USAID/GHANA SUSTAINABLE FISHERIES MANAGEMENT PROJECT (SFMP)

Information and Communications Technology (ICT) Strategy Paper

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ACRONYMS

B2C	Business to Consumer
BIT	Business Intelligence Tools
BOT	Build Operate Transfer
C2B	Consumer to Business
CAPI	Computer Assisted Personal Interviewing
CUG	Closed User Group
CoP	Chief of Party
CRC	Coastal Resources Center at the Graduate School of Oceanography, University of Rhode Island
DCA	Development Credit Authority
ECOFISH	USAID/Philippines Ecosystems Improved for Sustainable Fisheries project
FC	Fisheries Commission
FEU	Fisheries Enforcement Unit
FIP	Fisheries Information Portal
FMIS	Fisheries Management Information System
FSSD	Fisheries Scientific Survey Division
GPS	Global Positioning System
ICT	Information and Communications Technology
IUU	Illegal Unreported Unregulated
MCSU	Monitoring, Control and Surveillance Unit
MFRD	Marine Fisheries Research Division
MO	Mobile Operator
MOFAD	Ministry of Fisheries and Aquaculture Development
MOU	Memorandum of Understanding
MP	Marine Police
NAFPTA	National Fish Processors and Traders Association
NCA	National Communications Authority
NGOs	Non-Governmental Organizations
NITA	National Information Technology Agency
P2P	Peer to Peer
PPP	Public Private Partnerships
SFMP	Sustainable Fisheries Management Project
SPOC	Single Point of Contact
SSG	SSG Advisors
ToR	Terms of Reference
UAT	User Acceptance Testing
UCC	University of Cape Coast
URI	University of Rhode Island
USAID	United States Agency for International Development
VMS	Vessel Monitoring System
WARFP	West Africa Regional Fisheries Program

INTRODUCTION

The Sustainable Fisheries Management Project (SFMP) is a five-year effort to rebuild Ghana's small pelagic fisheries through the promotion of responsible fishing practices.

SFMP is working, together with the Government of Ghana, to: (1) Improve legal enabling conditions for co-management, use rights and effort-reduction strategies; (2) Strengthen information systems and science-informed decision-making for sustainable fisheries management; (3) Increase political and public support for rebuilding fish stocks; and (4) Implement applied management initiatives for several targeted fisheries ecosystems. As an implementing partner on SFMP, SSG Advisors is leading public-private partnership development, to support each of these four components. SSG also brings considerable experience developing public-private partnerships to advance information and communications technology (ICT) solutions to conservation and sustainable fishing challenges.

Ghana SFMP recognizes that ICT will be a valuable tool to support sustainable management in Ghana's fisheries sector. Smart applications of ICT can connect diverse stakeholders, improve the efficiency of critical data collection and analysis, and improve the flow of vital information to support marine enforcement and coastal livelihoods. To maximize the potential benefits of ICT for sustainable fishing – and to ensure coordinated and strategic deployment of ICT solutions – Ghana SFMP created an ICT working group, composed of representatives of the SFMP, the Fisheries Commission and the Ministry of Fisheries and Aquaculture Development (MOFAD), the Marine Police, the National Communications Authority (NCA), the National Information Technology Agency (NITA), the World Bank-funded West Africa Regional Fisheries Program (WARFP), and the University of Cape Coast (UCC). On November 12, 2015, the Ghana SFMP ICT working group met in Accra, Ghana, to co-design a comprehensive ICT strategy for fisheries management in Ghana. The workshop was led and facilitated by SSG.

At the workshop, participants took stock of current uses of ICT for fisheries management in Ghana, outlined key ICT needs and possible applications, and started to build a plan of action for implementing ICT solutions for sustainable management.

This **ICT Strategy** is the primary output of this ICT working group workshop. In what follows, we build on workshop discussions to explore how SFMP and the Government of Ghana could deploy ICT to advance critical project objectives and support Government of Ghana goals.

BACKGROUND

The Internet and the mobile phone have opened up new models for unlocking access to knowledge, services and information to drive local solutions to pressing development challenges.

In emerging markets in Africa and elsewhere, this revolution has been especially critical in the health (m-health), finance (mobile money), and agricultural sectors. In health, ICT has improved the accessibility and quality of training for front-line community health workers, as well as patient tracking, record keeping, and diagnosis, with new e-portals for patient records, mobile patient alerts, and innovative telemedicine solutions that connect rural health workers to specialists in urban centers.

In finance, populations who previously had no or little access to modern financial services such as savings, money transfer, cashless transactions, and other benefits such as access to loans and credit, are now able to benefit from modern financial services via their mobile phones, using mobile money services such as M-PESA in Kenya, MTN money, Airtel money, Vodafone Cash and others.

In the agriculture and fisheries sectors, successful examples of ICT deployment include the following:

- **Vodafone Connected Farmer Alliance**: The Connected Farmer Alliance uses mobile applications and mobile money to link farmers, agribusinesses, agro-dealers and content providers for more transparent and efficient agricultural value chains in Kenya, Tanzania, and Mozambique.
- **Vodafone Farmers' Club**: The Vodafone Farmers' Club provides farmers via their mobile phones with weather info and farming best practices; a mobile marketplace (linking seller offers with buyer bids); digital extension services through SMS; and access to a live call center. The Club is operational in five countries, and launched in Ghana in June 2015.
- **The mFish Project**: Implemented in partnership between Tone and the US Department of State, the mFish platform gives small-scale fishers in Indonesia access to real-time data, such as pricing and market information, and allows them to record, report, and share data about their catch. The project was implemented on the Tone platform and ran a successful pilot on 15 types of handsets between February and June 2015. Based on the pilot learnings, the project is being scaled up as a viable model for using ICT and connectivity to support sustainable fisheries.
- **The ECOFISH Project**: The ECOFISH project is a USAID-funded project seeking to improve the lives of fisherfolk and the management of coastal fisheries in the Philippines. In a partnership brokered by SSG between the ECOFISH project, the Philippine government and Microsoft, hundreds of rural fisherfolk communities were connected to the Internet using Microsoft's innovative TV White Space (TVWS) technology. Improved connectivity is supporting FishR, a Filipino government effort to implement mobile registration of fisherfolk across the Philippines.

PRIORITY ICT INTERVENTION AREAS FOR SUSTAINABLE FISHING IN GHANA

A number of complex challenges face the fisheries sector and sustainable fisheries management in Ghana:

- **Fisheries Research and Catch Data Collection and Analysis**: Sustainable fisheries management requires good data to track the health of key fish stocks and to understand the impact of new interventions. However, in Ghana, the Government's capacity for regular and comprehensive data collection is limited. Furthermore, catch data is currently recorded on pen and paper by enumerators at fish landing sites. This data then needs to be transmitted to central government offices for analysis. This process can result in significant delays, and data is often lost or misrecorded in the process. ICT could allow the Government of Ghana to improve the accuracy and efficiency of its data collection process, or to engage fisherfolk in data collection efforts to increase scale and coverage.
- **Lack of Access to Financial Services:** In Ghana, fishermen and fish processors often lack access to formal financial services (such as savings, credit, and loans) and rely on cash transactions, which can be costly in terms of time, effort and risk. Mobile money has great potential to help fishers access key financial services via their mobile phones.
- **Communication Between Stakeholders and Limited Access to Information for Fishers**: Effective fisheries management requires clear communication and coordination across stakeholders. Currently, the Government of Ghana is limited in its

means to communicate with fishers about fishing best practices, regulations and fisheries management interventions. Furthermore, fishers have limited access to key information – such as market prices and real-time weather data – that could help them improve their livelihoods.

- **IUU Fishing, Surveillance, and Enforcement**: Illegal, Unreported, and Unregulated (IUU) fishing is a major challenge for sustainable fisheries management. ICT has the potential to support increased detection and reporting of illegal fishing, improved communication between communities and enforcement agencies about fisheries laws and IUU reporting, and better coordination and management of IUU fishing enforcement efforts in Ghana.

In light of these challenges, participants at the first SFMP ICT working group workshop in November 2015 identified the following five pillars as priority intervention areas for ICT partnerships (Table 1)

Each priority intervention area has its own unique considerations and characteristics. In the sections that follow, we will explore each area in more detail.

Importantly, this ICT strategy is not confined by the timeline or scope of the USAID SFMP project. This strategy was designed to cover interventions that could be led by the Government of Ghana – either with or without the support of SFMP.

Research with Stakeholders (Collaboration Portal)

Greater collaboration across stakeholder groups – fisherfolk, universities, NGOs, and the Government of Ghana – could enhance the creativity, scale, and effectiveness of fisheries research efforts, in support of sustainable fisheries management. ICT could support this more collaborative approach. To facilitate collaboration and sharing of information between researchers, various agencies and key stakeholders involved in fisheries management, this strategy proposes the development of a Collaboration Portal that will be linked to a shared database and analytics tools (see Data and Information Systems section below).

