



Mobiles for Agricultural Development

Exploring trends, challenges and policy options for the Dutch government

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Currently many initiatives for m-Agri Apps for smallholder development are taking place. The effectiveness and sustainability of the development is promising, however factual evidence of its impact on livelihood improvements is still rare. As a whole the development of m-Agri Apps is mainly stimulated by donor incentives. Among different stakeholders there is the wish to collaborate more and exchange knowledge on: good practises, setting up learning communities, developing m-Agri Apps with open software, making existing data available, developing locally scaled agricultural content and connecting the poorest to mobile networks. Chances lay in better involvement of the agribusiness sector, which gets currently more and more involved with the smallholder communities around the world.

Keywords: mobile applications, agriculture development, global challenges.

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Preface

Last year, in 2013, the ministry of Economic Affairs commissioned an exploration study carried out by Alterra (research institute part of Wageningen UR) to scope the possibilities and barriers of the further use of mobile applications, targeted at small holder farmers in developing countries.

The objectives of this study was to explore the international collaboration around this topic, and the wiliness to unite and act together. In order to answer these questions, Alterra performed a literature review, of several evaluation reports touching the topic of mobile applications, identifying key-stakeholder active in this field and kept fifteen interviews by telephone among the selected key-stakeholders. Together with this letter, we want to share the results gathered and structured through the attached report, called *Mobiles for agricultural development*.

Besides the possibilities and barriers of mobile applications, all stakeholders interviewed agreed that there is a need for more international cooperation and pointed out that The Netherlands could contribute at different levels.

Summary

Currently many initiatives for m-Agri Apps for smallholder development are taking place. The effectiveness and sustainability of the development is promising, however; factual evidence of its impact on livelihood improvements is still rare. As a whole the development of m-Agri Apps is mainly stimulated by donor incentives. Among different stakeholders there is the wish to collaborate more and exchange knowledge on: good practises, setting up learning communities, developing m-Agri Apps with open software, making existing data available, developing locally scaled agricultural content and connecting the poorest to mobile networks. Chances lay in better involvement of the agribusiness sector, which gets currently more and more involved with the smallholder communities around the world.

1 Introduction

In the coming decades one of the major challenges is to feed the world in 2050 (FAO, 2009). In 2050 the population size has increased to 9.6 billion people and most of the growth is expected to take place in developing regions, especially in Africa (UN, 2013). Simultaneously historic crop yields have generally increased, but this increase is not equally spread around the world. Especially smallholder farming systems in development countries are lagging behind. Underlying reasons are lacking access to inputs and credits and the inability to bear risks. Simultaneously smallholder farmers face an information gap constraining the adaptation and exchange of good management practices and the awareness of market developments (Syngenta foundation, 2011).

However this situation is changing. Since 2000 the mobile communication network is vastly expanding, even in the very remote areas of developing countries. Prices of mobile devices are falling and become affordable even for the poorest (World Bank, 2011a). As a result the number of mobile phone subscriptions in developing countries has increased from 1.213 billion to 5.235 billion between 2005 and 2013. In the beginning of 2013 almost 90% of the population in developing countries had a mobile subscription. In comparison in 2013 only 28% of the population in developing countries had an internet connection and 11% of the households had a fixed-line subscriptions (ITU, 2013). In the developing world the mobile network has become the gateway for communication with the outside world.

The spread of mobile technology throughout the developing world has a significant impact in nearly all aspects of development, enabling users to exchange information real-time across large distances improving the coordination among spatial scattered groups. These connections can be particularly important in sparsely populated areas characterized by weak infrastructure, poor transportation systems and limited access to markets or information (USAID, 2012).

International donor agencies (i.e. World bank, Public services, charities and the private sector) recognize this opportunity and are investing in projects using mobile devices to provide smallholder farmers communities and the supporting agricultural supply chain with better information, aiming for better decision making and improvement of their livelihoods. Applications have been developed to increase productivity, provide market information and/or financial services (InfoDev, 2012).

However, so far the number of successful projects using mobile phones to support agricultural development is limited. Different projects seem to be set up independently, each project struggling with their own learning curves and pitfalls. Only a few applications become wide-spread and financially self-sustainable. It seems that the different actors: donors, NGO's, telecom providers, agribusiness and research institutes have not developed structural collaboration to join forces to make this development into a success.

In the Netherlands Agro-knowledge, ICT and data availability are considered to be the main drivers behind development of the Dutch agro sector (Top Sectors, 2012). Considering this knowledge and experience, from Dutch knowledge institutes and industry, the Dutch Ministry of Economic Affairs is exploring new ways to contribute to the global food security challenge from a ICT perspective.

Current within the Netherlands two steps have been taken: 1 the Dutch initiative on Open data and agriculture, including the involvement with Godan (Ministry of Economic Affairs, Agriculture and Innovation, 2011) and Geo4Agriculture and Water (NSO, 2013) focussing on the application of geo- and space data for smallholder farmers. This report provides an overview of the trends and challenges in the development of ICT for agricultural development focussing on mobile devices. Based on this overview recommendations for the Dutch government will be made considering the functioning of the global community and the initiatives mentioned above.

