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## **Dial ‘N’ for Nutrition? A Landscape Analysis of What We Know About m-Nutrition, m-Agriculture and m-Development**

Inka Barnett, Nigel Scott, Simon Batchelor and Lawrence Haddad  
November 2016



The title of this IDS Working Paper is inspired by Jenny Aker's 2011 paper entitled *Dial A for Agriculture: A Review of Information and Communication Technologies for Agricultural Extension in Developing Countries*, Boston MA: Fletcher School, Tufts University.

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# Dial 'N' for Nutrition? A Landscape Analysis of What We Know About m-Nutrition, m-Agriculture and m-Development

Authors: Inka Barnett, Nigel Scott, Simon Batchelor and Lawrence Haddad

## Summary

Child undernutrition is one of the most devastating realities in many parts of the world. Globally in 2015, 159 million children below the age of five years were too short for their age (stunted) and 50 million were too thin for their height (wasted).

Behaviour change is central to the effectiveness of many interventions that aim to address child undernutrition. Promotion of exclusive breastfeeding and good complementary feeding practices are two behaviour change interventions that have been shown to be effective in the efforts to tackle child undernutrition.

Agriculture is the sector with the most studies on the effectiveness of nutrition-sensitive interventions. For agriculture to become more nutrition sensitive, choices will need to be made about who controls resources, which crops and animals are farmed, the types of storage and processing patterns adopted, and the metrics used to assess interventions. All of these changes are embedded in long cultural traditions and are not necessarily straightforward to change.

Mobile phone technology has the potential to initiate behaviour change and facilitate the long-term maintenance of new behaviours. A number of m-agri and m-health interventions exist, and m-nutrition interventions are increasingly being developed. The number of high-quality studies that look at whether mobile technology interventions help behaviour change is small, but is likely to increase quite rapidly with rising mobile penetration rates and declining costs.

The purpose of this review is to assist would-be implementers and evaluators to understand the landscape they are operating in, so they can design nutrition and agriculture interventions that stand the greatest chance of working, and evaluation designs that stand the greatest chance of finding answers rigorously.

The review summarises what we know about behaviour change in nutrition (Section 2) and reviews evidence on the role of mobile phone technology in nutrition-related behaviour change (Section 3). Sections 4 and 5 repeat this for agriculture. Section 6 surveys the wider mobile technology and m-development landscape. Section 7 draws conclusions for impact assessment of m-nutrition programmes.

**Keywords:** Mobile phones, m-health, m-agriculture, behaviour change, nutrition.

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# Acronyms and abbreviations

ACRE	Agriculture and Climate Risk Enterprise
ARPU	average revenue per user
B2B	business-to-business
B2C	business-to-customer
BOP	bottom of the pyramid
DFID	Department for International Development
DRC	Democratic Republic of Congo
FAO	Food and Agriculture Organization
FTC	Farmers' Text Centre
GDP	gross domestic product
GNI	gross national income
GSM	global system for mobile communications
GSMA	Groupe Speciale Mobile Association
ICT	information and communication technology
IFFCO	Indian Farmer Fertilizer Cooperative
ITU	International Telecommunication Union
IVR	interactive voice response
KACE	Kenya Agricultural Commodity Exchange
LMIC	low- and middle-income country
MNO	mobile network operator
MVNO	mobile virtual network operator
NAADS	National Agricultural Advisory Services (Uganda)
NGO	non-governmental organisation
OTT	over-the-top
RCT	randomised controlled trial
RML	Reuters Market Light
UN	United Nations
USAID	United States Agency for International Development

# 1 Introduction

Child undernutrition is one of the most devastating realities in many parts of the world. Globally in 2015, 159 million children below the age of five years were too short for their age (stunted) and 50 million were too thin for their height (wasted) (IFPRI 2016). Inadequate nutrition in early childhood can have lifelong consequences, including poor physical and psychological health, and low educational attainment and employment opportunities (Alderman 2006; Hodinott *et al.* 2013; Victora *et al.* 2008).

Behaviour change of child carers is central to the effectiveness of many interventions addressing child undernutrition (see Bhutta *et al.* 2013; Ruel and Alderman 2013). For example, early and exclusive breastfeeding and the complementary feeding of infants between six and 23 months requires changes in feeding, caring and playing with children, as well as changes in the types and frequency of foods consumed and their preparation.

Agriculture is probably the sector with the most studies on the effectiveness of nutrition-sensitive interventions. For agriculture to become more nutrition sensitive, choices will need to be made about who controls resources, which crops and animals are farmed, the types of storage and processing patterns adopted, and the metrics used to assess interventions. All of these changes are embedded in long cultural traditions and are not necessarily straightforward to change.

If behaviour change is difficult, can the rapid rise of mobile technology help? A number of m-agri and m-health interventions exist, and m-nutrition interventions are increasingly being developed. The number of high-quality studies that look at whether mobile technology interventions help behaviour change is small, but is likely to increase quite rapidly with rising mobile penetration rates and declining costs.

The purpose of this paper is to assist would-be implementers and evaluators to understand the landscape they are operating in, so they can design nutrition and agriculture interventions that stand the greatest chance of working, and evaluation designs that stand the greatest chance of finding answers rigorously.<sup>1</sup>

First, the paper summarises what we know about behaviour change in nutrition (Section 2) and reviews evidence on the role of mobile (cellular) phone technology in nutrition-related behaviour change (Section 3). Sections 4 and 5 repeat this for agriculture. Section 6 surveys the wider mobile technology and m-development landscape. Section 7 draws conclusions for impact assessment of m-nutrition programmes.

It is a landscape rather than a systematic review for two reasons: there is too much behaviour change literature to synthesise in one systematic review and too little formal literature in the m-nutrition area to constitute a systematic review. We have been judicious and less comprehensive in our selection of evidence on behaviour change, but more inclusive on the types of evidence drawn on in relation to the facilitating role mobile technology plays.

To capture a wide range of evidence, using a purposive, iterative approach we searched a number of electronic databases: MEDLINE, SCOPUS, Web of Science and Google Scholar. Given the scarcity of published evidence on mobile phone-based health and nutrition behaviour change interventions, we also extensively searched grey literature sources. These

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1 This paper was produced during the inception phase of a three-year research programme to evaluate the impact of an m-nutrition intervention directed towards mothers and community health workers in Tanzania and mothers and farmers in Ghana.

included Google, online databases on m-health (e.g. mHealth Evidence (USAID 2011)) and Global mHealth Initiative (Johns Hopkins University 2014), and websites of UN bodies (e.g. UNICEF, WFP, World Bank).

We complemented this with citation and reference searches of the retrieved studies. We only considered studies from low- and middle-income countries (LMICs) that were written in English and published between January 2000 and January 2015. When considering the mobile landscape, the review focused on webpages that discussed existing and forthcoming changes in telecoms.

## 2 Nutrition behaviour change in low- and middle-income countries: what do we know?

Human behaviour, including nutrition behaviour, is complex, multifactorial and based on many interrelated determinants (Glanz and Rimer 2008). For example, motivational, social and environmental forces guide a mother’s decision to change her child-feeding practices, usually not cognition alone (Aboud and Singla 2012; Atkins and Michie 2013). Some of those forces may be beyond the mother’s control (e.g. availability of fresh fruits at the local market to provide a nutritious complementary diet). Automatically performed habits and traditionally and socially approved norms also influence behaviours and changes in behaviours (Aboud and Singla 2012). Consequently, changing behaviour is difficult and often time consuming, especially if the aim is to achieve maintained behaviour change.

### 2.1 Theories and techniques

Over the last three decades several theoretical frameworks have been developed to explain behaviour change and its predictors, and to inform the development of more effective behaviour change interventions (Michie *et al.* 2008). Behaviour change research has shown that interventions based on theory are more effective than interventions that were developed without theoretical frameworks (Glanz and Rimer 2008).

Table 2.1 presents the most commonly used behaviour change theories that have guided the design and delivery of nutrition behaviour change interventions in high- and low-income countries (Riley *et al.* 2011).

**Table 2.1 Common health behaviour change theories**

Theory	Core principles	Application	Disadvantages
1. Health Belief Model (Rosenstock 2014)	Focuses on attitudes and beliefs about behaviour. Based on four concepts: perceived susceptibility to the consequences of poor behaviour; perceived severity of these consequences (i.e. perceived threat); perceived benefits of the suggested behaviour change to address the consequences; and perceived psychological barriers to the change. Individuals change their behaviour only if they feel that the benefits of the change outweigh the barriers/costs of adopting the new behaviour. Individuals’ perceived self-efficacy to change behaviour is an addition to the model.	Preventive health behaviour change interventions and health promotion (e.g. breastfeeding promotion) Disease management behaviours.	Based on assumption that individuals’ beliefs and attitudes alone determine their behaviours. Disregards complex system of cognitive and non-cognitive facilitators and inhibitors to behaviour change (e.g. environment, economic factors, social norms, habits, emotions).

(Cont’d).