The portal would include a public area based on the Open Data concept that is freely open to the public; and a private area where staff and authorized users from stakeholder organizations such as NGOs and universities would be able to login. Access to the portal and access rights would be based on organization, role, clearance level and other criteria that may be defined by the Fisheries Commission and other stakeholders.

The Fisheries Commission would need to work with key stakeholders and the portal's designers to decide what types of data and information will be shared through the portal. Champions would then need to be identified at key institutions and stakeholder groups to ensure that information and recent data are regularly shared via the portal.

User organizations would likely include:

- Fisheries Commission staff
- Ministry of Fisheries and Aquaculture Development (MOFAD) staff
- Enforcement agencies such as the Marine Police
- Accredited universities and research organizations
- Accredited NGOs working to support sustainable fisheries programs
- Any other approved bodies

Many options for collaboration software and platforms already exist and can be easily customized and configured for the Fisheries Commission. We describe one sample software below (see section on Liferay).

1	2	3	4	5
Research with Stakeholders	**Financial Services and Benefits**	**Data and Information Systems**	**Communication between Stakeholders**	**Surveillance and Enforcement**
• Collaborative research with stakeholders • Integration of universities and NGOs using ICT tools for collaborative research and stakeholder education • Strengthen the capacity of stakeholders and the Fisheries Commission (FC) to use and contribute to ICT apps	• Mobile money platform to receive payments and pay for services (insurance and goods) • Mobile money platform for fish processors • Fisherfolk accessing Fisheries Commission-sponsored benefits and services via SMS	• Fisheries data collection, storage, analysis and access automated, digitized and optimized • Robust database for infraction trend analysis • Centralized repository of fisheries data with advanced repository analytics capability • Robust fisheries management information system • Real time reporting of fish catch data	• Innovative communication system and feedback mechanism • Robust interagency communication connectivity • Network connectivity at all stakeholder sites	• Call center for fisheries infractions. • Fisheries Commission response performance reporting via SMS platform • Apps to monitor Ghanaian vessels and access data/ repository for Fisheries Commission staff • Monitoring system to track foreign vessels entering Ghana Exclusive Economic Zones (EEZ) • Fisheries Commission staff able to access Vessel Monitoring System (VMS) data via mobile phones • Stakeholder Illegal, Unregulated, Unreported (IUU) reporting increasing

Table 1: SFMP ICT Working Group Workshop Priority Pillars

Solution Features:

- A public portal designed to (1) share approved data and information with the public, and (2) allow the public to register and submit feedback to the Fisheries Commission. This could optionally be linked back to social media and other mobile tools as part of the overall PR and communication strategy for the Fisheries Commission.
- A private portal with carefully segregated and controlled rights. This will require login by staff and approved users, and will allow them to access data and analytic tools relevant to their functions.
- Integration of existing and new data sources and repositories including existing fisheries databases, new mobile databases, third-party sources such as satellite weather data, and data from local and international partners such as Interpol or the UN.
- Analytic tools to allow manipulation, data mining and processing of data (both real-time and historical) stored in the shared databases.
- Users will be able to initiate discussions and forums on any topic of interest, share research findings and learnings, and do online consultations and brainstorming on any area of interest.

Solution Considerations:

- Ability to segregate between public (open data) and secured data where rights for access are well defined and enforced.
- Classification of data into security sensitive, internal, and public.
- Ownership of data and protocols for access.
- Integration of existing and new data repositories.
- Integration of mobile apps and web access.

Financial Services and Benefits (Mobile Money)

Fishers engage in a critical economic sector, but many have no or limited access to basic financial services such as savings, secure payments and receipts – both for deliveries and for purchases – convenient access to their money, and financial records to qualify them for credit and loans.

Mobile money services could potentially expand access to critical financial services for fishers. This area is diverse and will require specialized partnerships.

Possible Partnership Features:

- Partnership with a mobile operator to extend mobile money services to all members of the proposed Fishers' Network (or Fishers' Club). (The Fishers' Network is a proposed public-private partnership under SFMP to design a suite of mobile applications for fishers – to extend access to real-time weather and fish price information, improve communications between sectors, and help fishers access information about fishing best practices and fisheries regulations.) This would grant all Fishers' Network members money transfer, deposits, and the ability to pay for goods and services – and get paid directly – on their phones (peer to peer [P2P], consumer to business [C2B], business to consumer [B2C] services).
- Partnerships with primary inputs dealers (e.g., canoe makers, net sellers, and other fishing related services) as well as social service providers (e.g., health facilities) to encourage them to accept mobile money as a form of payment. Further negotiate with them to develop a voucher-based credit scheme where fishers can access goods and services on credit in exchange for vouchers via their mobile money service.
- Partnerships with financial and microfinance service providers to develop financial products targeting fishers such as:

- ***Micro-health insurance*** recognized in main health facilities in fishing areas. Features could include:
    - Low, flexible premium payments that could be paid in small installments daily, weekly, or at any time when the fisher has money – in recognition of the fact that fishers' incomes may not be consistent
    - Premium payments via mobile money
    - Coverage for in-patient care with a cash compensation if admitted for more than three days. This would protect fishers and their families from financial hardship from lost income due to hospitalization.
- ***Inputs financing***: partnerships with fishing inputs and equipment distributors to allow fishers to take out loans for the purchase of inputs and equipment. The loans once approved would be converted to mobile money vouchers that could be redeemed at any affiliated store in landing areas and fishing villages/towns.
- ***Development loans*** for fishers to build their own homes or establish alternative businesses to improve and diversify their livelihoods and reduce dependency on fishing.

- Partnership with a mobile operator, input suppliers, fish processors and traders to develop a Business to Consumer (B2C) and Business to Business (B2B) service targeting processors that allows them to pay using mobile money for deliveries, field staff salaries, and inputs. The solution should also include electronic (SMS) receipts and integrate with partner internal accounting and financial systems.

Data and Information Systems (Shared Online Database and Information Systems Integration)

Robust fisheries data collection and analysis are critical to effective fisheries management. ICT can improve the efficiency and scope of data collection efforts, as well as the ease and effectiveness of data sharing, storage and analysis.

Solution Features:

An ICT solution for data collection, sharing/storage, and analysis would involve multiple components:

Mobile apps for field operations and support staff: These would include android/windows/iOS mobile applications accessible via mobile phones and tablets. The functionality here would depend on the specific functions of the staff member, but would likely include the ability to:

- Record and register fishers and canoes.
- Collect and submit data in real-time such as catch landings, incident reports, arrests, and complaints.
- Receive alerts and notifications on incidents, complaints, sightings and other issues that may require immediate follow-up.
- Access reports and other data from the shared database, such as registration and ownership details for canoes.
- Access training content and information from the knowledge database and online training programs targeted for field staff.

This system may also be complemented by direct reporting of catch or illegal fishing by fishers, through mobile applications or vessel-based monitoring systems (see Communications Between Stakeholders and Surveillance and Enforcement sections below).

Shared cloud database where all data collected using the mobile platform applications and reports from the public will be uploaded in real-time. This data will be hosted at either the National Information and Technology Agency (NITA), the Fisheries Commission or an ICT partner's cloud. To allow real-time access, availability and optimum performance, it is proposed that several versions of the database be held in the cloud (for real-time high speed availability for mobile device uploads and queries), with a primary copy to be held at the Fisheries Commission or NITA data centers with scheduled and constant synchronization between the two.

Integration with existing information systems and databases: Many of the organizations and agencies involved in fisheries management in Ghana, such as the Fisheries Scientific Survey Division (FSSD), the Monitoring, Control and Surveillance Unit (MCSU), the Marine Fisheries Research Division (MFRD), the Fisheries Enforcement Unit (FEU), and the Marine Police (MP) already have existing information management systems. These systems hold both current and historical data. The analytical and statistical value of this existing data will be enhanced when processed and analyzed with the new real-time data coming from the mobile applications. This proposed ICT strategy hence recommends the creation of an integration layer that allows exchange and consolidation of data from all relevant sources. Data and reports can then be accessed and further analyzed by authorized stakeholders and users for purposes of research, proactive interventions, planning and policy.

Communication Between Stakeholders (Fisheries Management Portal)

To make it easier for fishers to access important and up to date information and to facilitate direct, two-way communication between fishers and the Government of Ghana to support fisheries management, we recommend expanding the mobile services and tools available to fishers.