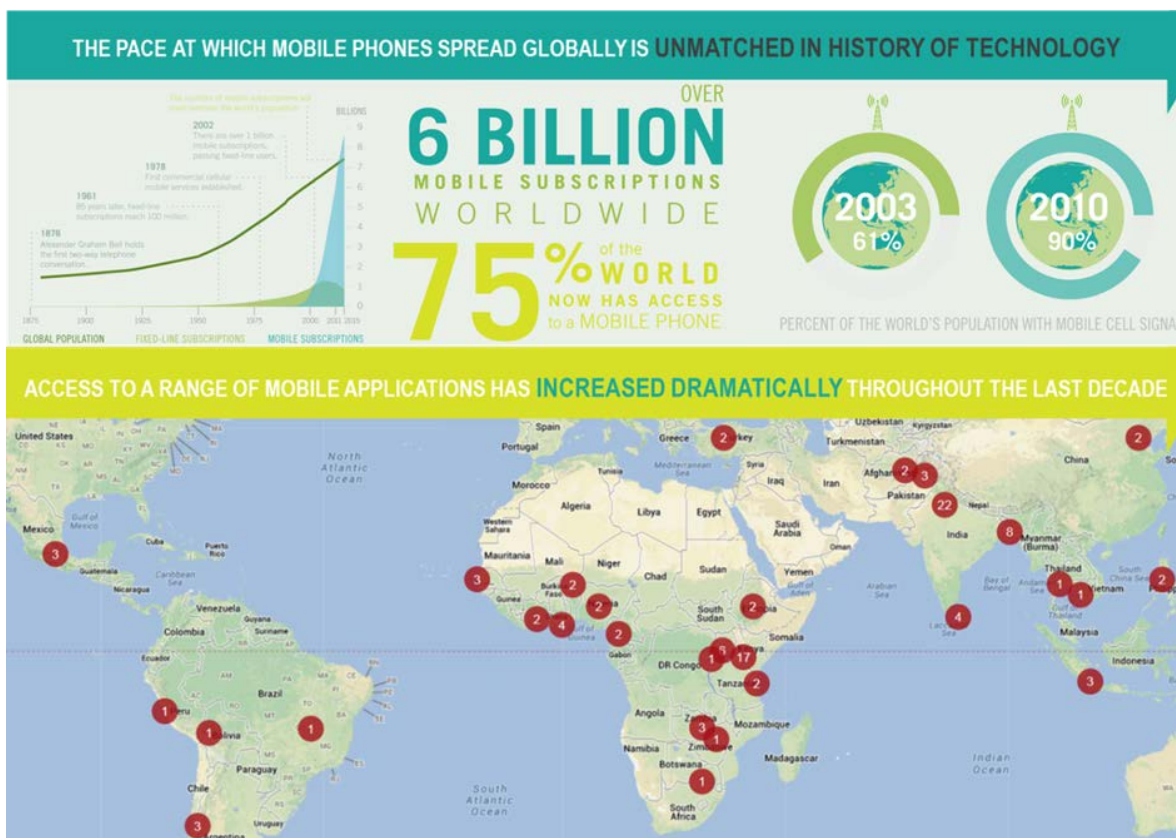


Figure 1.1 Development of mobile access (infoDev, 2012) together with mobile projects for agricultural development around the world (GSMA, 2013).

1.1 Objective

The objective of this study is to provide an overview of the current trend in m-Agri Apps development and to answer the question how to improve information provisioning to smallholder farmers. The second objective is to translate this into success factors, weaknesses, and opportunities for global cooperation. And the final objective is to explore whether there is a position for the Dutch government within the international community, to share expertise on entrepreneurship in the domain of agro, food and ICT, and to identify possibilities to catalyse the development of mobile applications in smallholder agriculture.

Main research questions are:

- What are the current trends and developments in the application of mobile telephones for the development of small holder farmers?
- What makes an mobile application successful for rural development of smallholder farmers?
- What are the main challenges for mobile application for rural development of smallholder farmers?
- How is the global community developed and will it help to enforce cooperation between the different stakeholders?
- What could be the role for the Dutch government in this development?

1.2 Methodology

This research is based on a literature study and interviews.

In recent years numerous evaluation studies have been carried out on mobile agricultural applications by the World Bank, USAID and the IICD. The findings from these evaluation studies are used as background information and initial orientation in our research. Our main sources are:

- ICT for Agricultural Livelihoods – IICD 2006.
- ICT in Agriculture Sourcebook – World Bank 2011a.
- Leveraging Information and Communication Technology for the Base Of the Pyramid – Hystra 2011.
- Maximizing Mobile – infoDev, World Bank 2012.
- Mobile Agriculture – USAID 2012.
- Mobile Applications for Agriculture – Syngenta Foundation 2011.
- Mobile Applications for Agriculture and Rural Development – ICT Sector Unit, World Bank 2011b.