**Table 2.1 (Cont'd).**

<b>Theory</b>	<b>Core principles</b>	<b>Application</b>	<b>Disadvantages</b>
2. Transtheoretical (Stages of Change Model) (Prochaska <i>et al.</i> 2008)	Focuses on individuals' decision making and intentional change. Change is slow, with six separate stages. At each stage, individuals use cognitive, affective, and evaluative decision-making processes.	Tailored health behaviour change interventions (e.g. dietary changes).	Does not consider social context and its influence on individuals. Assumes individuals make logical decisions at each stage. Needs to address each stage separately to be most effective.
3. Theory of Reasoned Action/Planned Behaviour) (Ajzen and Fishbein 1980)	Predictor of behaviour is intention (cognitive readiness) to perform it. Intention is determined by individuals' attitudes towards the behaviour, subjective norms (i.e. social pressure and desire to comply), and perceived behavioural control.	Preventive health behaviour interventions and evaluation studies (e.g. promoting hand washing).	Does not consider environmental, economic, emotional or habitual determinants of intentions and behaviours. Assumes behaviour is the result of a linear process and does not consider changes over time. Link between intention and behavioural action not specified.
4. Diffusion of Innovation Theory (Rogers 2003)	Focuses on patterns of adoption of new behaviours in a social system. Distinguishes between five adopter types, from early adopters (innovators) to late adopters (laggards); and five central factors that determine adoption or rejection (perceived complexity, compatibility, observability, trialability and relative advantage).	Public health behaviour change interventions.	Does not consider individual resources or social support for behaviour change.
5. Social Cognitive Theory (Bandura 1989)	Focuses on the dynamic and reciprocal interaction between individuals (with past experiences), environments and behaviours.	Health promotion interventions.	Does not consider individuals' motivations or emotions as predictors of behaviour.
6. Socio-ecological model (McLeroy <i>et al.</i> 1988)	Focuses on multiple levels of influence (such as individual, interpersonal, organisational, community, and public policy) and the idea that behaviours both shape and are shaped by the social environment.	Health promotion interventions.	Has not been well-articulated in its use throughout the intervention yet.

Sources: Glanz and Rimer (2008); Shumaker, Ockene and Riekert (2009).

These theories address a multitude of cognitive, interpersonal, social, environmental and cultural factors that may influence individuals' behaviour change. No theory is perfect or manages to capture all possible dimensions of influence on human behaviour. Therefore behavioural scientists recommend drawing on multiple behavioural change theories to capture complexity and levels of behaviour change, and to inform the design and evaluation of behavioural change interventions (Aboud and Singla 2012; Glanz and Rimer 2008). Interventions and programmes aimed at large-scale health and nutrition problems might need to draw on both individually oriented models to select effective techniques and ecological models to address the effect of environments on behaviour change.

Briscoe and Aboud (2012) reviewed common health and nutrition behaviour change techniques in low-income countries. They identified six categories, which are presented in Table 2.2.<sup>2</sup> Each technique has been shown to be effective in triggering behaviour change and supporting long-term maintenance of new behaviours. According to Briscoe and Aboud (2012), all reviewed successful behaviour change interventions employ techniques from at

<sup>2</sup> Abraham and Michie (2008) identified 26 behaviour change techniques for health behaviour changes in high-income countries. However, there is no evidence that the majority of these techniques have been used in low-income countries.

least three different categories, with most interventions incorporating the provision of information as an important component. The use of multiple techniques may influence different psychological processes (e.g. social, behavioural, cognitive) and thereby increase the learning experience and likelihood of take-up and active recall of the new behaviour (Aboud, Shafique and Akhter 2009). We could not identify a successful intervention that used just one behaviour change technique.

**Table 2.2 Most commonly used health behaviour change techniques**

Technique	Features	Participants' engagement level
Provision of information on desired behaviour	Information on the source of nutrition/health problem and instructions on how to improve behaviour (e.g. feed certain foods to the child).	Cognitive
Performance of desired behaviour	Demonstration of correct behaviour in practice to the community (e.g. preparing complementary foods, video).	Behavioural
Problem solving	Identification of context-specific barriers to new behaviour with the community and ways to overcome them.	Cognitive
Social support from the community	Advocacy and support for behaviour throughout the entire community (e.g. peer support, community-based organisations such as churches, religious leaders).	Social
Provision of materials necessary for behaviour	To incentivise participation in the intervention, to provide cues for the behaviour, to give examples to the community (e.g. bed nets, soap).	Sensory
Media	Not just as a channel for delivery of information, but also during personal interaction to discuss behaviour (e.g. pictures, theatre, drama).	Sensory and social (for small-scale media)

Sources: Briscoe and Aboud (2012); Abraham and Michie (2008).

Several studies assessed the linkages between behaviour change theories and techniques used in common interventions aimed at promoting health behaviour change. These studies found that most intervention were either developed without an underlying theoretical framework or that there was a disconnect between the underlying behaviour change theory and the technique/s proposed to change behaviour (Abraham and Michie 2008; Briscoe and Aboud 2012; Glanz and Rimer 2008; Painter *et al.* 2008).

## 2.2 What worked and what did not

Behaviour change is a critical component of the ten core interventions. Perhaps the two interventions that require most change relate to early-life feeding practices. Optimal breastfeeding practices (including early initiation, no prelacteal feeding and exclusive breastfeeding for six months) have been shown to significantly reduce the risk of gastrointestinal and respiratory infections and all-cause mortality, even in poor and unhygienic settings (Debes *et al.* 2013). Adequate complementary feeding practices describe the timely introduction of nutritious, age-appropriate and safe foods for children from six months onwards, in addition to breastfeeding (WHO 2003). Poor complementary feeding behaviours have been associated with poor nutritional outcomes (both stunting and underweight) (Arimond and Ruel 2004; Menon *et al.* 2013) and development delays (due to lack of stimulation during responsive feeding) (Elder *et al.* 2014).

Horton *et al.* (2010) and Aboud and Singla (2012) identified hand washing and promoting other hygiene behaviours as a third highly effective behaviour change intervention in improving child nutrition. Although the *Lancet* review did not include water- and sanitation-related behaviours in the core intervention, they were nevertheless part of the reviewed non-core interventions for improving child nutrition (Bhutta *et al.* 2013). Good hygiene practices,

and in particular regular hand washing, have been shown to significantly reduce the incidence of diarrhoea (40 per cent reduction), respiratory diseases and eye infections among young children (Freeman *et al.* 2014). It has even been suggested that promoting hand washing might be the most cost-effective approach to reduce the global burden of diseases (Cairncross *et al.* 2005).

Behaviour change interventions to improve child nutrition in resource-poor settings have produced mixed results. In the following factors for success and failure of behaviour change interventions for breastfeeding, complementary feeding and hand-washing practices will be discussed.

### **2.2.1 Interventions to change breastfeeding practices**

Several reviews have concluded that a combination of individual-level support and group-level behaviour change counselling was most effective in promoting early initiation and continuous breastfeeding for the first six months of life (Bhutta *et al.* 2013; Elder *et al.* 2014; Haroon *et al.* 2013). Individual-level counselling included one-on-one breastfeeding support and education for mothers during home visits, in health facilities (after delivery) or by telephone. Group counselling comprised group sessions or classes with mothers and often other family members (e.g. mothers-in-law who have been shown to be very influential on childcare practices in many settings) (Haroon *et al.* 2013). Promoting non-interactive breastfeeding (e.g. awareness-raising campaigns in print media, or on television or radio) has had mixed results (Naugle and Hornik 2014; Wakefield, Loken and Hornik 2010).

### **2.2.2 Complementary feeding**

A review by Elder *et al.* (2014) found peer coaching and individual-level guidance significantly improved quantity and quality of complementary foods and feeding behaviours (e.g. responsive feeding). Reviews by Bhutta *et al.* (2013) and Lassi *et al.* (2013) echoed these conclusions and also highlighted that educational interventions were effective in food-secure and -insecure populations. In all successful interventions counselling and education were interactive, tailored to the specific needs of the child and/or the local context, provided face to face by a facilitator in a number of sessions with the mother, and used different behaviour change techniques (e.g. information, performance demonstration and material (e.g. food)) (Fabrizio, van Liere and Pelto 2014; Pachón *et al.* 2014; Penny *et al.* 2005; Roy *et al.* 2005).

Complementary feeding education appear to be particularly effective if they focus on a small number of concise and achievable key messages, using different channels and techniques (Imdad, Yakoob and Bhutta 2011; Lutter *et al.* 2013). In a review on determinants of effective complementary feeding behaviour change interventions, Fabrizio *et al.* (2014), stressed the importance of context-specific interventions that address local barriers and enablers of optimal feeding practices (rather than providing generic behaviour change messages). Aboud and Singla (2012) identified lack of time, inconvenience, limited resources and unsupportive family members as common barriers that prevented mothers from changing behaviours despite awareness and knowledge about optimal practices. Media were sometimes used to increase the outreach of interventions, but usually combined with community-based facilitators (Fabrizio *et al.* 2014; Haroon *et al.* 2013).

### **2.2.3 Interventions to change water- and sanitation-related behaviour**

The largest body of evidence was on the effectiveness of behaviour change interventions aiming to improve hand-washing practices among individuals, households and communities. Results from large-scale interventions to improve hand-washing practices with community-based hygiene promoters were relatively modest (Huda *et al.* 2012), whereas small interventions that used multiple techniques (e.g. information, social support, performance

and provision of soap) were more promising (Briscoe and Aboud 2012; Elder *et al.* 2014; Luby *et al.* 2011).

A review of media interventions to promote behaviour change found that media campaigns (including television, radio and pamphlets) were relatively successful in promoting short-term improvements in hand-washing practices among mothers and children, but less effective in bringing about long-term behaviour change and more comprehensive hygiene skills (Naugle and Hornik 2014). The main challenge for hand-washing interventions was to maintain practices. The reasons were that hand washing was not habitual in most communities and often seen as unnecessary, because germs and other contaminants are invisible to the naked eye (Aboud and Singla 2012).

With regard to hand washing and other hygiene behaviour change interventions, the framing of messages has been shown to significantly influence the effectiveness of messages. Positively and negatively framed messages led to a significant increase in hygiene practices, whereas neutral messages led to increased awareness but hardly any change in behaviours (Biran *et al.* 2009; Cairncross *et al.* 2005; Luby *et al.* 2011).