Solution Features:

Mobile apps for fishers: These will comprise simple short codes that support basic handset technology such as Voice (IVR), SMS, and Unstructured Supplementary Service Data (USSD), with an additional android app version that supports Internet access. All applications should be designed for use by semi-literate users, with content in local languages. On the user's side, the functionality will include the ability to receive SMS and Voice messages with content such as:

- Weather alerts
- Market prices
- Information on fish stock sightings
- Training and information on best fishing practices, laws and regulations on fishing and other trainings organized by stakeholders
- Marketing information for relevant services such as insurance and mobile money from partners and stakeholders
- Survey questions

Users will also be able to submit requests and information such as:

- Reports of fish sightings
- Reports of daily catch type and quantity
- Reports of sightings of illegal activities
- Questions about services, prices, laws, etc.
- Responses to survey questions
- Registration for various services such as health insurance, fisher associations, etc.

The Fisheries Commission will need to decide whether to limit access to these short-codes and services to registered fishers, to make them open to the public, or to define services available to the general public (e.g., reporting illegal activities and sightings) and those only available to registered fishers.

In line with current discussions, these applications can be developed in partnership with a mobile operator, such as Vodafone or Tigo, or with a technology company such as Tone.

Enhanced technology access for communications: The collaboration portal described above (in the Research with Stakeholders section) will help unlock and ease collaboration between the various agencies and stakeholders involved in fisheries management in Ghana. However, to help users and agencies effectively participate in the portal, the following tools and technologies may be needed:

- Mobile telecommunications tools and services such as mobile phones and tablets, mobile data, and closed user group (CUG) subscriptions for key teams and staff. The same tools are required to access the fisheries platforms described in the Data and Information Systems section.
- Training and policy framework for leveraging social media and communications products such as WhatsApp for sharing experiences and knowledge.
- Equipping all regional and site offices with networked computer systems. This should build on the current networking of coastal landing sites with the head offices and cover all areas and inland sites.
- Email services for all critical fisheries staff to allow sharing of data, documents and information. This will also be necessary to facilitate their participation in the collaboration portal and groups.

Surveillance and Enforcement (Artisanal Fleet Monitoring and Tracking System)

Smart applications of ICT could help law enforcement agencies in Ghana to (1) educate communities about fisheries laws; (2) engage citizens in detecting and reporting illegal fishing; and (3) coordinate an effective law enforcement response to incidents of fishing violations.

Solution Features:

Critical features and considerations for this ICT strategy pillar include:

- Real-time sharing of information between fishing communities and law enforcement agencies (e.g., an anonymous SMS or voice hotline that allows for **two-way** communication between law enforcement and informants).
- Ability for law enforcement to task, track and monitor response across the diverse agencies and individuals involved in surveillance and enforcement.
- Integration of key surveillance systems and agencies – both local and international.
- Integration of mobile-based and vessel-based applications for reporting, surveillance and response.
- Integration with internal reporting systems for M&E and improvement interventions.

This may be achieved by:

- Implementation of an artisanal fleet monitoring and tracking solution.
- Inclusion of real-time data collected via the mobile platform (see Communication Between Stakeholders section above) and the artisanal fleet monitoring system.
- Development of a separate hotline and reporting management system (see example below).

- Equipping enforcement agency officers with mobile phones and apps that allow them to receive real-time alerts, record and report incidents, and receive and/or share intelligence with other stakeholders.

Example: For the ECOFISH project in the Philippines, SSG facilitated a partnership between the Philippine Marine Police and Smart Communications, a local mobile operator, to use Smart's Infoboard technology – a web-based SMS-broadcast service – to create an SMS hotline that lets citizens anonymously report illegal fishing and wildlife poaching via their mobile phones.

The 700DALOY hotline transmits SMS tips directly to a center operated by the Philippine Marine Police. Marine police staff members acknowledge each report and communicate directly with informants over SMS messages sent via Infoboard. 700DALOY also coordinates the law enforcement response: For credible reports, Marine Police use Infoboard to transmit the report to the appropriate local or regional law enforcement office for a more strategic and efficient response.

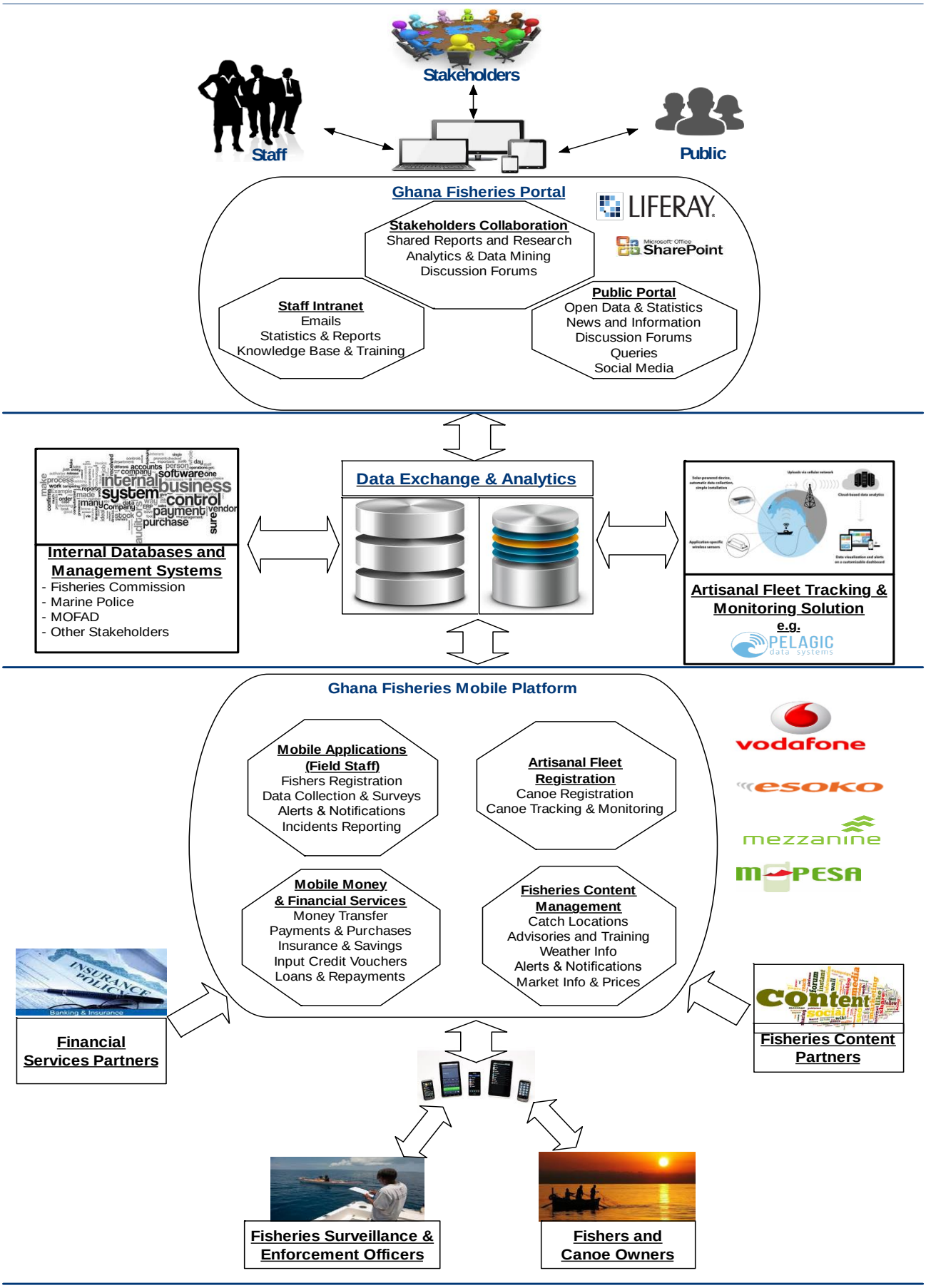


Figure 1: Conceptual diagram of the proposed ICT Strategy Framework for sustainable fisheries in Ghana

LANDSCAPE OF POSSIBLE ICT SOLUTIONS

A number of solutions already exist that could be adapted, combined and modified to address the ICT needs and pillars within the framework described above. Some provide stand-alone functionality with the ability to integrate into other components, while others are platforms that combine a whole range of end-to-end functionality covering multi-channel access, content management, communications services, reporting, user management and 3rd-party platform integration.

This section will describe a number of existing ICT solutions that could potentially be adapted or serve as models for the fisheries sector in Ghana.

The Vodafone Connected Farmer Alliance

The Vodafone Connected Farmer platform was developed as a jointly-funded initiative between USAID and Vodafone. The applications were developed by a Vodafone SA subsidiary, Mezzanine PLC, on their Helium platform.

Initially targeting implementation in three countries (Kenya, Tanzania and Mozambique), the Connected Farmer solution deploys a managed service model that allows a telecommunication operator to provide a set of linked solutions to agribusinesses and other players involved in typical agricultural value chains.