To deepen our research and to explore the international community, a number of key stakeholders has been interviewed. These key stakeholders have been identified from the literature study, internet search and in our professional network (Table 1).

Table 1
(List of key stakeholders interviewed)

Organization		
AgriTerra	FAO	Syngenta foundation for sustainable agriculture
Bill & Melinda Gates Foundation	GSMA	World Bank
CGIAR	IICD	
CTA	Newspaper - Indépendant	

The remaining document is subdivided into three main parts. The first part is descriptive, zooming in on the definitions of mobile apps and the agri-value chain, and explains the generic lifecycle development of mobile applications. The second part elaborates on the challenges for international collaborations identified by our stakeholders. In the third part recommendations and policy options for the Dutch Ministry are provided.

2 Definitions

2.1 Mobile applications

Mobile phones provide a wide variety of services, including voice, SMS, MMS, voice-to-text, beeping (calling and hanging up before the call is answered), and many more (see also Table 2). Each type of technology has its own benefits and drawbacks, including availability, cost, information capacity and user-friendliness. Understanding the benefits and drawbacks of each specific technology is critical for understanding the potential for m-Agri Apps (World Bank, 2011a).

Despite the large variety of services (Table 2), the majority of the successful mobile applications consists of simple and easy-to-use SMS and voice technologies.

Table 2
(List of mobile application technologies - World Bank, 2011a)

TECHNOLOGY	DESCRIPTION	AVAILABILITY
Voice	The most basic channel; avoids most literacy or linguistic barriers	Basic phones
Short Message Service (SMS)	Ubiquitous text-based messaging limited to 160 characters	Basic phones
Unstructured Supplementary Service Data (USSD)	A protocol used by Global Service for Mobile Communications (GSM) phones to communicate with the mobile network	Basic phones
Interactive Voice Response (IVR)	Computer programs that respond to the voice input of callers	Basic phones
General Packet Radio Service (GPRS)	Low bandwidth data service	Midrange phones
Software App (e.g. Java or iOS)	Preinstalled or downloaded software of varied sophistication	Midrange phones, but increased sophistication with smartphones
Mobile Wireless Application Protocol (WAP)	A limited manner of browsing the internet	Midrange phones
Multimedia Messaging Service (MMS)	SMS-based technology to transmit multimedia (including images and video)	Midrange phones
Camera	For capturing still or moving images	Midrange phones
Bluetooth	Protocol for transmitting data over short distances	Midrange phones
Mobile Web	Full-fledged web access	Smart phones
Global Positioning System (GPS)	Technology allowing for location-based information	Smart phones

2.2 Smallholders and the Agricultural Value Chain

Smallholders operate in a highly diverse environment, both from a biophysical, agronomic, and socio-economic point of view. They often own highly diversified farms, with a priority for their own food production. Cash crops and surplus are offered through informal systems on agricultural markets. Even on a local scale, cultural differences, including language and origin, play an important role. Biophysically smallholders operate in diverse environments, with problems like soil fertility or insufficient use of inputs.

The potential impact of m-Agri Apps on the smallholder activities includes basically two aspects. First, it improves the smallholder's management capacity by providing local specific information about inputs, good practices, transport or market prices. Secondly it allows for improved integration of the entire agricultural value chain, making it more efficient as a whole (World Bank, 2011b).

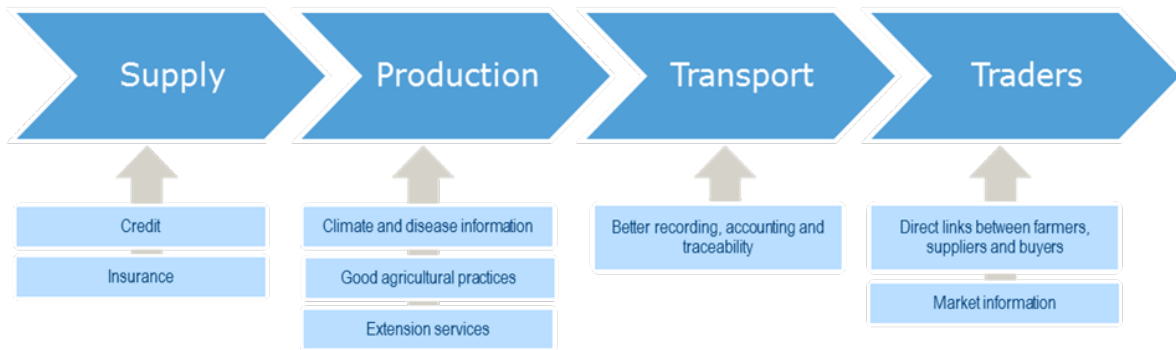


Figure 2.1 Agricultural Value Chain, combined with the information demand for each level. Source: World Bank 2011b.

2.3 Mobile motives

The application of mobile technologies would be a natural step to enhance transparency in the agro value chain, to organise logistics, to have access to the rural market or to support production of the smallholder farmers. In fact mobile applications have the potential of covering the last mile to the end-user, meaning providing timely and relevant information at low cost and covers numerous aspects of extension and agriculture development (Syngenta foundation, 2011). The locally desired information can be anything from physical characteristics, meteorological circumstances, to management practises, market prices and logistics.

