sector to Higher National Development Plans: PNG Vision 2050, PNG Development Strategic Plan 2030, and Medium Term Development Plan 2015.* Department of Agriculture and Livestock. Port Moresby, Papua New Guinea.

DCI (2016). *IGIS*NET – Building the Platform To Deliver E-Government Services.* E-agriculture Taskforce Workshop 25-29 July 2016. PowerPoint presentation.

DCI (2009). *National Information and Communication Technology (ICT) Policy; Phase 2 Reforms* – Final Report. 2009, Port Moresby, Papua New Guinea.

DCI (2008). *National Information & Communications Technology (ICT) Policy.* Final Report. Department of Communication and Information. Port Moresby, April 2008.

FAO et al (2016). *E-agriculture Strategy Guide; Piloted in Asia-Pacific Countries.* Food and Agriculture Organisation of the United Nations and the International Telecommunication Union. Bangkok, Thailand.

Ghodake, R. (2007). *Status and Future of Information Communication Technology and Management in Papua New Guinea.* APAARI-GFAR-FAO RAP-AIT Workshop on ICT/ICM for National Agricultural Research Information Systems in the Asia-Pacific Region, 14-16 September 2010, Asian Institute of Technology, Bangkok, Thailand.

GOPNG (2009). Papua New Guinea Vision 2050. The Independent State of Papua New Guinea. Port Moresby, Papua New Guinea.

GOPNG (2010). *Papua New Guinea Development Strategic Plan 2010-2030. "Our Guide to Success".* March 2010, Department of National Planning and Monitoring. Port Moresby, Papua New Guinea.

GOPNG (2014). *National Strategy for Responsible Sustainable Development For Papua New Guinea. We will be a Smart, Wise, Fair and Happy Society by 2050*. Department of National Planning and Monitoring. 2nd Edition. Port Moresby, Papua New Guinea.

MTDP (2015). *Papua New Guinea Medium Term Development Plan 2 2016-2017: "Pathway to a Reasonable Sustainable Future".* Department of National Planning and Monitoring. Port Moresby, Papua New Guinea.

MTDP (2010). Papua New Guinea Medium Term Development Plan 2011-2015: "Building the foundations for prosperity". Department of National Planning and Monitoring. Port Moresby, Papua New Guinea.

NARI (2011). *Strategy and Results Framework 2011-2020; A Strategic Contribution to Realising PNG Vision 2050.* Corporate Document No 8. National Agricultural Research Institute. Lae, Papua New Guinea.

NADP (2017). *National Agricultural Development Plan 2007-2016.* Implementation Plan, Volume 1. Ministry of Agriculture. Port Moresby, Papua New Guinea.

NFA (1991). *National Forest Policy.* Ministry of Forests. September 1991. Port Moresby, Papua New Guinea.

NICTA (2013). *National Broadband Policy,* National Information and Communication Technology Authority. Port Moresby, Papua New Guinea.

NICTA (2016). *Development of PNG's E-Agriculture Strategy: "ICT Development Status".* E-agriculture Taskforce Workshop 25-29 July 2016. PowerPoint presentation. Port Moresby, Papua New Guinea.

NFA (2007). Corporate Plan 2007-2012. Papua New Guinea Forest Authority. Port Moresby, Papua New Guinea.

Powaseu, I. (2004). Agricultural Information Systems supporting Research and Development in PNG. Paper prepared at the APAARI Training Workshop on Integrating National Agricultural Information Systems (NAIS), 1-5 November 2004, Bangkok, Thailand.