The solution targets government agencies that provide services such as extension services, training, and subsidies to farmers; agribusinesses that work with farmers as part of their supply chains (e.g., processors, exporters, retailers and wholesalers); and agro-dealers who provide farming inputs such as fertilizer, equipment and seed to farmers.

A modified version of the Connected Farmer platform has also been implemented for the Government of Kenya's **eSubsidy** program which targets farmers across the country with subsidized fertilizer and farming inputs meant to improve their productivity. The platform registers farmers, then delivers electronic vouchers that can be redeemed online at approved agro-dealer stores and distributors across Kenya.

A detailed list of functionality offered by the solution includes:

Registration And Data Collection

The solution provides a mobile application that can be used by extension officers and field operations officers to register farmers (documenting their identity, location, farm size, produce type, etc.). This allows government agencies and businesses to develop farmer databases that can be used to subscribe farmers to a number of services such as training and extension services or to contract them into agribusiness supply chains.

Further, the application can be used to develop and distribute a set of periodic questionnaires and surveys to farmers to collect data on key questions for supply chain management.

Communication and Content Management

Connected Farmer is directly integrated into Vodafone's network Internet and SMS systems, allowing government agencies and businesses to use a number of communication channels to interact with their registered farmers. Communications could include structured training on SMS or multi-media (video, audio and SMS), SMS- or voice-based extension/advisory services, marketing communications, general alerts, notifications or information broadcasts.

Further, through their unique short-codes, every organization on the platform can also allow farmers to contact them directly with queries, requests, and responses to surveys.

Critically, the Connected Farmer platform includes a content management service that allows a content provider to load and distribute content to all registered farmers, or a subset of them based on segmentation parameters such as location, produce type, season, or gender. This allows client organizations to reach partnership agreements with content owners such as research organizations, NGOs, trainers, and marketers to develop unique content targeting their registered farmers.

Stocks and Supply Chain Management

Using the Connected Farmer mobile applications, field officers, agribusiness buyers and other staff are able to record and upload every delivery from every farmer, provide farmers with an electronic receipt by SMS directly to their mobile phones, and track how much produce has been collected at every buying center/landing site. This makes it possible for agribusinesses to track what is coming through the supply chain and plan accordingly.

Financial Services

The Connected Farmer solution includes Vodafone's mobile money service, which allows organizations using the solution to provide financial services such as:

- Paying farmers directly via their mobile phones
- Disbursing loans or input credit vouchers redeemable at specific agro-dealer and retail stores
- Creating a transaction history that can be used to qualify farmers for a set of financial services such as development loans and various types of insurance
- Partnering with financial service providers to develop and disburse a set of financial products such as index-based risk financing/insurance services, micro-health insurance, and asset financing.

Farmers are able to access financial services directly from their phones, which also eliminates the risks and costs associated with cash handling for both businesses and individual farmers.

The Vodafone/Esoko Farmers' Club

In Ghana, the Vodafone Farmers' Club is a partnership between Vodafone Ghana and the ICT company Esoko to deploy a set of services and solutions to smallholder farmers in various supply chains. The Farmers' Club has also been deployed in four other countries, including Turkey, Kenya, India, and Tanzania. It was launched in Ghana in June 2015.

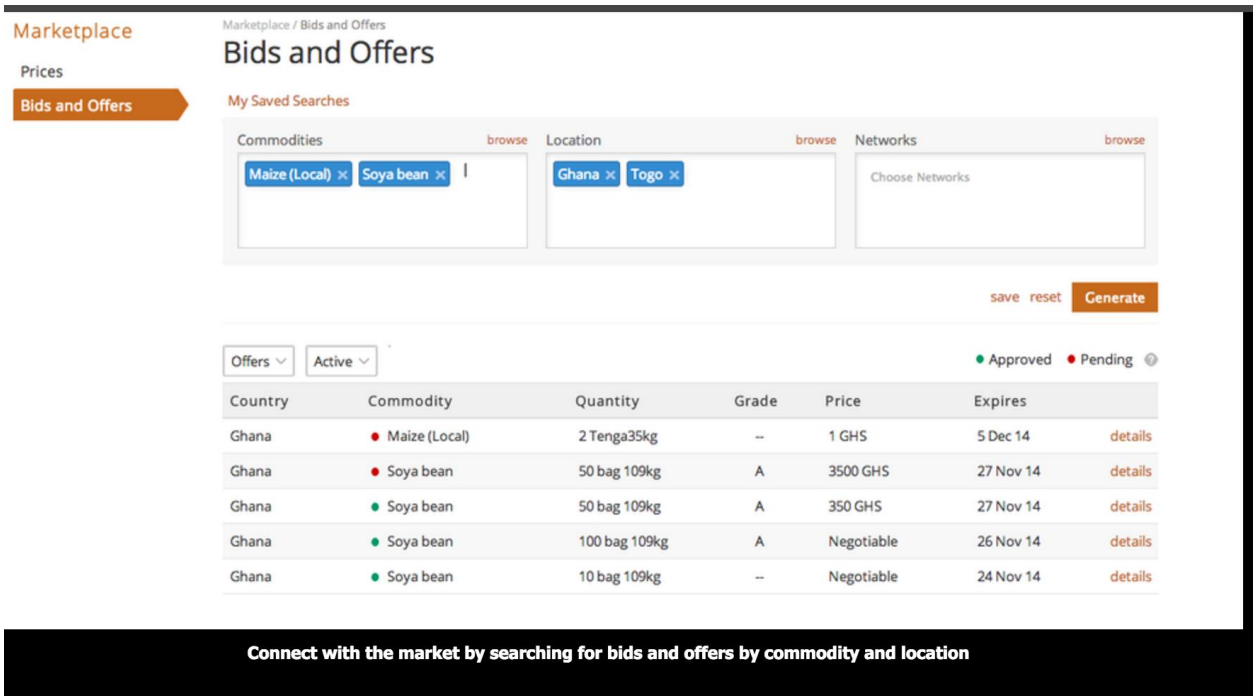
In Ghana, the solution is implemented on the Esoko platform and targets farmers and organizations that work with farmers such as government agencies and agribusinesses. The Farmers' Club offers the following features:

Data Collection and Surveys

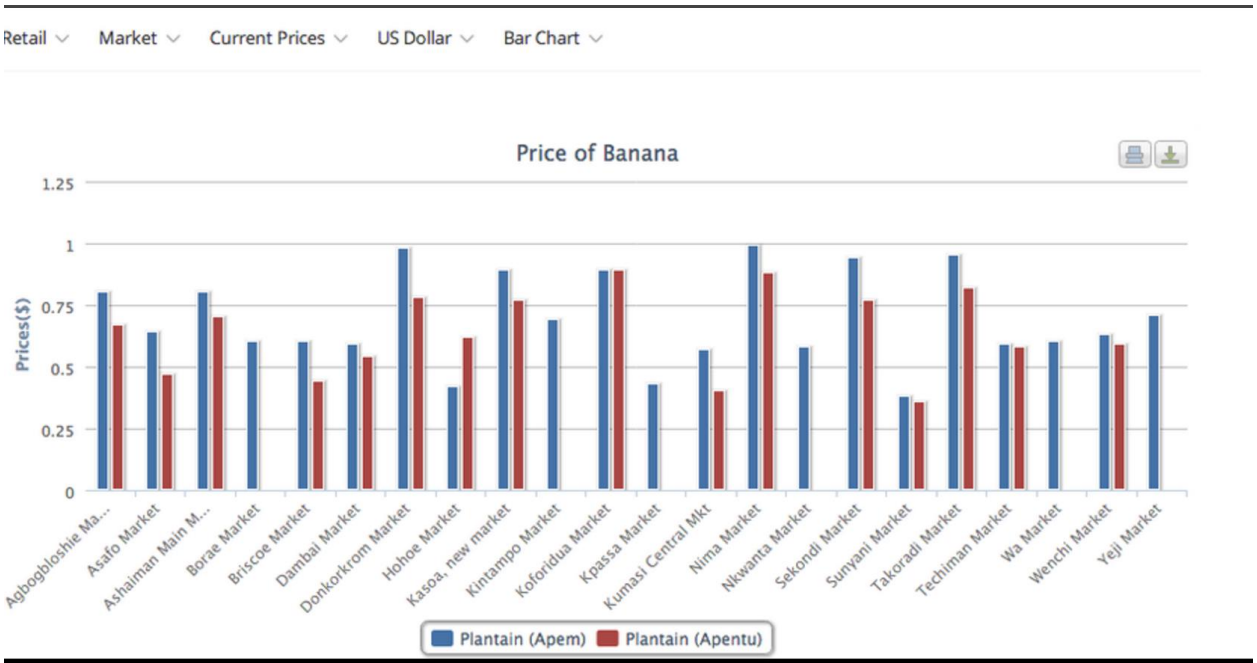
The Esoko platform provides a set of mobile applications for tablets and smart phones that can be used by extension workers and other field staff to collect data on any number of parameters, including market prices, farmer surveys and farmer data. The client organization is able to design and customize forms that are downloaded directly onto their field staff's tablets and smartphones in real-time. Collected data can also be uploaded in real-time.