The World Bank (2011b) presents a generic logical framework, linking the potential of various mobile applications to rural development objectives (Figure 2.2).

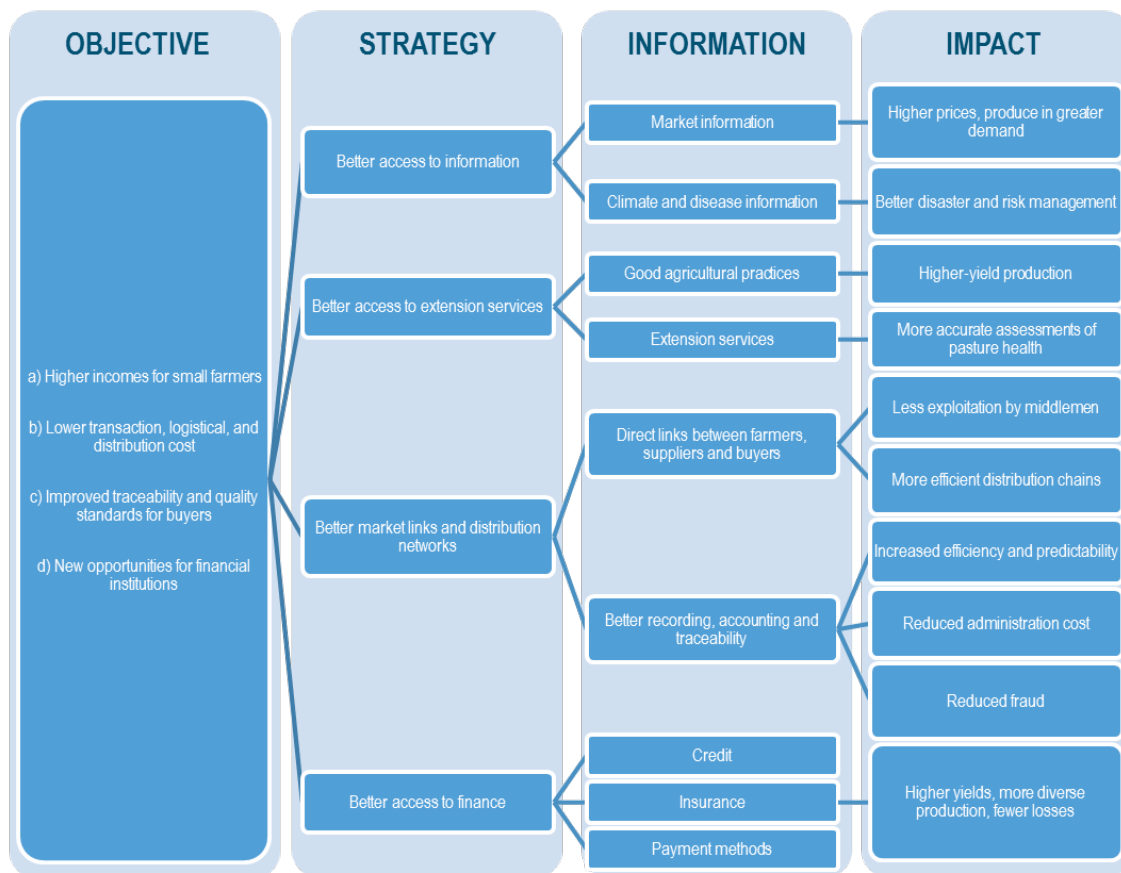


Figure 2.2 Generic logical framework linking the objectives of various mobile applications to rural development goals (World Bank, 2011b).

3 Lifecycle

In projects for m-Agri Apps development 3 stages can be recognized (World Bank, 2011b):

- The pilot stage: In the first stage of a project the m-Agri App is developed and tested. The tests are generally done within a small target groups and, whereas the service is free-of-charge. Generally donor and government support is necessary during this stage of the development.
- The up-scaling stage: After a successful pilot stage m-Agri Apps need to scale up and increase the number of users. The actual size of the user community aimed for is depending on the goals to be met and whether the costs of scaling justifies the extra expected revenue's. Often commercially oriented m-Agri Apps change during this stage their revenue model, from being free to charging fees.
- The sustainability stage: when the m-Agri Apps becomes profitable or at least break even, they are considered to have reached an level of economic sustainability. Growth is still a major focal point, but medium-term sustainability is guaranteed. For commercial initiatives, it means that the business plan is working and only investments are required to maintain up to date and a live.

Similar subdivisions of the m-Agri App lifecycle, using different terminology, are recognized in the evaluation reports of Syngenta (2011) and USAID (2012).