#### **2.2.4 Other lessons learned from previous health behaviour change interventions**

Three reviews on behavioural change interventions in low-income countries identified several shortcomings of previous interventions that may explain their often only modest impact (Aboud and Singla 2012; Briscoe and Aboud 2012; Dreibelbis *et al.* 2013):

- Limited or no attention to behaviour change theory (many interventions draw on outdated and often too simplistic theory). If behaviour change models were used to develop the intervention, models that only focused on behavioural determinants at an individual level only and did not consider context, environment and inter-personal determinants. They also relied too much on logical models of change and/or initial qualitative formative research that could not capture the whole complexity of underlying determinants of behaviour;
- Limited knowledge and understanding of the target population (including their willingness to change);
- Lack of context-specific approaches that were based on an understanding of current behaviour, its social, environmental, economic and motivational determinants, and potential obstacles to change;
- Lack of learning from the success or failure of previous similar interventions.

Several authors also criticised evaluations of behaviour change interventions that focused only on the outcome of the behaviour change (e.g. lower incidence of diarrhoea and respiratory infections) rather than the targeted behaviour in itself (e.g. hand washing practices) (Dombrowski *et al.* 2012; Michie and Johnston 2012). This focus on outcomes further along the causal line might miss important opportunities to learn from the interventions and could also misinterpret the interventions effectiveness due to other factors that might influence the link between behaviour and outcome (Hardeman *et al.* 2005).

# 3 The potential of mobile phone technology for health-related behaviour change in low-income countries

Mobile phone technology delivers a wide range of m-health and nutrition services in LMICs. A review by Labrique *et al.* (2013) distinguished 12 common applications:

- Behaviour change communication;
- Diagnostics;
- Vital events tracking and registries;
- Data collection and reporting;
- Electronic health records;
- Decision support for providers;
- Provider-to-provider communication;
- Provider work planning;
- Provider training;
- Human resource management;
- Supply chain management; and
- Financial transactions.

Mobile phones offer new channels to increase participants' knowledge and awareness about child nutrition, and thus may help to modify attitudes and support initiation and maintenance of behaviour change (Hall *et al.* 2014). The ubiquity of mobile phones makes it possible to reach and contact target audiences for behaviour change interventions at all times and in a cost-effective manner. Contactability often poses a challenge for 'traditional' behaviour change interventions, especially in geographically spread-out populations (Hall *et al.* 2014).

Repeated contact and exposure to behaviour change messages may reinforce content and increase the effectiveness of the intervention (Labrique *et al.* 2013). Another potential strength of mobile phone-based behaviour change may be that participants often perceive the anonymous provision of information as less stigmatising than face-to-face counselling (Fielden 2011). Child undernutrition can be a very sensitive issue for mothers (because it is often perceived as a sign of poor mothering). Mobile phone-based nutrition information may therefore be a preferred channel for advice and support.

While mobile phone-based behaviour change interventions predominately target individuals and their households, it has been speculated that the provision of information may also trigger an increase in community-driven demands for better nutrition and healthcare services, leading to community-wide improvements (Labrique *et al.* 2013).

## 3.1 Evidence on mobile phone-based nutrition behaviour change

The search identified a large evidence base (including several high-quality randomised controlled trials (RCTs) and systematic reviews) on the efficacy of mobile phone-based interventions to improve health behaviours. Mobile phones helped disease self-management and treatment compliance, especially the treatment of tuberculosis (Nglazi *et al.* 2013) and HIV/AIDS (Finitis *et al.* 2014; Horvath *et al.* 2012; Huang *et al.* 2013; Lester *et al.* 2010; Pellowski and Kalichman 2012), and non-communicable diseases such as Type 2 diabetes (Ramachandran *et al.* 2013; Rotheram-Borus *et al.* 2012). Mobile phones were also successfully used to change high-risk health behaviours such as smoking (mainly in high-income countries) (Fjeldsoe *et al.* 2009; Free *et al.* 2013; Whittaker *et al.* 2009) and unsafe sexual practices (Cole-Lewis and Kershaw 2010; Gurman *et al.* 2012; Hall *et al.* 2014).



Far fewer studies were found on the use of mobile phones to improve infant and child feeding practices (n=9) and hygiene behaviours (n=1) (see Table 3.1 for a summary of the studies and Annexe B for further details). Six studies set out to change behaviours and practices, whereas the remaining four aimed to increase knowledge on child health and feeding. The majority of studies reported findings from formative evaluations (n=5); three were RCTs and two pre/post designs. All but one study were published after 2010, and five were published in 2014, suggesting a rapidly growing interest in the application of mobile phone technology for nutrition-related behaviour change interventions in LMICs. Five studies were located in Africa and five in Asia.

All mobile phone interventions used text messaging (SMS), with five studies also offering voice messages as an alternative option for illiterate participants. However, far fewer voice messages than SMS messages were sent to participants due to the higher set-up costs for voice. One study provided different options for the delivery of the messages depending on participants' literacy levels and familiarity with information and communication technology (ICT).

Most of the interventions reviewed sent information to participants. Interactive, two-way approaches were possible in five interventions, though the extent of the interaction was limited (e.g. weekly interactive quizzes; being able to contact a call centre with specific questions). Ongoing interaction (e.g. confirmation of receipt of messages or that certain behaviours had been completed) was not part of any intervention.

None of the studies reported any theoretical basis that guided the intervention design and most studies used only one behaviour change technique (i.e. providing information). Three studies each used two or three techniques. Behaviour change messages were tailored to participants' baseline characteristics in only three studies, and messages were generic and non-specific in the other interventions. No intervention adjusted or adapted the message content to changes in the contextual factors of the participants.

Methodological rigour was weak in most studies (n=8), with very little detail provided about the intervention, participant selection and outcome measure. The two remaining studies were of medium quality and provided more details about the study methodology used.

### **3.2 Effectiveness of mobile phone technology for nutrition behaviour change**

Only two studies assessed the effectiveness of mobile phones in triggering and maintaining changes in infant feeding or hygiene behaviour (Jing *et al.* 2014 and Flax *et al.* 2014, both RCTs). Both interventions employed other behaviour change techniques in addition to the provision of educational SMS messages, one used social and media support and the other only social support in addition to SMS. Interactive two-way communication was an important part of the interventions and actively encouraged. Both interventions were effective in increasing the odds of exclusive breastfeeding for six months (although in one study the relative number of women who exclusively breastfeed was still only 15 per cent). Complementary feeding practices (targeted in only one of the studies) did not change in response to the interventions, although women reported an increase in their awareness of optimal feeding practices.

None of the other studies attempted to measure changes in behaviours, but several reported anecdotal changes (based on qualitative interviews with very few participants) or assessed changes in knowledge.

**Table 3.1 M-nutrition behaviour change interventions identified**

Author	Country	Purpose	Design	Participants	Behaviour change theory and technique	Technology	Findings	Comments
Jing <i>et al.</i> (2014)	China	Improve breastfeeding and complementary feeding practices	RCT	n=582	No theory Provision of information, social support	Weekly SMS tailored to baseline characteristics Interactive SMS communication	Higher odds of exclusive breastfeeding practices No change in complementary feeding practices	Environmental and social contextual factors conflicted with recommendations Importance of tailored messages
Flax <i>et al.</i> (2014)	Nigeria	Improve breastfeeding practices	RCT	n=390	No theory Provision of information, social support, media	Weekly SMS or voice message to groups (combined with drama and songs based on messages, monthly meetings)	Higher odds of exclusive breastfeeding and early initiation	Importance of different behaviour change techniques and delivery channels
Datta <i>et al.</i> (2014)	Tamil Nadu, India	Increase knowledge about child health and nutrition	Pre/post	n=120	No theory Provision of information	Daily SMS with generic content	Increased knowledge about breastfeeding and complementary feeding No assessment of behaviour change	Illiterate women could not access messages Generic messages not seen as relevant Action in response to message was often unclear
Jareethun <i>et al.</i> (2008)	Thailand	Promote healthy pregnancy and increase breastfeeding knowledge	RCT	n=68	No theory Provision of information, social support	SMS twice a week (combined with routine care)	Increased confidence and satisfaction with pregnancy and postnatal care No assessment of behaviour change	SMS in addition to routine face-to-face care
Datamattion Foundation (2013)	Uttar Pradesh, India	Increase knowledge about child health and nutrition	Formative evaluation	N/A	No theory Provision of information, social support	SMS twice a week, tailored to baseline characteristics	Authors claimed women's knowledge increased (no details on how assessed)	Involvement of families of women can help to ensure uptake
Crawford <i>et al.</i> (2014)	Malawi	Increase knowledge about child health and nutrition	Pre/post	N/A	No theory Provision of information	SMS (several each week) or voice message (weekly) or retrieved voice message (weekly) Call centre with expert advice	75% participants claimed they learned 'something new' Some reported they intended to change behaviour	Women often had no access to a phone/husbands used phone Illiterate women preferred voice messages (but most costly to set up)
Rajan <i>et al.</i> (2013)	Bangladesh	Promote healthy pregnancy and increase knowledge, and improve child health and nutrition practices	Formative evaluation	n~250	No theory Provision of information	SMS or voice messages twice a week Call centre with expert advice (June 2013)	Overall satisfaction with service Some participants claimed behaviour changed in response to message (no further details)	Participants would have preferred more interactive services (e.g. for clarification, to ask specific questions) Messages too generic, content already known Lack of trust in messages only (with no physical staff in the field) Women sometimes had no access to phone

**Table 3.1 (Cont'd)**

Author	Country	Purpose	Design	Participants	Behaviour change theory and technique	Technology	Findings	Comments
MAMA South Africa (2014)	South Africa	Promote healthy pregnancy and increase knowledge, and improve child health and nutrition practices	Formative evaluation	n~200	No theory Provision of information	SMS or voice messages (weekly) USSD (weekly interactive quiz) Mxit (daily messages within web community)	Satisfaction with service (no details about impact on behaviour)	Delivery channel of messages tailored to participants' literacy/familiarity with ICT
Grameen Foundation (2011)	Ghana	Promote healthy pregnancy and increase knowledge, and improve child health and nutrition practices	Formative evaluation	N/A	No theory Provision of information, social support, media	SMS or voice message tailored to women's baseline characteristics	42% of women who listened to/read first message also listened to/read message; 36% third message No details on behaviour change	Illiterate women preferred voice messages Tailored messages were important Importance of involving fathers and other family members
Jalameso <i>et al.</i> (2013)	Uganda	Improve water, sanitation and hygiene practices	Formative evaluation	N/A	No theory Provision of information, social support, media	Weekly SMS with interactive quiz	Authors claimed participants changed behaviour (no further details)	Importance of using different behaviour change techniques and channels to increase uptake Participants liked interactive quiz
N/A = not available.								