Mobile Marketplace

This feature allows farmers and resellers to upload products available for sale with details such as produce type, quantity, and price; and it allows buyers to respond with bids, providing details such as quantities required and price counter-offers. It also provides updated information on current and historical prices for different produce types by region and location.



Connect with the market by searching for bids and offers by commodity and location



Search and compare price trends by commodity and location, and over time

Figure 2: Esoko Mobile Marketplace

Communication, Training and Content Management

The Esoko platform enables client organizations to design content such as multimedia training packages and alerts and notifications on weather, market prices, events, and general marketing information and to share this with farmers using a number of channels such as SMS (for farmers) and mobile apps (for field staff).

The communication can be scheduled to run automatically, and can be targeted to all or a subset of farmers or staff based on any number of parameters.

Call Center Services

Esoko runs call centers in Ghana and Kenya that provide direct helpline and support services to farmers and users registered on the platform. Using the call centers, farmers are able to call in with requests for information, support, and advisory services, all of which can in turn be provided directly via their phones. The call centers can also be used for outbound calling services such as surveys, campaigns, and impact studies.

Financial Services

Esoko does not currently support mobile financial services integration, though there are plans to launch these in 2016.

Tone - mFish

Tone is a technology company dedicated to expanding access, in partnership with local network operators, to mobile broadband and digital content around the world. Tone's mFish platform, launched in partnership with the US State Department in 2014, is harnessing mobile technology to advance sustainable fisheries and improve economic returns for fishermen.

Tone uses an innovative model that provides underserved communities and users with access to affordable mobile data plans and devices (smart phones), giving them access to specially designed content with training, advice and best practices for better, safer and more sustainable fishing practices. The platform also allows users to communicate more easily with their community groups and with their families, and has even allowed for communication between fishers on different islands. To this point, Tone has created a WhatsApp-style user experience for group messaging: Fishermen can see and connect with all other fishers on mFish, allowing them to share catch data and locations.

In its pilots, Tone works with local mobile carriers and local NGOs to provide fishers with a free smart phone, a solar charger, and a pictorial guide and training on how to use the mobile content and applications. The partner NGO trains fishers on how to use the applications and the phone. It also provides support in validating catch data and reports from fishermen before submission to a government database.

To do this, Tone has developed (and continues to develop) local and international partnerships with:

- Mobile technology operators to develop, brand and market affordable mobile devices and data packages for specific national or international markets.
- Content developers and NGOs to develop content that is relevant to the targeted user communities.
- Private businesses to develop sponsored informational, marketing and other content that is of interest to the users.
- Governments and development partners to develop programs and initiatives to roll-out mobile broadband solutions to underserved communities and users.

Tone's mFish programme in Indonesia, in partnership with the US Department of State, has been recognized internationally for impact, reach and scalability. It targeted rural fishermen with a sustainable and affordable data plan that:

- Allows them to connect and communicate with each other (e.g., via social media apps and groups).
- Links them to sources of vital information and tips on weather, tides and sustainable fishing, leading to improved productivity.
- Includes GPS and interactive maps that improve fishers' navigation both night and day, and helps them feel safer.

- Allows them to log catch data and upload it to a database operated by a local NGO partner.

The Tone model can be replicated in Ghana as a sub-pilot alongside the proposed Fishers' Network partnership to:

- Link more fishers with mobile broadband technology, which in turn has huge potential to link them with content and opportunities that can support their livelihoods in the long term.
- Assist the mobile operator leading the Fishers' Network in driving smart phone and mobile data adoption among fisherfolk and rural communities.
- Develop solid sustainability models for content financing based on private business sponsorships. For example, a fishing equipment business could sponsor some category of content for fishers in exchange for access to the fishers' database for marketing communication via SMS.

Pelagic Data Systems – Vessel Monitoring System, Landing Site Catch Data Application & Fisher Registration Application

Vessel Monitoring System

Pelagic Data Systems develops and deploys a simplified Vessel Monitoring System (VMS) that targets small-scale fishers, who have traditionally not been covered by the larger systems that rely on satellite technology and on-board servers. Pelagic Data Systems' solution addresses the challenge of providing small-scale fishers and artisanal fleets with the capacity to track and collect data about catch and individual vessel paths.

Using a simple, solar-powered plug-and-play device that can be mounted on any vessel, the Pelagic technology is able to collect and store many days' worth of data offline (in case there is no mobile network coverage), and to automatically upload this data to a cloud server as soon as the vessel returns to network coverage. Authorized users can log onto an online portal where they can view and manipulate the collected data, generate alerts for the vessels and generate various types and formats for reports.

Pelagic's VMS records a range of data, including fishing trip duration, fishing times, and fishing trip range and distance. Further, in some cases, Pelagic can determine types of gear used by looking at vessel movements and patterns.

Pelagic also has an on-boat temperature monitor that can prove to buyers that fish were kept on ice, for improved safety and handling and improved sales for fishers who use cold storage on their boats.

Pelagic Data Systems charges roughly USD $150 per unit for the VMS technology and roughly USD $20 per month for its data analytics service. However, costs could be reduced through partnership with Pelagic and other private sector or governmental organizations.

Landing Site Catch Data Application

In addition to its VMS, Pelagic has partnered with the Smithsonian Institution to develop a landing site catch documentation application, compatible with smart phones and tablets.

The application includes:

1. An Android application for phones or tablets for collecting and documenting catch data at landing sites.
2. A server that collects the data and allows for online administration, data analysis and reporting.

The application includes the following features:

1. Collects catch data (fish species, weight, count), including fisher name and information (can draw on fisher information provided via the registration application described in the next section).
2. Allows fish buyers to record their transactions (e.g., fuel sales, ice consumption, catch purchases) with each fisher.
3. Can record by weight, volume, or bulk units (e.g., baskets).
4. Provides information about trends in catch size, catch species or fisher effort and distribution.
5. Can include a customizable range of fish species.
6. Uses graphics and symbols, with minimal text.
7. Uses local languages and currencies.

Fisher Registration Application

Pelagic Data Systems has also developed a tool that can be used both offline or online for registering fishers and storing their details in a central online database. This information can then be connected to catch data at landing sites using the application above.

The system allows for government representatives to collect fisher information and register fishers even in locations without Internet or phone coverage (i.e., files can be stored on laptop computers and then uploaded to the online database at the next available opportunity). Registered fisherfolk receive a plastic ID card with a bar code on the back. The online database is secure and password protected.

The application requires laptop computers for inputting registration details, a plastic card printer to print ID cards, and periodic access to the Internet.

Liferay (Portal and Analytics)

Liferay is an open source collaboration and workforce engagement platform that is widely used worldwide. Liferay is a potential tool for enhancing stakeholder collaboration and communications; the exchange of ideas, knowledge and information; and interactive engagement with fishers and the wider public.

Based on secure open source technology, Liferay allows flexible and affordable deployment of complex analytical tools, intranets and public portals across a wide range of mobile devices and online. Liferay links and unifies all data sources and internal systems in a seamless and transparent way, ensuring ease of use for end users.

By forging a partnership with a Liferay integration company keen on entering the African market, the Government of Ghana could potentially deploy these tools and portals to support a new inter-agency/stakeholder collaboration model.