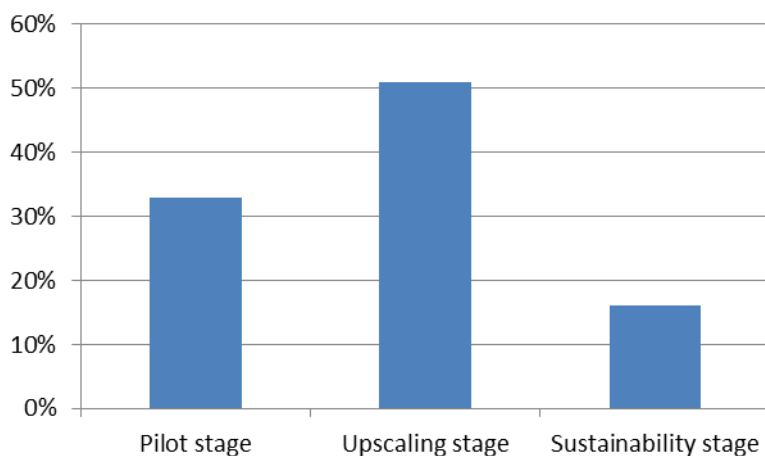


Figure 3.1 Distribution of 92 evaluated mobile applications across three lifecycle stages (World Bank, 2011b).

Despite the focus on commercial business initiatives, start-ups and operational costs are generally covered by donors (both public as private) during the pilot stage. After a successful pilot all m-Agri Apps - commercial and non-commercial - face difficulties in scaling (Hystra, 2011). From the study of World Bank (2011b) it appears that most m-Agri Apps are still in the pilot or the up-scaling stage and only 16 percent managed to reach the level of economic sustainable.

For non-commercial m-Agri Apps the upscaling stage involves a constant evaluation of beneficial provisions to subscribers and whether these provisions justify the expansion costs. Lacking profit motives often implies that non-commercial m-Agri Apps suffer from clear goals. (World Bank, 2011b). Without these profit motives, Non-commercial m-Agri Apps always need financial support from donors to stay alive, and they quickly disappear whenever such support ends (USAID, 2012).

3.1 Revenue models

A self-sustaining business model is often seen as an important precondition of sustainable applications. In case of m-Agri Apps, revenue models exist based on subsidy, fees, consultancy or sponsorship (USAID 2012, see also Table 3). Many of the m-Agri Apps have a diversified revenue stream, obtaining partly resources from subsidies, fees for service, franchise & consulting and/or sponsorship. Population size is important for selecting its revenue model. However, as securing sufficient revenue is still a challenge for most providers of m-Agri Apps, population size does not appear to be the only major determinant (World Bank, 2011b). Evenly relevant factors of self-sustaining potential are the size of the target market, customers' willingness to pay, education level and the focus and usefulness of the services offered. In addition, cost may still be a barrier for smallholder farmers, community knowledge workers and local entrepreneurs. Nevertheless users are increasingly able to afford these mobile services, incorporate them in their work and collect and disseminate information (infoDev, 2012).

Table 3

(Type of revenue models used for m-Agri Apps - USAID, 2012).

Revenue Model	Customer	Business Proposition
Subsidy	International donors, local governments	Public organizations subsidize particular costs to develop public goods
Fee for service	Farmers and farmer cooperatives	End-users pay direct for the access to information and services.
Franchise/Consulting	NGOs, agricultural purchasers, research organisations	Basic technology/platform distributed open-source, consulting services offered for pay
Sponsorship	Agricultural purchasers, input providers, local retailers, research organisations, MNOs	Organizations pay fees for advertising, data collection, increased market access, new mobile subscribers.

3.2 Impact

Theoretically the impact of mobile devices influences decision making across the entire agriculture value chain, regarding topics like; inputs, production, marketing, processing, and distribution – decisions that can potentially lead to greater efficiencies, reduced transaction cost, and increased incomes (infoDev, 2012). However, actually measuring this impact is much more complicated and most proof is anecdotal lacking a systematic evaluation of the impact of m-Agri Apps on livelihood improvements of the small holder (Hystra, 2011).

In literature most describe is the impact of ICT projects on price information and market access. Less strong examples can be found on the impact m-Agri Apps on the efficiency and sustainability of agricultural production or on political empowerment (IICD, 2006).

3.3 Success criteria

All of the interviewee confirmed that developing an economical sustainable application is very difficult. However they also indicated that not all successful m-Agri Apps need to be economical sustainable. For example, an application can be designed to monitor a project or an experiment. The m-Agri App does not need to be continued outside the experiment or project.

According to the interviewees, a commercially successful app should minimally fulfill the following criteria:

- Reaching a certain scale, resulting into a community that guarantees both usage and support.
- Commercially viable, requiring a community of over 150.000 members.

-
- Integrates multiple activities of the agri-supply chain, in order to become more valuable for the user, increase its usage, increase the number of stakeholders interested and finally increases the economic viability.
 - The application being appreciated as such by the users (includes factors like user friendliness, usefulness and willingness to pay).
 - Empowers smallholders to increase their general agricultural performance (both in efficiency and knowledge).
 - Is flexible enough to adapt for changing information demands.