### 3.3 Lessons from the studies

In several interventions social and environmental contextual factors interfered with the uptake of the behaviour change messages provided. For example, in one intervention the official maternity leave was only four months and thus made it impossible for women to follow the advice from the SMS messages and exclusively breastfeed for six months. Social factors, such as pressure from peers, husbands and other family members, also often prevented successful uptake of the messages. To address these challenges three studies also included behaviour change messages for fathers and other household members.

Several of the studies reviewed mentioned equity issues with over access to mobile phones, with husbands restricting their wives' access. Consequently, the women could not receive the behaviour change messages on a continuous basis.

Several studies stressed the importance of tailoring messages to participants' specific needs and situations. Participants generally regarded generic messages to be less useful and often ignored them.

In one study, trust in message content emerged as an issue. Participants said that they would trust messages more if intervention staff were physically present more often.

### 3.4 Discussion and conclusion

Interest is growing in the use of mobile phones for nutrition behaviour change interventions in LMICs. But hard evidence is very limited, often based anecdotal findings and methodologically weak. Based on the small number of studies identified, the following features were repeatedly described as important for mobile phone-based interventions to improve child-feeding practices and hygiene behaviours:

- Use of different behaviour change techniques in addition to SMS, context-specific messages tailored to the needs of the target populations;
- Two-way interaction;
- Voice messages for illiterate participants; and
- Taking into account participants' social and environmental contexts (e.g. husbands attitude towards mobile phone-based interventions).

Unsurprisingly, most of these observations and recommendations corroborated the findings from 'traditional' behaviour change interventions (see Section 2).

Most of the reviewed studies did not consider the environmental context of the m-nutrition intervention, and hence the ability of participants to adopt the behaviours, or only considered it to a very limited extent. Interventions that are more deeply embedded in the participants' context may be perceived as more relevant and may therefore be more effective in triggering behaviour change. A systematic review by Briscoe and Aboud (2012) on the role of media in promoting health behaviour change (including hygiene behaviour, bed net use and complementary feeding) in LMICs, found that interventions are most effective if they use a multilevel approach to modify behaviour at different levels of the community in parallel.

Several other health and nutrition behaviour experts echoed this view (Higgs *et al.* 2014; Waisbord 2014). For example, Higgs *et al.* found mobile phone technology to be effective in changing mothers' knowledge about health-care practices; however, they could not address the poor social standing and treatment of mothers in the community that prevented them from applying the newly acquired practices. Similarly, mobile phone messages may raise awareness about optimal complementary feeding practices, but without economic, spatial and cultural access to nutritious food, these practices cannot be put into practice.

Several of the studies reviewed were based on relatively small pilots with several intensive intervention components to encourage behaviour change (e.g. SMS message plus intensive media campaigns and/or social support). It is doubtful whether large-scale roll-out of these intensive interventions would be feasible and/or cost effective.

None of the interventions reviewed drew on behaviour change theory for guidance. Stronger theoretical frameworks might have increased the likelihood of a positive impact significantly. Previous reviews (from high- and low-income countries) found that direct-to-participant mobile phone-based behaviour change interventions often did not draw on behaviour change theory or the existing evidence base, or follow medical recommendations or guidelines (Cowan *et al.* 2013; West *et al.* 2012). Some health behaviour change interventions were even developed without active input from health professionals or academics with health and/or nutrition expertise (Breton *et al.* 2011). This could be a serious challenge, because advice might conflict with national-level health and nutrition recommendations.

In this context Riley *et al.* (2011) point out that many of the common behaviour change models may struggle to capture the dynamic of mobile phone-based nutrition behaviour change intervention sufficiently. For example, it is relatively common that m-health interventions are constantly adjusted and altered throughout the implementation process to enhance the abilities of the mobile phone application. Predominately linear and static health behaviour change models may be unsuitable to address these dynamic and iterative adaption processes and their consequences on behaviour change (*ibid.*).

Despite the lack of hard evidence on the use of mobile phone technology for nutrition behaviour change, evidence from other successful m-health interventions is promising. While mobile phone-based nutrition interventions have a few specific features, overall, they face very similar challenges to 'traditional' behaviour change interventions.

## 4 Agricultural behaviour change in low- and middle-income countries: what do we know?

The primary form of formal behaviour change in farming is through agricultural extension services. Governments originally created agricultural extension systems to disseminate knowledge about agricultural management practices among farming communities.

### 4.1 The evolving nature of agricultural extension

The nature of these services has changed dramatically over the past 20–30 years. Across a number of countries, the quality and availability of services has suffered a huge decline as governments have withdrawn investment (Lowder and Carisma 2011). Although a number of new entrants have emerged, farmers have been left with a somewhat patchy array of potential advisers and without clear access to trustworthy advice. Governments are now beginning to re-engage, and as extension services reshape themselves and learn from past mistakes, professionals have realised that the simple delivery or dissemination of information is no longer enough. Instead, service providers are looking to create new platforms for the co-construction of specific farming knowledge, emphasising local knowledge and farmer-to-farmer learning.

During the 1980s and 1990s agriculture generally declined as an economic priority. Under the influence of economic liberalisation and structural adjustment programmes of the World Bank and IMF, public financing and political support for extension services to rural

communities also declined precipitously. At one time, many developing countries had, on average, one government extension agent for every 300 farmers; today it may be one for every 1,500–3,000. This is well below the FAO recommended ratio of 1:400 (CTA, KIT and IICD 2009).

## 4.2 Increasing plurality of agricultural information sources: opportunities and challenges

Notwithstanding the decline in public extension services, the landscape has simultaneously become more varied. Non-governmental organisations (NGOs), producer groups, farmers' cooperatives and associations, consultants and the private sector have all started to play a stronger role.

In Uganda, 49 per cent of farmers reported having used an agricultural advisory service (Uary 2013). The study ranked the top three types of information as market prices, post-harvest handling and storage practices, and disease management, although these were not disaggregated for the cropping cycle. Farmers benefitted least from fertiliser recommendations and product processing. The most common channels were radio, face-to-face interactions with extension agents, family friends and other farmers. NAADs, NGOs and religious organisations provided extension services. In contrast, a similar survey in Zimbabwe found that the most common advisory services that farmers accessed were 'fertiliser recommendations' (88 per cent), 'seed recommendations' (87 per cent) and 'technical production assistance' (86 per cent). Farmers requested help about 'market prices', product processing and weather information; 2 per cent reported that they got information via SMS and 3 per cent by podcast,<sup>3</sup> but the majority reported face-to-face advice. These figures contrast with 16 per cent who said they relied on friends and family for market prices, and 9 per cent the radio for weather information.

Batchelor *et al.* (2014) suggest this increasingly varied landscape is best viewed through an actor-centric lens. Figure 4.1 shows the range of people they found who might advise a farmer.