Below are some figures illustrating how Liferay has been deployed in knowledge sharing, collaboration, knowledge management and document sharing:

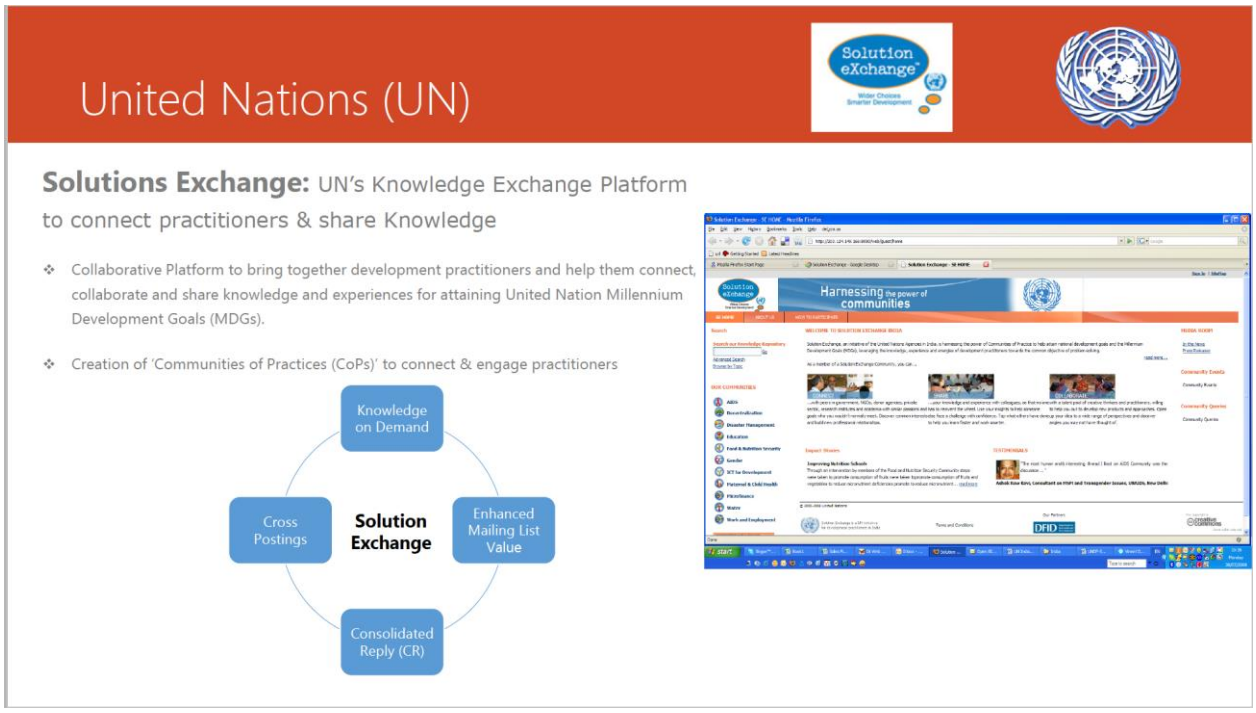


Figure 3: Liferay's knowledge sharing and collaboration solution for UN – India agencies

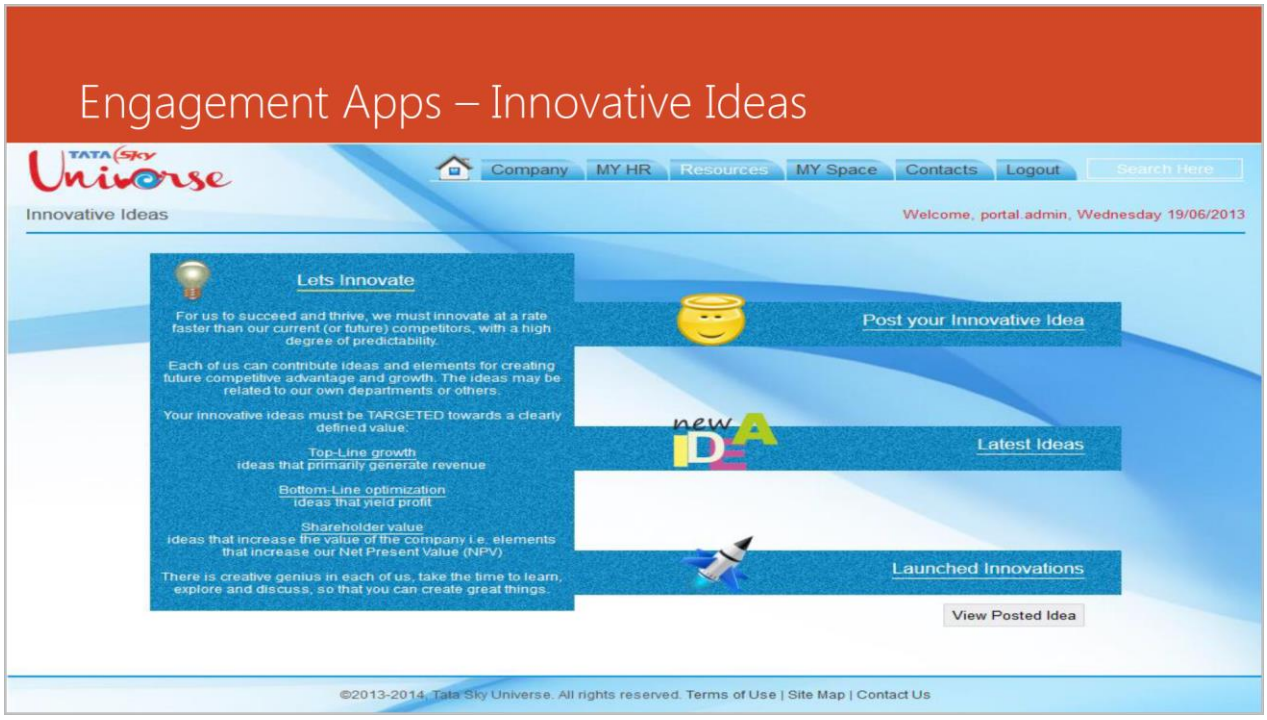


Figure 4: Liferay's Idea-sharing solution for TATA dealers

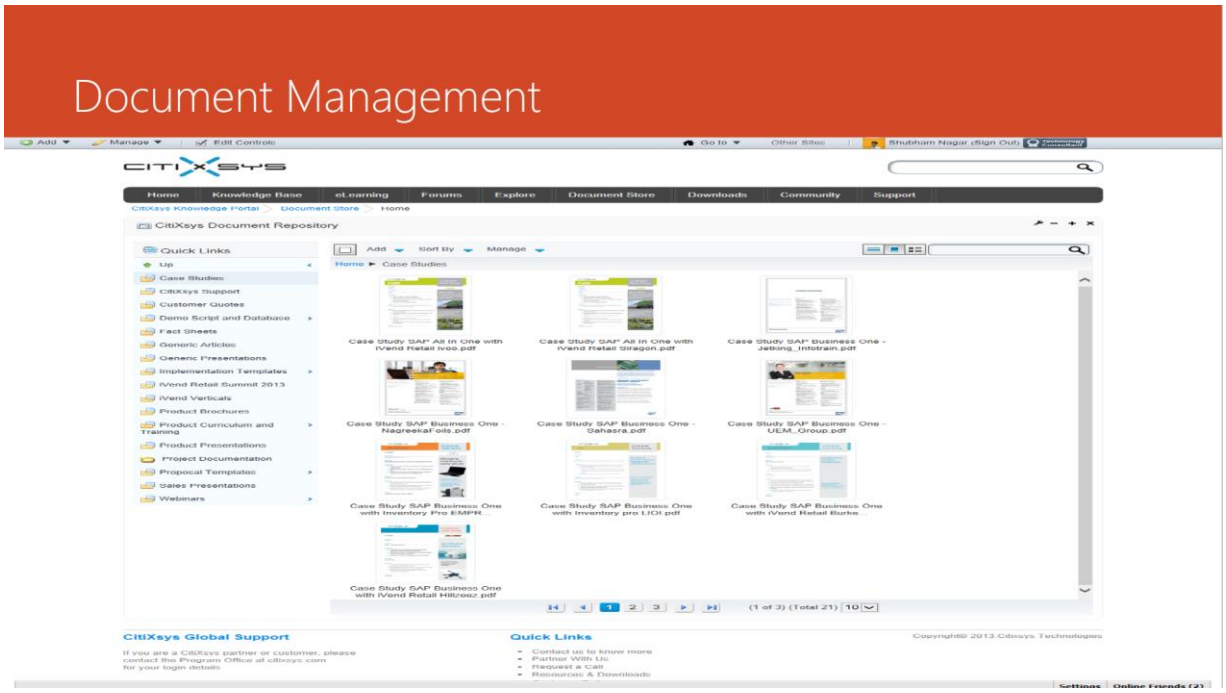


Figure 5: Liferay's document-sharing solution

SUCCESS FACTORS FOR THE ICT STRATEGY FRAMEWORK

The tables below summarize important success factors for the effective deployment of an ICT strategy for sustainable fisheries management in Ghana.

Joint Ownership by Both Government and Fishers' Communities

It is imperative that the Fisheries Commission and associated government departments and agencies buy into and take ownership over the entire process of solution identification, prioritization, deployment, and management.

- The long-term impact and success of the ICT solutions identified in this strategy – as well as others to be identified over time – will depend on the enthusiasm and commitment of government champions to invest in, implement, use, fine-tune, and maintain new ICT infrastructure and systems over time.

- Where relevant, fishers should be consulted to ensure their needs, interests, and capacities are taken into account for new ICT solutions. For ICT solutions targeting fishers, fishers should be closely consulted throughout design and implementation, to secure buy-in and to ensure that the technology is as relevant as possible to target communities.