4 Main challenges

The main challenges mentioned in our interviews can be grouped into two main categories:

1. providing the link between available information and smallholders needs and
2. the sustainability of applications.

Smallholders are constrained by the availability, reliability or generality of content; the capacity to act on information; and the lack of connectivity.

4.1 Linking available information to smallholders needs

4.1.1 Content: Smallholders are constrained by the availability, reliability or generality of information

- Information is not always easily to collect from a technical or social perspective. For example price information is often collected by individuals observing bargaining conversations from a distance between traders on markets.
- Not all types of relevant information can be included in an app, e.g. details like quality or freshness of a product.
- The spatial or time resolution not always matches the expectation of local smallholders. Often information is collected for other purposes (policy or research).
- Collecting information is one but sharing another. Especially in developing countries civil servants tend to safeguard information rather than to support access for others.



Figure 4.1 Challenges to link smallholder with information, include Content, Capacity and Connectivity.

4.1.2 Capacity: not all local actors have the capacity to act properly on the information received.

- Farmers are often unaware of the possibilities of a phone, besides phoning to relatives and acquaintances. Intermediaries may play an important role to break these barriers and create more awareness.
- Information may not be trusted. Building on the existing networks of relatives, known traders and local consultants help to overcome this barrier.
- Education level and cultural aspects may restrict the local capacity to interpret and act on information received. People may be illiterate or are limited to speak other languages than local dialects.
- Information may be too rigid or recipe like. Information or an instruction should be applicable whenever a farmer decides to deviate from the recommended practises based on personal motives.

4.1.3 Connectivity:

- In the poorest rural regions of the world, there is still a lack of physical infrastructure and connectivity. Setting up a commercial mobile network in those areas is very cost intensive.
- It can be difficult for m-Agri App initiatives to get a so-called premium short code at low cost. The non-commercial ambitions of NGO's are not easily trusted by governments or mobile network operators.

4.2 Towards a sustainable application

The second category describes the challenges of m-Agri App development towards sustainable exploitation. The interviewees confirmed the conclusions of the World Bank (World Bank, 2011b) that the most challenging phases in m-Agri App Development are the upscaling and sustainability phase.

4.2.1 Upscaling phase: from a technical and content perspective, reaching scale adds complexity.

- A fundamental problem for many initiatives is that they are designed as a pilot and therefore have difficulties to scale up;
- The technical capacity of the design may fail when the scale is increased;
- The importance of marketing and capacity building (training users, marketers, etc.) is often underestimated;
- Diversity in literacy and language implies that customization is necessary and the advantages of scale are difficult to reach.

4.2.2 Sustainability phase: achieving economic sustainability is not as easy as hoped for, as frequently business aspects are not well established.

- Many initiatives are financially supported by donor funding, despite this funding an evolution into an economical sustainable app is hardly ever achieved. A lot of initiatives collapse when donor money ends;
- A minimum service volume of 150.000 users is required for a commercially viable service;
- From a high volume, low margin business perspective it is not easy to make a sustainable business model on agricultural information alone. There needs to be substantial contact with farmers over a long time periods to exchange enough data volume. Therefore a combination of different services (market, weather, etc.) is recommended. However providing several services adds complexity;
- In some communities there is a lack of willingness to pay, especially when services are offered for free during the piloting phase. The willingness to pay for information is often related to the education level and is higher when the return on investment is expected in a relatively short time span.

5 Global community and cooperation

M-Agri Apps currently receive a lot of attention from development stakeholders within the international community. The stakeholders selected are very diverse, but in order to evaluate their responses and relate those to international cooperation, we subdivided them into five distinct groups. Each group having a unique role and position: Donors, NGO's, Research institutes, Private sector and the End-Users. Based on our findings we briefly discuss these 5 groups below, sketching their 'ideal' role in m-Agri App development and some additional observations on their current functioning in the network.

5.1 Stakeholders involved

5.1.1 Donor

- Role: initiates and supports new initiatives, stimulates strategic developments, or allows for bottom up initiatives and strategic developments.
- Currently donors start mainly from their own objectives and motives, but are seeking strategic collaborations to enforce these objectives.

5.1.2 Research institutes

- Role: Providing new content and knowledge to the agri-development sector.
- There is a large gap between knowledge and practical use. For smallholders, extension services and NGO's it is not always easy to get access or to communicate relevant knowledge. On the other hand for the research community it can be difficult to start with the today problems of the smallholder; Perhaps one can think of a role for the media industry, in order to communicate agricultural information better to the smallholder community. Current involvement of the media industry is lacking.

5.1.3 Private sector

- The role of the private sector is twofold:
 - Most companies currently act from corporate responsibility, supporting the development of m-Agri Apps as a Donor.
 - However to develop financially sustainable m-Agri Apps in the future, more involvement of the private sector is necessary from a business perspective. The m-Agri App service in itself can function as a business generator, or m-Agri App may support another business (financial service, agribusiness).
- Currently the mobile operators are the main private stakeholders, developing new m-Agri Apps as part of their rural connectivity strategy;
- Promising is that more and more international businesses are getting interested into smallholders communities as producers, as market, or because of regulations. The growing interest of the large international enterprises in the smallholder farmer communities provides a promising future for the development of financially sustainable m-Agri Apps;
- Despite their lack on domain specific knowledge, the mobile industry holds a prominent position within the m-Agri App development.