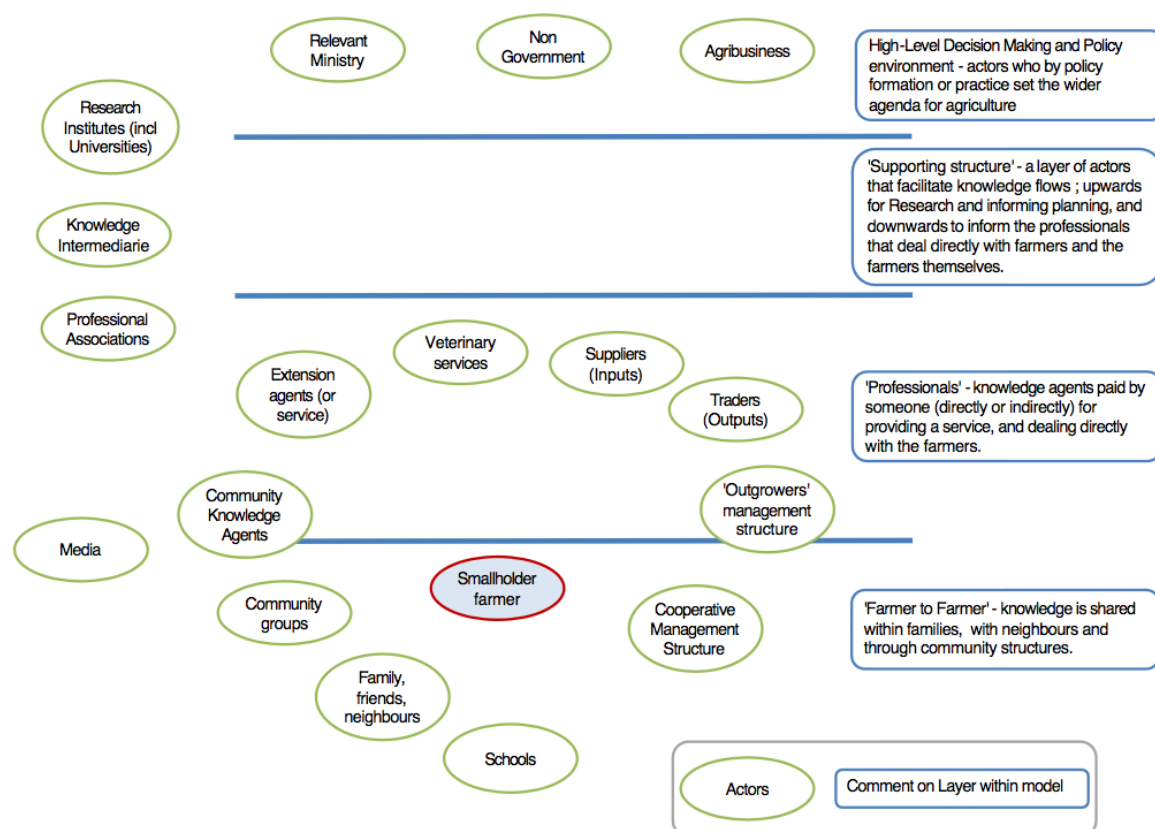
As extension services diversify it is important to ask how farmers might navigate them successfully, because it is not always easy to assess trustworthiness and relevance. In the same way that the poor may have lower levels of literacy due to a lack of formal education, so too they may have lower levels of 'information capability', which can make them particularly vulnerable to aggressive marketing and to being co-opted into commercial relationships without full understanding of the implications.

Modern extension recognises that farmer field schools, farmer-to-farmer extension and other farmer-centric processes are at the core of effective adult learning (Swanson and Rajalahti 2010). It is no longer sufficient for trained agriculturalists to present farmers with a solution to their problems; it is about co-constructing knowledge drawing on the farmers' own experience, as well as the experts' text book knowledge. ICTs could make each of these four activities more cost-efficient and effective for providers, which would mean more intensive support available for farmers.

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3 Definition of podcast: a digital audio file made available on the Internet for downloading to a computer or portable media player, typically available as a series, new instalments of which can be received by subscribers automatically.

**Figure 4.1 Actor-centric lens interpretation of a farmer's advice**



Source: Batchelor *et al.* (2014).

One of the major challenges to finding new ways of providing extension services is farmers' general unwillingness to pay for information. They tend to expect that the costs of an advisory service will be built into a particular value chain, or that other extension services will cross-subsidise them. For these reasons, models where the cost of information is subsumed into the price of a telephone call or other service tend to be more acceptable.

New ICT models need to take into account studies in Africa and Asia that have found that face-to-face communication trumps all other modes (e.g. Lokanathan and Kapugama 2012). Where pricing allows, voice calls are also an important source of information exchange. Indeed, voice calls on mobile phones easily outrank other non-face-to-face means of sourcing information.

An additional challenge is that farmers' information requirements are complex and dynamic. For example, Brigger (2011), explored information needs over an agricultural cycle and found that farmers needed markedly different information at different stages of the cycle.

Agricultural knowledge is peculiar to specific contexts, and it is therefore harder to generalise advice. Although high-input mono-cropping may seem straight forward, most small farmers operate complex ecosystems of mixed cropping. The FAO noted that 'ecology-based knowledge-intensive farming systems... tend to rely on the observation and knowledge of ecosystem services much more than high-external-input systems' (FAO 2012). This clearly influences the potential role and design of mobile-engaged knowledge systems, with scope for interaction and co-construction of knowledge becoming increasingly important.

### 4.3 The challenge in reaching female farmers

Women play an important role in small-scale agriculture but tend to have less access to productive resources than their male equivalents. Policymakers and society at large also frequently overlook their role as unpaid family workers.

Such gender inequality creates a scarcity cycle: fewer resources and less access to resources, advisory services and to markets, leading to less output, leading to less access to resources and so on. Where gender inequity exists, women may also have less access to mobile phones, not only because of economic constraints, but cultural and literacy ones also. With this in mind, advisory services – whether face-to-face or using mobile technology – need to be designed specifically with women in mind. Current data indicates that projects that start with a positive bias towards women are more likely to succeed in redressing social power imbalances (Scott *et al.* 2003).

In the past five years recognition of the need for gender equality within agriculture has increased. Many governments, donors and civil society organisations are committed to improving gender equality, but have usually based their interventions on a generalised understanding of gender issues. Instead, a more nuanced understanding of gender issues in specific activities (such as farming) is often required to ensure that programmes are targeted appropriately and that real progress can be made.

Examples of the commitment to addressing gender inequalities and empowering women in agriculture include:

- The G8 New Alliance for Food Security and Nutrition, building on the 2009 L'Aquila Food Security Initiative, is committed to inclusive and sustained agricultural growth in Africa. Greater visibility of women is a particular focus of interventions.
- In 2009 the World Bank published the Gender in Agriculture Sourcebook, a compendium of key issues on gender and agriculture. In 2013, with support from DFID, the Bank launched the Gender Innovation Lab for Africa to examine what interventions work in addressing gender inequalities in the agriculture sector.
- The FAO dedicated its 2010/11 State of Food and Agriculture report to women in agriculture and closing the gender gap in the sector.
- Gender integration is one of the six focus areas of Feed the Future, the US government's global hunger and food security initiative. This emphasises using gender analysis and impact tools, such as the Women's Empowerment in Agriculture Index (IFPRI 2013), to understand how investments reduce gender-based constraints and improve women's lives.

Beyond donor and government investments, the private sector is also engaged in addressing gender issues in agricultural supply chains by changing how they do business. For example, in 2011 Wal-Mart launched its Global Women's Economic Empowerment Initiative. Among its goals was '[empowering] women on farms and in factories through training, market access, and career opportunities'. Wal-Mart intended to have trained 500,000 women in the agriculture value chain in emerging markets by 2016 (Global Women's Economic Empowerment Initiative 2013).

Not only is including gender equity in agriculture vital in terms of human rights and women's empowerment, it could also have significant effects on agricultural productivity. The FAO's State of Food and Agriculture 2010/11 report said that 'given equivalent access to productive resources as men, women could increase yields on their farms by 20–30%. This could raise total agricultural output in developing countries by as much as 4%, and reduce hunger by as much as 17%' (FAO 2012).



Women's access to and use of mobile phones and ICT also lags behind men's; however, differences are not as great as might be expected. Research published in 2010 by the GSMA and the Cherie Blair Foundation (GSMA and Cherie Blair Foundation 2010) estimated that the greatest differences were to be found in Africa (where women were 23 per cent less likely to have access to mobile phones), the Middle East (24 per cent less likely) and South Asia (37 per cent less likely).

The information channels that female farmers use tend to build on existing social networks. These are often limited, and in comparison to men provide fewer opportunities to learn about new productive and commercial opportunities. Their sources of information include farm visitors, and people they meet at markets or other social spaces (such as church). Given the differences in their social networks and norms, promoting peer-to-peer learning between women presents particular challenges that must be taken into account.

## 5 Mobiles in agriculture: current status

Significant changes are taking place in mobile access, usage and innovation in developing countries, and this has direct relevance for the design of m-agri services. This section gives examples of current services, and looks at where m-agri projects are currently concentrated. The majority of impacts on m-agri services have been in the efficiency of markets rather than increased agronomic or livestock production (with a few encouraging exceptions).

### 5.1 What have we learned from m-agri projects to date?

Table 5.1 shows the range of m-agri services and products. They include information on prices, weather, market conditions, advice on animal health and general extension services.

**Table 5.1 Sample of current m-agri services**

Name	Country	Description
*1677 Farmer Information Superhighway	Thailand	Free SMS information service for market trends, commercial crops, farming techniques, news and weather.
1920 (Govi Sahana Sarana)	Sri Lanka	Crop and technology advice via a toll-free call.
b2bpricenow.com	Philippines	Trading portal that provides price and market information for agriculture (among other industries).
Community Knowledge Worker (CKW)	Uganda	A network of rural community members, who have been trained to use mobiles to access information sources, provide agricultural extension and advisory services (and other types of information) in remote areas.
Dialog Tradenet	Sri Lanka	Delivers spot and forward agricultural commodity price information to mobile phones. Has started to allow trades on their platform for all types of services and goods.
DrumNet	Kenya	Platform to improve cooperation and information sharing between farmers/producers, agro-dealers, buyers and banks.
Dunavant	Zambia	The largest cotton company in Zambia, it is pilot testing the use of e-vouchers that farmers can redeem for cash, merchandise, and other services including school fees.
e-Choupal	India	Provides village internet kiosks for agricultural communities to access information in local languages on the weather, market prices, etc.
Edairy	Sri Lanka	Pilot project began in Dambadeniya district in 2009 for dairy farmers to request veterinarian services via SMS and touch-screen computers.
Esoko	Ghana	Gives farmers access to up-to-date market price information, and serves as a platform for virtual trading internationally.
Farmers' Text Centre (FTC)	Philippines	SMS service providing rice farmers and agricultural extension workers with technical knowledge.