Technology Adoption Model and Support

A key factor in the design and deployment of a new technology solution targeted for underserved or excluded market segments is motivating new users to adopt and use the new technology.

•**Relevance and Usability**: Solution design must be driven by requirements derived and documented jointly with end users. Hence the requirements for collaboration portals and analytics must be driven by the Fisheries Commission and enforcement agencies, while solutions for content delivery and financial services must be driven by the needs and interests of fishers.

•**Tech Literacy**: Apart from academic illiteracy (inability to read and/or write), ICT illiteracy is a major contributor to the failure of technology solutions. While new technologies are exciting, a new solution that demands target users to learn new skills is almost guaranteed to fail – unless the benefits are extremely motivating. Successful mass market/bottom of the pyramid applications ride on existing skills and technologies to introduce a new service or way of doing things (e.g., M-PESA is successful because it relies on native SMS and exisiting mobile devices). A good solution will leverage existing skills and familiar technology then introduce baby-steps to more advanced technology as part of the sustainability model roadmap.

•**Early Adopters and Early Majority:** Identify early adopters at the start and nurture local champions in each pilot area. In a technology deployment life cycle, there will be early adopters, an early majority and laggards. It will be important to identify local champions in every fishing community, who will in turn influence the late majority and laggards to adopt – or to at least try – new ICT solutions.

•**Training**: Early on, a partner organization should be tapped to design a training program and materials for fishers and staff on how to take best advantage of a new ICT solution. Typically, there will be existing programs and infrastructure for training fishers and stakeholders. It is therefore highly recommended that SFMP or the Fisheries Commission leverage these existing programs to support training and adoption of new technologies.

•**Deployment and Support Partners**: Where possible, the Fisheries Commission and SFMP should leverage partnerships with existing organizations familiar with fishing communities to support local training needs and technology deployment. Consider building the capacity of these partners where it does not exist, or strengthening it where it does exist.

Sustainable Commercial Model and Business Case

The sustainability of new ICT solutions is highly dependent on private sector partners. It is important that they see the initiative as a sustainable business opportunity that is worth investing in and dedicating resources to for development, support and continuous innovation.

•**Revenue**: What services will be offered and at what price? Who will pay for these services – fishers, value-added service providers such as insurance and content companies, government agencies and/or development partners? What price points are realistic?

•**Costs**: What costs will the business cover? How much of those costs can they incorporate into their pricing within the parameters of the partnership?

•**Dominant Business Driver**: If revenue is not the immediate business driver, are there other intermediate but significant business drivers such as customer acquisition, new market penetration or brand equity?

•**Marketing and Scale**: What support and assets will this partnership leverage to ensure up-take and sustained usage by the fishers and target government departments? Will fishers and canoe associations and government facilitate marketing? What numbers are realistic over the next 1, 3 and 5 years?

•**Brand and Reputation**: Are there any aspects or participants in this partnership that pose existing or potential reputational risks to the private sector partner brands?

Technology Access and Affordability

Any solution contemplated and adopted for deployment must seek to use technology that is easy to use, familiar, affordable, and accessible.

•**Existing and familiar to users**: Realistically, the primary goal should not be to develop new technologies, but rather to use existing technologies in new and innovative ways to transform the management of fisheries in Ghana. Further, fishers and stakeholders may not be as keen to invest in new skills and technologies if they can achieve the same results with an innovative application of a technology they already own and use.

•**Readily accessible**: An ICT solution that demands reliable network coverage and advanced mobile devices may not presently be the best fit for the fisheries sector in Ghana. To the exent possible, ICT solutions targeting bottom of the pyramid (BOP) segments should be designed with realistic expectations as to the availability of network coverage and Internet access and should be designed for commonly available devices and channels.

•**Cost and Affordability**: The ICT partnership must attempt to minimize costs for end users.

•**Effort and Step-Change**: The new ICT solution should be perceived by end users as easier and more convenient than existing tools and methods.

Technology Partner Selection

The motivation and business model of the partner is a key consideration.

- **Existing Technology**: Do they have an existing, fully compliant solution as defined in this document?
- **Willingness to Invest and Take Risks**: Are they willing to invest in the development of a unique solution for fishers or in a partnership model whose business case and financing model is based on ongoing customer subscriptions and acquisitions as opposed to up-front payment for development costs? Typically, this type of partnership scores high on sustainability and scale as the partner sees itself as a co-investor in a promising business venture.
- **Customer Base and Positioning**: Does their business model and positioning fit with the fisheries sector, and specifically do fishers fit as a target market for them?
- **Pricing Model**: Are they willing to develop a flexible pricing model that fits within the realities of fishers' revenue cycles?
- **Brand and Capacity**: Do they have experience and capacity in the deployment and support of the specific solutions under consideration? This may either be direct experience or via complementary partnerships.

ICT SOLUTIONS PROCUREMENT: VENDOR VS PARTNER RELATIONSHIPS

Both private sector organizations and development agencies and projects have similar guidelines on the procurement of new ICT solutions and services. The common models for on-boarding ICT solutions are:

Direct Purchase (Vendor or Supplier Relationships)

In this model, the client organization will typically develop a detailed description of features, functions and parameters for the desired solution (also called Statement of Compliance), and issue a tender or request for proposals either publicly (open tender) or to a pre-selected list of potential suppliers (closed tender).

The engagement under this model will be regulated by a supplier contract, a detailed scope of work and a Service Level Licensing Agreement that stipulates the detailed parameters for solution implementation, maintenance and support. The new solution or system will be recognized as a capital expenditure item fully owned by the client organization.

Advantages

i. The buyer has direct and full control over the solution including customization and re-configuration

Disadvantages

i. The initial investment may be high, and this introduces the risk that the solution will never pay for itself or that pricing for products and services delivered by the solution will be unsustainable.
ii. The client organization will need to build internal capacity to support the new solution, which may introduce other costs such as staff hiring, new hardware purchases and maintenance, space expansion, etc.

This engagement model is recommended in situations where:

- The solution is critical to the core business of the client organization and loss of control over the ICT solution's performance and quality is unacceptable.
- The business case for the solution is clear and supported by strong return on investment (ROI) ratios.
- There exists sufficient in-house or partner capacity to support the new solution.

Full Partnership or Revenue-Sharing Relationships

In this model, the client organization avoids incurring up-front capital expenditure by entering into a direct or indirect joint venture engagement with the solution owner. The solution owner will typically bear all up-front/capex costs for development and deployment. The client organization may pay for some direct solution rollout expenses such as staff training, purchase of devices such as phones and tablets, and marketing and communications. The technology partner will be motivated to enter into such a relationship by factors such as:

- They have a desire to enter and build a new market by demonstrating their solution.
- Their business plan is based on long-term managed services and licensing models that guarantee them long-term revenues and returns.
- They have strong confidence in the market and the specific customer ability to generate enough business to guarantee return on investment.

These engagements are typically guided by documents such as:

- Revenue Share agreements (and a joint business case and plan)
- Memoranda of Understanding (MOUs) stipulating the roles and responsibilities of each partner
- Partnership agreements (optional) for legal grounding of clauses such as partnership termination and exit, arbitration, IP rights and confidentiality.

The solution ownership (and sometimes billing) remains with the technology partner who is also typically responsible for maintaining and supporting the solution within the parameters defined in the MOU. The procuring organization is often responsible for marketing the service, customer relationship management, and direct customer support. The technology partner will recover its investment by either billing the customers directly for services consumed, or by billing the client organization who then has the option of passing the cost directly on to customers or absorb it via smart pricing of related subscriptions and services.

Advantages

i. The client organization is less exposed to the risk of the technology failing by ensuring that the technology partner is equally invested and hence motivated to provide the best in service, support and quality.
ii. No up-front capital expenses are incurred or loaded to the services and products delivered by the solution. This allows for flexible pricing of products and services.
iii. The client organization does not need to invest in new capacity to support the technology such as staff, hardware, and equipment. Most of the expenses will be related to staff training and marketing.

Disadvantages

i. The client organization will not have full control over the solution, and will need to consult the technology partner for even minor changes and improvements. The technology partner may also opt to exit the partnership at an inconvenient moment, possibly leading to loss in reputation and potential business for the client organization.

This engagement method is recommended for situations where:

- The client organization has budgetary or resource restrictions that do not allow them to engage in upfront capital investments.
- The solution is not critical to the core business of the client organization, and its functions can be comfortably outsourced.
- The client organization is pursuing a lean organization framework, and has a strategy for outsourcing non-critical services.
- The solution is seen as a long-term investment and the risk appetite is low.