5.1.4 NGO

- Role: Setting up and leading development projects; allowing bottom-up developments. Acting as a linking pin between donor organisation and local developers.
- Development is also business, meaning NGO's and developers experience a level of competition instead of collaboration.

5.1.5 End-user

- Role: Their involvement should be central. M-Agri Apps development should be user driven and simultaneously the smallholder community could function as collectors of valuable local information;
- In the global discussion end users are not enough involved. As a result there is insufficient knowledge at a global level about the information demand and impact among smallholders.

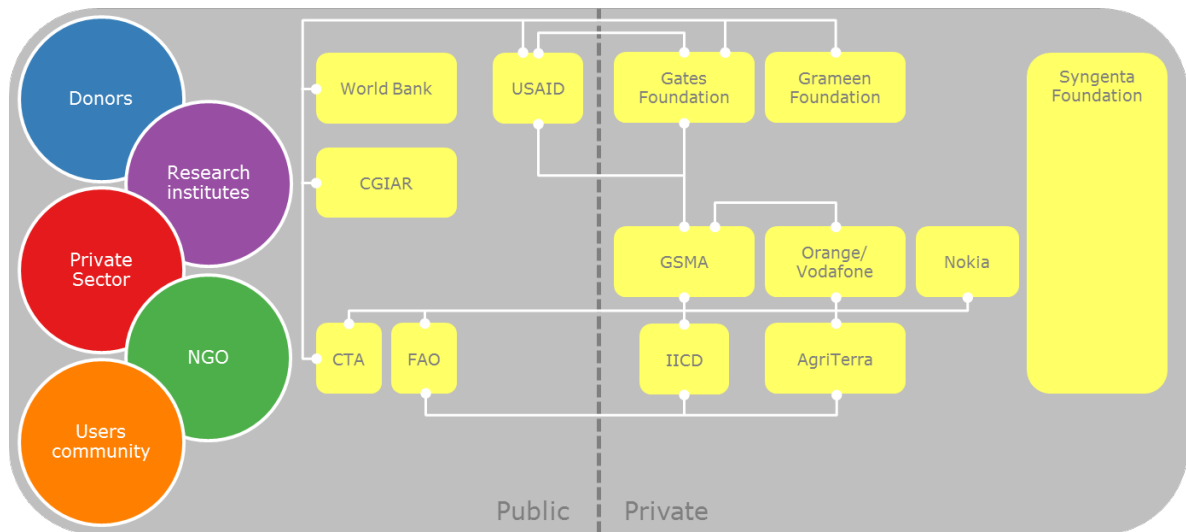


Figure 5.1 Perceived perception of International cooperation from interview results, clustered along the five different stakeholder groups.

5.2 Donor driven cooperation

During our interviews we discussed the global cooperation between parties. We presented our impression of this cooperation in Figure 5.1. The white lines between the different actors express connections explicitly mentioned during the interviews. In general this scene description of global cooperation as presented in this report is a sketch based on a limited number of interviews and does not pretend to be complete. Additional to that this scene appearance may soon be outdated as international enterprises show more and more interest in smallholder communities for their production, as a market, or due to trade regulations.

From our interviews it appears cooperation between the actors seems to be somewhat ad hoc and fragmented, donor-driven (Hystra, 2011) and the involvement of the end-user in the global discussion is rather limited. Collaboration is pointed 'vertical', between different stakeholder groups, and less 'horizontal' among stakeholders within the same group. Especially on the lower levels, within the private domain, stakeholders experience mutual competition.

With the platform e-Agriculture, the FAO steps over this competition and aims to stimulate experience sharing among NGO's and other development workers. Simultaneously, CTA also tries to stimulate experience sharing with a new initiative called ICT4Ag. But CTA aims at the entire global community, besides development workers, around the entire ICT4Ag topic.

Another remarkable cooperation is between Bill & Melinda Gates Foundation, USAID and GSMA in which private mobile operators and public and private funders join forces. In general all donors collaborate in different programs and constellations. Except for the Syngenta foundation, who appears to have a more independent approach as they both finance (together with Seco) and execute their own program.

6 Picking up the challenge

Smallholders operate in a highly diverse environment from a biophysical, agronomic and socio-economic point of view. They often own highly diversified farms, with a priority on their own food production and livelihoods. They only sell some of their products in often informal systems on agricultural markets. Cultural differences, including local languages, low literacy and origins, play an important role. Biophysically smallholders operate in diverse environments, with problems like soil fertility or insufficient use of inputs.