**Table 5.1 (Cont'd).**

Google Trader	Uganda	Part of a suite of SMS-based services from Grameen Foundation's AppLab. Originally a platform for trading agricultural commodities, it has evolved into a marketplace for any products or services.
IFFCO Kisan Sanchar Limited (IKSL)	India	Joint venture formed between Bharti Airtel and IFFCO (Indian Farmer Fertilizer Cooperative Ltd) in 2007. Provides farmers with advisory and market information; subscribers get free daily voice updates and access to helplines.
Infotrade	Uganda	Promotes business and agricultural marketing information.
Jigyasha 7676	Bangladesh	Banglalink (Orascom) helpline provides advice on agriculture, vegetable and fruit farming, poultry, livestock, fisheries.
Kenya Agricultural Commodity Exchange (KACE)	Kenya	Private-sector company providing marketing information and intelligence. SMS and Interactive Voice Response services provide access to daily market prices.
Kilimo Media International (Farmer Voice Radio)	Kenya	A network of community radio stations and extension agencies that uses ICT and radio to share information, resources and new techniques.
Kilimo Salama	Kenya	Mobile platform to register and administer micro-insurance policies (Syngenta Foundation).
Manobi T2M, Senegal	Senegal	Current weather and market price information for the fishing sector.

Source: Qiang *et al.* (2012); GSMA (n.d.).

A number of studies have looked at the potential role for mobile technology in agriculture in developing countries; for example, FAO (Miller *et al.* 2013), USAID (FACET 2012) and the World Bank (Qiang *et al.* 2012). Common principles for success begin to emerge that resonate strongly with the more general findings noted in Section 4.

The FAO study offers the following lessons:

- Keep technology simple: resist the temptation to use state-of-the-art technologies for their own sake. Low-tech or 'appropriate' solutions tend to reduce costs, improve reliability, are easier to source and frequently easier to use.
- Build on existent ICT infrastructure where possible: using common platforms and sharing application development across users can significantly reduce costs. It is also likely to enhance the likelihood of success, supporting a smoother customer transition to new platforms, and reducing risks that the ICT will be too difficult to use or faulty.
- Plan for the future, not the present: planning for sustainability (financial, ecological and social) and scalability of initiatives needs vision and an awareness of multiple interacting factors. Pilot projects frequently fail because this kind of planning has not been done. Planning at the pilot stage should also consider how the project will be financially sustainable, an exit strategy, the legal and regulatory situation, as well as current and potential mobile infrastructure in the area.
- Listen to clients: continuing stakeholder engagement is vital to understanding their needs, habits and risk factors, and maximising their control and ownership over services. Measuring impact is important to ensure that services meet clients' needs.

USAID (2010) offers these lessons:

- Use ICT-enabled services to maximise the potential for sustainability and scalability.
- Plan an exit strategy up front when using grants, subsidies and pilot projects.
- Resist the urge to use excessive technology; use the lowest-cost and simplest technology.
- Look for opportunities to build on ICT already in use.
- Encourage shared application development and operations to reduce costs.
- Consider the legal and regulatory situation of the telecoms sector.
- Measure impact.

In Qiang *et al.* (2012), 92 mobile agriculture applications were studied from Asia, Africa and Latin America with 15 in-depth case studies in Kenya, Sri Lanka and the Philippines.

Their key findings were that:

- Standard mobile phones (non-smartphones) will continue to dominate in rural areas in the medium term;
- Funding was inadequate, especially after the pilot phase;
- Mobile money (or an equivalent) is a pre-requisite for commercial apps;
- The sector is rapidly evolving;
- Government m-apps lack clear objectives; and
- Common platforms would increase efficiency and reduce costs for customers.

Smartphone subscriptions are predicted to triple by 2021 (Middle East and Africa) (Ericsson 2015), which means that penetration, even in rural areas, is likely to be significant.

## 5.2 Mobile phones in agriculture can make a difference

Qiang *et al.* (2012) identified improvements in the efficiency of agricultural activities.

**Table 5.2 Sample of m-agri programmes**

Application	Country	Increased income through access to information/ services	Higher-yield production	Improved efficiency in supply chain	Better access to finance
Virtual City AgriManager	Kenya	9% increase in income for each small-scale farmer through improved measurement and recording of produce weights.	–	Transaction time reduced from 3 minutes to 22 seconds. Cost of delivery reduced by 75%. Fraud minimised.	–
KACE	Kenya	75% of farmers and 60% commodity traders reported increased income.	–	Market integration (linkage efficiency) improved for 2 commodities: maize and beans.	–
Kilimo Salama	Kenya	US\$150 increase in income per smallholder farmer.	50% improvement in production due to insurance on higher-yield inputs.	More efficient value chain, leading to lower retail costs.	In first year, farmers insured 10–20% of inputs, increasing to 50% the following year.
DrumNet	Kenya	Farmers' income increased by 32%.	–	Easier access to agricultural inputs. Suppliers gain economies of scale.	Bank credit worthiness increased due to secure produce supply contracts. Reduced transaction costs.
b2bpricenow.com	Philippines	Total vol. of trade since inception (2000): US\$29.8m	–	Direct access to buyers improves sales.	More efficient payment to members using secure payment layer.
Farmers Texting Centre (FTC)	Philippines	Planting varieties with higher yields.	20% of farmers reported increases in production.	–	–
Tradenet	Sri Lanka	23% premium on produce due to timely market price information.	–	Lower information asymmetry between farmers and brokers.	–
eDairy	Sri Lanka	Additional income of US\$262 per additional calf from timely access to veterinary services.	Milk production increased up to 30%.	Accurate prices at delivery point compared to prices confirmed days after delivery.	–

Source: Qiang *et al.* (2012).

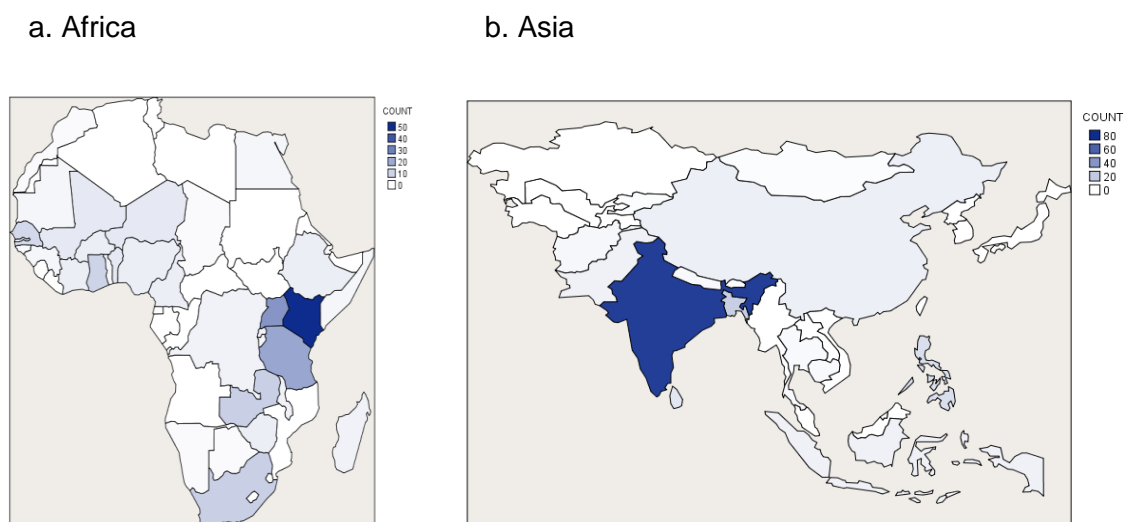
Many of these improvements are in the efficiency of markets, not necessarily in increased production. Exceptions include eDairy (Sri Lanka), where disease and poor livestock health is mitigated; FTC (Philippines), which assists with seed selection; and Kilimo Salama (Kenya), which helps mitigate risk through insurance. Other authors have not attempted to document impact on production, and we are reminded of calls by Heeks (2010) and USAID (2010) for more rigorous measurement of impact.

### 5.3 More detail on the characteristics of m-agri projects in Africa and Asia

#### 5.3.1 m-agri projects are concentrated in Kenya and India

Analysis published in 2012 of 322 m-agri projects across Africa and Asia suggested that projects were concentrated in Kenya and India (see Figures 5.1a and 5.1b).

**Figure 5.1 Geographical distribution of m-agri projects in Africa and Asia**

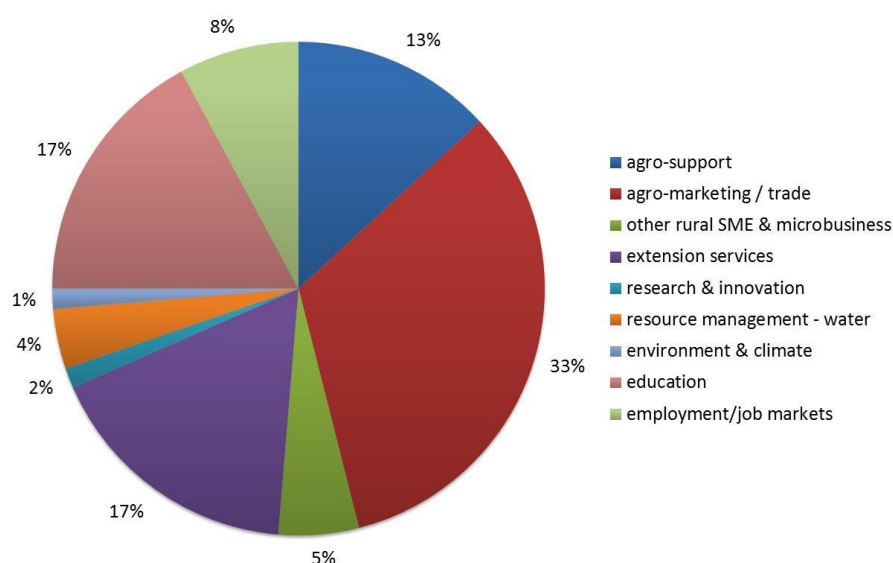


Source: Authors' own, based on data from Qiang *et al.* (2012).