Partial Partnership/Hybrid Engagement

This engagement model may apply where the partners agree to share the implementation costs based on an agreed matrix of roles and responsibilities. The same parameters are used to agree on a revenue share ratio.

A variation may be a PPP Build, Operate and Transfer (BOT) model where the technology partner may agree to build the entire solution, operate it for a few years and then transfer it to the client organization after they recoup their investment through profits.

Advantages

Same as for full partnerships above

Disadvantages

Same as for full partnerships above

This engagement model is recommended in cases where:

- The client organization views the solution as a critical long-term investment, but has no readily available resources to invest up-front.
- The client organization needs time to develop either internal or market capacity (or both) for the solution. In this case the engagement model will comprise an elaborate skills transfer and training plan.

PARTNERSHIPS IMPLEMENTATION AND GOVERNANCE STRUCTURE

Project Governance Structure

We propose the following unified project structure across all ICT initiatives:

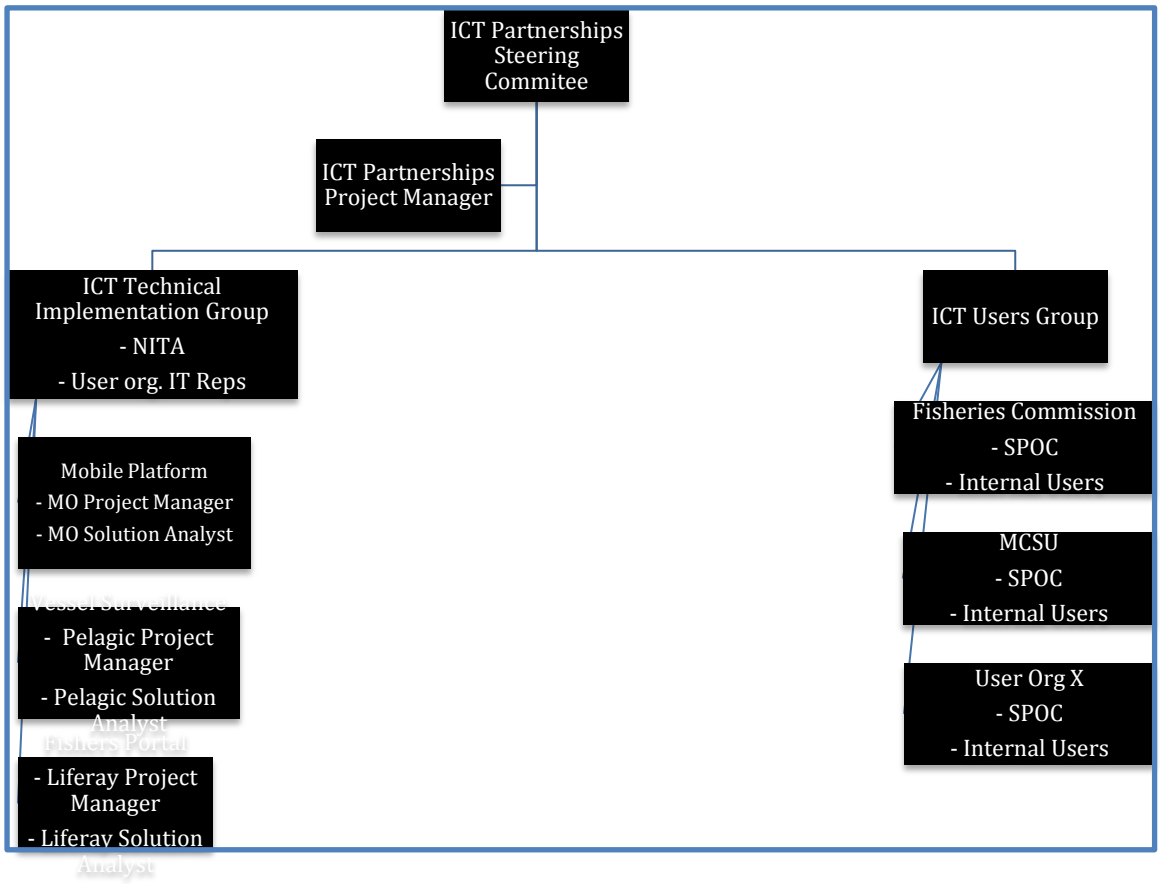


Figure 6: Ghana Fisheries ICT Project Governance Structure

ICT Partnerships Steering Committee

The steering committee will provide final decision making and strategic direction to the partnership projects. It will also approve the initial scope, resource requests and other decisions for each partnership initiative. The committee will meet at least once every 2 months.

The committee will be composed of nominees from senior management levels of the user organizations, ICT partners, SFMP, and NITA.

ICT Project Manager

The ICT project manager will have an overall coordination and oversight role for all the initiatives. Reporting directly to the steering committee, he/she will be responsible for ensuring that there is effective communication between the initiatives, users, steering committee members and other project stakeholders.

He/she will also be responsible for setting up and coordinating user forums to discuss, test and review the proposed ICT solutions.

ICT Users Group

The users group would potentially include:

- A Single Point of Contact (SPOC) from each user organization. The SPOC will also act as the partnership ambassador and champion within their organization. Their role will include ensuring that the needs of their organization are well documented and met, to the extent possible, in partnership implementation, that all critical users are engaged and aware of the project, and that users are fully trained and supported prior to launch.

- Internal users will comprise selected users in each organization who will work with the SPOC to determine and document specific needs within their organization. They will form part of the partnership think tank responsible for collating and representing ideas from each key stakeholder organization for project consideration.

ICT Technical Implementation Group

The technical implementation group would bring together:

- An IT representative from the responsible user organization, NITA or both
- Representatives of the ICT partners comprising:
    - A partner project manager responsible for the partnership initiative
    - A solution analyst responsible for working with users to determine requirements and translate those requirements into a solution

The partner project manager would be responsible for coordinating the delivery of the partnership solution, and would report to the steering committee via the overall ICT project manager.

Partnerships Review Forums

This would be a monthly forum (during the partnership implementation period), and quarterly post-implementation and rollout. It would bring together the following:

- Overall ICT project manager
- ICT partner solution analysts
- Members of the users group (SPOCs and relevant internal users)
- NITA representative(s)
- Steering committee members (optional)

The forums would have the following scope:

- Review feedback and new suggestions from users, solution analysts and project managers on the partnership projects, new ideas, technology upgrade opportunities, new potential partners, etc.
- Document critical action items coming from the feedback and suggestions, and agree on a work plan for their implementation.
- Prioritize ideas for adoption. Prioritized ideas will need to be presented to the partnerships steering committee for approval before adoption.

If properly constituted and managed, the partnership review forums have the potential to evolve into wider forums where players and vendors in the fisheries management sector could be invited to present ideas and explore opportunities for new or expanded ICT partnerships.

PROPOSED NEXT STEPS

We propose the following three-stage activity plan for each ICT partnership's implementation:

Stage 1 Activities: Solution and Partner Selection

i. Nominate and convene the ICT partnerships steering committee
ii. For each of the proposed solutions, draw a shortlist of potential interested partners
iii. Engage each of the partners with the specifics of the desired solution and partnership model to gauge their availability, level of interest and capacity to deliver within the parameters defined by stakeholders.
iv. Convene a session for each partnership initiative to discuss the roles, scope, high-level activities and contributions for each partner.

v. Develop a Strategic Concept Note for the partnership and finalize partner negotiations.
vi. Develop and sign MOUs with each partner.
vii. Nominate and convene the ICT user groups and the technical implementation groups in preparation for phase two (requirements and solution definition).

Stage 2 Activities: Requirements and Solution Definition

i. Convene a detailed requirements and solution design workshop, bringing together users from stakeholder organizations and ICT partner solution teams. With guidance from the partner solutions teams, possible requirements should be prioritized according to level of effort required and potential impact.
ii. The ICT partner would then revert with requirements and solution design specification documents, including a detailed project plan showing major milestones and timelines. This should be approved by all stakeholder representatives.
iii. Once approved, the partner would proceed with development and implementation.

Stage 3 Activities: Solution Implementation and Pilot/Rollout

i. Once development of the solution design, including internal technical tests, is completed, the ICT partner will release the first version and train the user SPOCs.
ii. The trained SPOCs will carry out tests to ensure all requirements are met and that the ICT solution works as intended. This stage might require the ICT partner to fix a number of identified bugs before the solution is ready for pilot or rollout.
iii. Upon successful user acceptance testing (UAT) by SPOCs, the solution should be released to a wider group of users for use in the field in a controlled pilot or trial. The ICT partner will need to work with the field pilot users and capture any critical issues or gaps identified.
iv. The results of both the UAT and field trials or pilot should then be presented to the ICT partnerships steering committee for approval before full rollout and launch.