Despite the constraints m-Agri Apps technology seems very promising to distribute information to smallholder farmers in developing regions, and it is currently not reaching its glance:

- **m-Agri Apps have a lot of potential** to bridge the last mile to the farmer, to reach a large group of people at relatively low cost and for rural people to communicate with the outside world to find relevant information or trade.
- Most effect can be obtained by **improving communication efficiencies** within the agro supply chain.
- At the moment there is **little factual evidence of improved livelihoods** among smallholders or food security due to m-Agri Apps. Most of the evidence is anecdotic or theoretic. However, in the case of market information systems, price stabilisation and increasing incomes have been observed after the introducing m-Agri Apps.
- There is **no blue print available for m-Agri App development**, but they need to be developed tailor-made and bottom-up. Agriculture is complex and location specific. The way agriculture is performed varies regionally due to physical conditions and cultural aspects. In addition the way information needs to be communicated depends again on cultural aspects but also on the level of education. This differs from other sectors like the health sector where many procedures are standardized and a certain level of education can be expected. Because the agri sector is so diverse the m-Agri Apps development will benefit from an open source approach, allowing software parts to be reused and adopted to the regional diversity.
- **Financial sustainability may not always be the right focus.** To reach a financially independent app, the following success factors need to be achieved: 1) The potential market volume needs to be large enough, which sometimes contradicts the size of certain smallholders communities with similar cultural and product characteristics; 2) Multiple services need to be bundled to diversify the user group, increase the number of contact moments, to create new information by linking different data streams and to interest different commercial parties to invest.
- Collected information for monitoring, policy or research information is **too general or course to be useful**. The information is often not detailed or specific enough for smallholders and is rather nice-to-have, instead of need-to-have for farm managing.
- Currently **m-Agri App development is donor driven**. It is timely to encourage other (commercial) parties to enlarge their involvement in the next stages of development. There is a large potential in the increasing interest of the international private sector in smallholders for both production as market.
- **In the international community there is an urge to collaborate more.** All interviewees are willing to join a round table conference. There is a communication lack between actors preventing the exchange of good practices, develop joint practices, and collaborative investments in possibilities like open source applications or specific content. There is potential for enhancing international collaboration and community building.

In our view, action is needed at two levels: 1) the level of individual projects and their implementation; 2) and at a programmatic level across the different initiatives. Such a program can best be rooted in the international community, where each actor should re-enforce the collaborative effort from its own interests and needs.

6.1 Recommendations for project level

- M-Agri Apps should be developed from a technical perspective on **open source software, supported by an ICT community**. In this way a single technical base for the development of m-Agri Apps is maintained and exchange of software and ideas between projects is easier. The software should be adaptive to user's needs since there is no single solution to the problem.
- Scale can only be reached when the development is **embedded in existing rural networks and communities in developing countries**.
- Initiatives for mobile applications should be **designed as a bottom-up process** using a user centred design, matching the farmer community needs with information available in the appropriate way. Local ownership of the project is a key to success.
- **Early involvement of multiple stakeholders groups** from the agri value chain is necessary to obtain commitment and could potentially even lead to a reduction in operational costs.
- The technique **should match human capabilities and intuition** (oral culture, literacy level).
- **Sustainable business plan** should be the starting point for project design. This should be implemented in technical aspects, marketing aspects and capacity building aspects.
- The business plan should be based on multiple sources to derive enough income and to spread risks.
- **But start simple and focussed**. It is better to add new services to an existing trusted application than to set-up a complex services at once.

The recommendations are based on the interviews and do not pretend to be exhaustive. Additional recommendations can be found in the literature of the World Bank, USAID and IICD.

6.2 Recommendations at program level

There is a need for:

6.2.1 Investing in the 3C's

- Content
 - **Good content**. Agriculture is complex and divers. There is a need for good practical localized agricultural knowledge.
 - **Access to information (open data)**. A lot of information is being collected by research and by governments. There is a need to make this information accessible. Not all data collectors are aware of the need to share their information. The open data formats is a logical way of sharing information.
- Capacity
 - **Facilitate learning communities (N-S, S-S and S-N)**. (incubator labs, hacketons may help to slay barriers between different actors and to encourage creativity).
- Connectivity
 - **Extent Connectivity**. Although the mobile network has expended enormously over the past decade, the connectivity of the poorest groups is still limited.
 - **Open source software**. Although m-Agri App development cannot be blueprinted, the technique of different services can a shared and maintained in an open community making the development more efficient in lowering costs.
 - **Securing the lifetime of an m-Agri App**. The road to sustainability is still under development, for some apps or locations financial sustainability should not be the main goal.

6.2.2 Research

- **Evaluating good m-Agri App practices**. There is still a need to identify good practises. This should go beyond a descriptive report, but touching elements like, what made it good, usage, influence of local environment, technical assessment.
- **Explore the possibilities to evaluate megatrends** with data gained at farm level (e.g. food prices development or food security risks).

6.2.3 Community building

- In general all questioned stakeholders shared the opinion that there is a need for **more global cooperation, convergence and coordination** in the m-Agri App development.
- **Encourage the involvement of Agri private sector.** The growing interest of the large international enterprises provides a future for financially sustainable m-Agri Apps.

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