#### 5.3.2 m-agri projects focus on value chain support rather than knowledge co-creation

Small farmers seeking to farm more sustainably need knowledge-intensive support systems. However, our analysis of Qiang *et al.*'s (2012) projects shows that many of the existing services are less concerned with such 'knowledge products', and instead promote value chain transactions. Nearly half of them focus on trade and direct support to the value chain (see Figure 5.2), with knowledge-related services (such as extension and education) accounting for only one-third of projects.

**Figure 5.2 Breakdown of projects by service offering (based on 92 projects)**



Source: Authors' own, based on data from Qiang *et al.* (2012).

### 5.3.3 Emerging typology of services for m-agri projects by service model

The literature wrestles with how to describe emerging ICT opportunities. The analysis of Qiang *et al.* (2012) focuses on the intended development impact and emerging business model. USAID (2010) attempts to categorise emerging ICT-agriculture projects in terms of intended service provision – how the action is designed to improve the agricultural value chain.

**Table 5.3 Analysis of developmental impact**

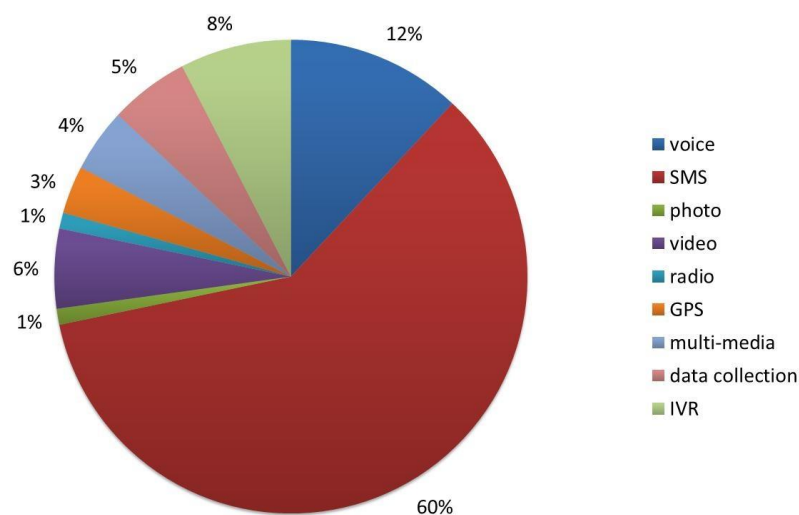
Area of focus	Reason	Examples
Access to market information	To help farmers find out about market prices. This helps them make decisions regarding when to harvest, how to negotiate with intermediaries, and so on. Often combined with other information such as weather forecasts.	Esoko (various countries in sub-Saharan Africa); e-Choupal and Reuters Market Light (India); Manobi (Senegal); Infotrade (Uganda); Zambian National Farmers Union MIS (Zambia).
Distribution and supply chain management and traceability	To increase efficiency and predictability, reduce spoilage, and more. To record movements along the value chain, respond to quality standard requirements, and help large buyers track, manage, pay, and reward small producers.	Application across dairy sector (Kenya); Dunavant Cotton (Zambia); Infosys system for horticulture (India); EJAB Bangladesh; SourceTrace (Costa Rica, Mexico).
Financial services (mobile payments, mobile banking)	To make financial transactions more accessible, faster, and safer, as well as making it easier to save and link to financial services.	M-Pesa (Kenya and Tanzania); Mobile Money (Ghana, Uganda, Zambia); Standard Chartered Bank (South Africa Division: Loan Appraisal, M&E Software); WIZZIT (South Africa).
Farm extension services, access to sector experience, research, and other resource information	Using ICT to deliver better farm extension services (use of best agriculture practices, research, weather, climate and more).	Grameen AppLab Community Knowledge Workers (Uganda); Farmer Voice Radio Project (Kenya); IFFCO/Kassan Sanchar (India); Radio (Mali and many others in Africa).
Commodity exchanges/ warehouse receipt systems	To provide transparency in price discovery and facilitate better prices and efficiencies between buyers and sellers. It avoids moving crops themselves, reducing spoilage, transportation, and transaction costs. Exercises temporal and spatial arbitrage.	Ethiopia Commodity Exchange (ECX); Uganda Commodity Exchange (warehouse receipt system); Zambian Commodity Exchange (ZAMACE); SAFEX (South Africa).

Source: Qiang *et al.* (2012).

### 5.3.4 SMS and voice as preferred modes of communication in m-agri projects

Although a range of technologies are used to provide m-agri services, our analysis found that the majority of initiatives rely on SMS and voice as the primary channels of communication, with very little use of multimedia technologies (Figure 5.3)

**Figure 5.3 Breakdown of projects by principal technology used (based on 92 projects)**



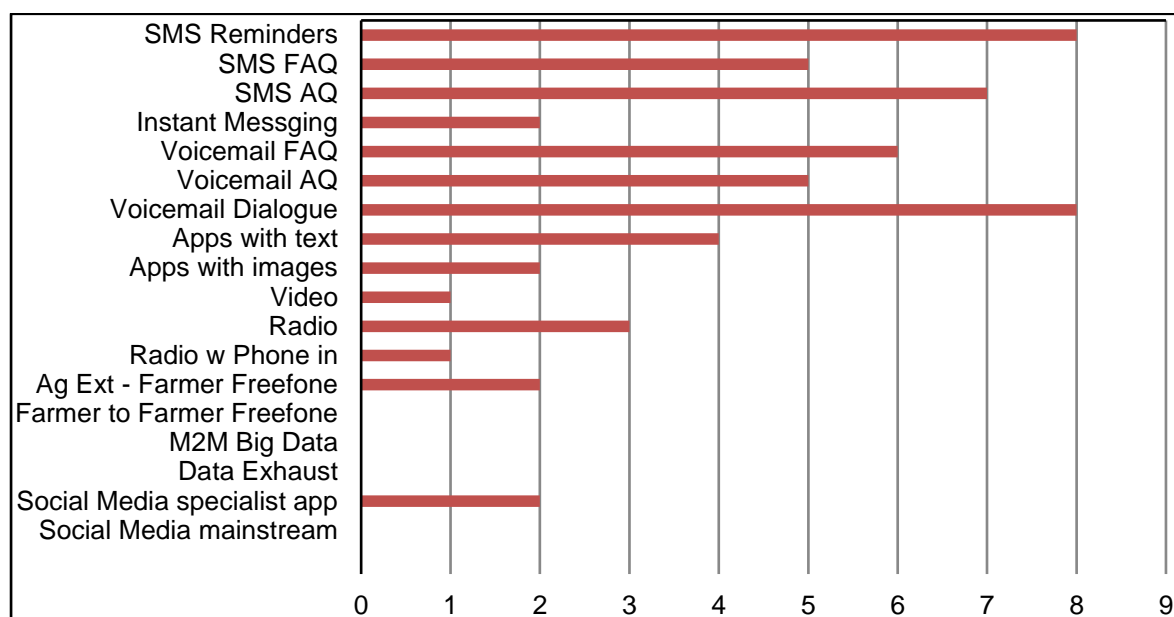
Source: Authors' own, based on data from Qiang *et al.* (2012).

The apparent predominance of SMS in m-agri services is at first glance a little surprising, particularly given the target group's stated preference for voice communications, and high rates of illiteracy in sub-Saharan Africa, and South and West Asia (UNESCO 2012). Yet this seeming dichotomy highlights the role and potential importance of 'communications mediators' (e.g. extension agents and other community-based actors). In many documented examples, illiterate users have asked friends and family to read or write their messages. Elderly parents often ask their children to help them use modern communication services, and the role of professional mediators is also important; for example, the community knowledge workers Grameen uses in m-agri initiatives or the more traditional role of 'letter writers' in India.

For complex information, voice (and interactive voice response (IVR)) tends to be the stated preference. However, the cost of voice calls has limited their use in scaled agricultural support programmes (e.g. helplines). This could change in the near future, however, with the development of alternative models that make voice-based services vastly more affordable. Some newer m-agri services, such as Banglalink Agri23, for example, use voice as a means to communicate information to farmers (one way) and supplement this with the provision of a helpline if users need further explanation, and even help with the co-construction of knowledge (two-way).

In a final analysis of technology used, we took into account that a service might use several channels (this analysis included only a small sub-set of the total projects listed). Few projects, if any seemed to be exploiting cheaper mechanisms for 'SMS' such as Mxit and WhatsApp. However, Figure 5.4 shows that projects in the sub-listing are beginning to use social media and instant messaging.

**Figure 5.4 Agricultural information channels**



Source: Authors' own, based on Chiang (2012).

### 5.3.5 The 'usual' development actors and mobile network operators

An assessment of the principal actors involved in these projects (Table 5.4) suggests that the 'usual' development actors lead the majority of projects, beside telecommunications companies, which tend to operate fairly separately in terms of project design and delivery.

**Table 5.4 Institutions acting as principal partners in m-agri projects**

Players	Assets and capabilities	Roles	Incentives and business model	Limitations, constraints and threats
Technology and ICT service providers				
Private-sector mobile network operators (MNOs)	Mobile infrastructure. Extensive retail outlets/agent networks. Large customer base. Strong branding. Customer trust. Ability to make good margins on low average revenue per user (ARPU)s	Provide infrastructure and communications service. Host applications, databases and/or take app development on board. Provide incentives to app developers and hosts in the form of bulk data discounts, etc.	Acquire customers. Manage churn (customers changing networks). Increase ARPU. Capture additional revenue opportunities. Meet service obligations and corporate social responsibility goals.	Regulatory limitations on providing financial services, (e.g. issuing e-money, on-phone advertising, etc.) Shareholder pressure for faster, higher returns. Strategic focus that may not include some rural applications.
Software/app developers	Creativity/innovation, ideas. Technical skills to develop apps. Knowledge of specific sector or part of society where need exists.	Develop applications. In developing countries, need to seek partnerships with platform developers, handset vendors, MNOs, etc.	Earn revenue from selling apps. Meet community needs/development objectives.	Small scale. Require platforms or partnerships to distribute apps.
Content providers				
Extension workers	Knowledge. Presence in rural areas.	Provide training, advice using apps. Support rural users to learn to use apps.	Improve training, knowledge, skills of rural people.	Lack of technical knowledge about mobile or ICT apps.

(Cont'd).

**Table 5.4 (Cont'd).**

Financiers				
International financial institutions and donors	Financial resources. Best practice expertise.	Provide financing. Provide business development assistance. Technical assistance.	Support development objectives. Creation of profitable businesses.	Lack of local knowledge, legal systems, etc. Lack of integration with commercial communities.
Users				
End-users (farmers, householders, youth women)	Relevant needs.	Use apps to improve their lives.	For example, targets farmers with agri-price information service and consumers with health, entertainment and education. Facilitates scale, cross-subsidisation, advertising.	Lack of awareness. Limited mobile literacy. Cultural and psychological resistance.
Rural produce buyers/food-processing plants	Warehouses. Transfer points to end buyer.	Aggregation points and provide economies of scale.	Lower cost of supply. Increase quality of supply by supporting apps that improve farmers' position.	May be short of funding (but Kenya and Sri Lanka examples showed buyers willing to invest in improved quality and efficiency).
Product companies with interest in the rural market	Financial resources to spend on marketing and research.	Participants.	Broaden customer reach. Reduce customer acquisition costs.	Strategic focus may not include using research and development-oriented apps.

Source: Authors' own, based on Qiang *et al.* (2012).

## 6 The changing mobile technology landscape

This section describes the changing mobile technology landscape with an emphasis on emerging technology, new combinations of stakeholders, and evolving business models. All of these will be important to an evaluation of the feasibility of m-nutrition business models.

### 6.1 Handheld computers

#### 6.1.1 Smartphones

Advancing technology is giving poor people access to more computing power. Basic phone handsets have largely been replaced with feature phones, which have colour screens and run Java software, as well as playing audio and taking photos. Now smartphones are replacing feature phones – global sales of smartphones overtook sales of feature phones in 2013<sup>4</sup> and smartphone subscriptions in Middle East and Africa are predicted to triple by 2015 (Ericsson 2015).

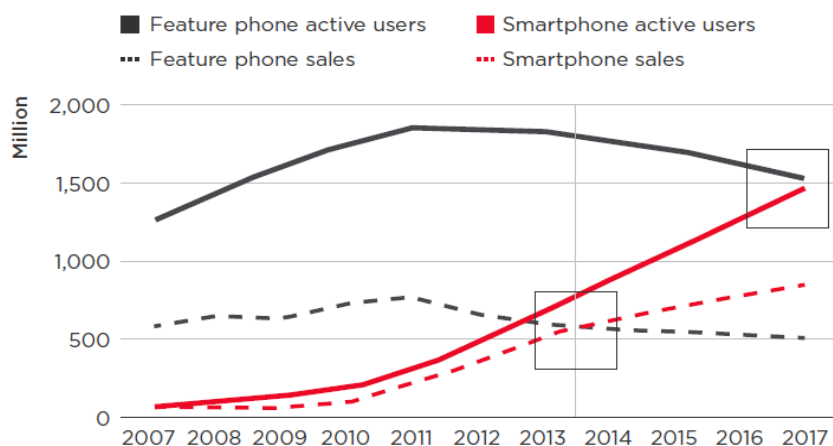
However, now smart phones are beginning to replace feature phones. In 2013, sales of smartphones to the continent were climbing steeply, up 21 per cent on the same period in the previous year. The GSMA forecast that that smartphone sales across developing countries would overtake sales of feature phones in 2014 (GSMA 2014b), and that

4 [www.gartner.com/newsroom/id/2665715](http://www.gartner.com/newsroom/id/2665715)



smartphone adoption (in developing countries) will reach 63 per cent by 2020 (GSMA 2015). Moreover, that it would only take a further three years for the total number of smartphones in use in developing countries to exceed the number of feature phones (Figure ). Even the more pessimistic forecasts suggested this would happen by 2020 (Dediu 2014). But variation across countries is great; for example, Safaricom, Kenya’s leading mobile network operator (MNO), with 68 per cent of mobile subscriptions in the country (Communications Authority of Kenya 2014), said in 2013 that smartphone penetration was already at 67 per cent.<sup>5</sup>

**Figure 6.1 Phone sales and users in emerging markets**



Source: © GSMA Intelligence (2014c). Reproduced with kind permission of GSMA.

### 6.1.2 Low-cost handsets

In 2013, Balancing Act (a group of journalists focusing on ICTs in development) said that prices would have to be well below US\$100 for smartphone sales to take off. At that time the price for a simple, basic handset in Kenya was US\$40–50, so they estimated that a market changing price point for smartphones would be around US\$60–70 (Balancing Act 2013). In South Africa, MTN’s Steppa handset already retails for 499 rand (around US\$45) (Tarrant 2014), and handsets running Mozilla’s Firefox operating system were scheduled to go on sale for US\$25 in India and Indonesia (BBC 2014).

A number of new producers from developing countries have emerged. Xiaomi is a rapidly growing Chinese manufacturer of Android handsets that has overtaken Lenovo and LG to become the world’s third-largest smartphone manufacturer after Samsung and Apple (Gibbs 2014). Indian companies account for 32 per cent of the domestic market (Bhattercharjee 2014). Micromax is the leading Indian smartphone manufacturer, second only to Samsung in terms of sales in the country. Other successful Indian companies include Karbonn, Symphony and Spice, which sell cheap smartphones, mostly produced in China.

### 6.1.3 Tablets

In 2015, global tablet sales were expected to exceed those of personal computers (desktops and laptops) (Anthony 2014). Low-cost devices, designed specifically for developing markets, have dropped below the US\$50 threshold (e.g. Datawind’s 7-inch tablet retailed at US\$40). (Segan 2014) Users need tablets equipped with SIM cards to access internet services independently, and these are more expensive than normal tablets with no SIM card capacity. Entertainment is set to drive the data markets in developing countries, and tablets

may become popular if they provide a more satisfactory viewing experience than cheap smartphones.

## 6.2 Extending the reach of information and communication technology

### 6.2.1 New communication media

Organisations are working to extend the reach of communication infrastructure into remote and low-income communities. Village Telco, which was launched in 2008 in South Africa, is an initiative to develop low-cost telephone networks (for voice calls) based on a meshed WiFi network that covers a small area such as a village. In addition to cheap local calls, it provides access to national voice and internet networks. Other organisations working on the idea of WiFi systems include the Digital Empowerment Foundation in India, which runs the Wireless for Communities programme.

### 6.2.2 Television 'white spaces'

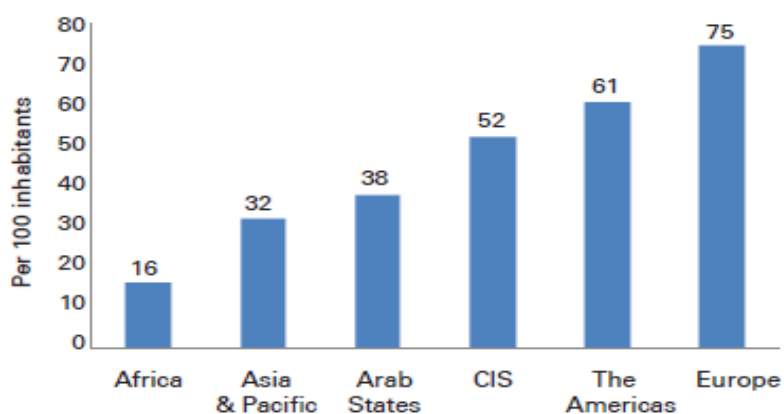
The use of unused television frequencies and point-to-point connections, is attracting growing interest as a way to provide low-cost broadband internet, especially in remote rural areas. Since 2013, Google has been running pilot programmes in a number of countries. Using this technology on a commercial basis will depend on deregulation of the spectrum (Balancing Act 2014). The government of the Philippines is also experimenting with the technology, with a view to developing e-Health services (Vota 2014).

Companies including Google and Facebook have run trials using aerial networks. Balloons, drones and satellites provide network coverage to large areas on the ground. Google's trials have used the high frequency, unlicensed spectrum (GSMA 2014a).

### 6.2.3 Internet access in Africa

Africa has particularly low internet usage rates, followed by Asia (see Figure 6.2), but annual growth rates are high (e.g. 27 per cent in Africa (ITU 2013b)).

**Figure 6.2 Internet users by region (2013)**



Source: ITU (2013b). Reproduced with kind permission of ITU.

Overall, the International Telecommunication Union (ITU) estimated that by the end of 2014 20 per cent of people in Africa would have internet access, up from 10 per cent in 2010. This can almost entirely be attributed to increased mobile broadband, up from 2 per cent coverage in 2010 to 20 per cent in 2014 (ITU 2014). However, these figures hide the uneven distribution of access: only one in ten households across Africa are estimated to have direct

access to internet services, although the growth rate is 18 per cent annually (twice the global average) (ITU 2014).

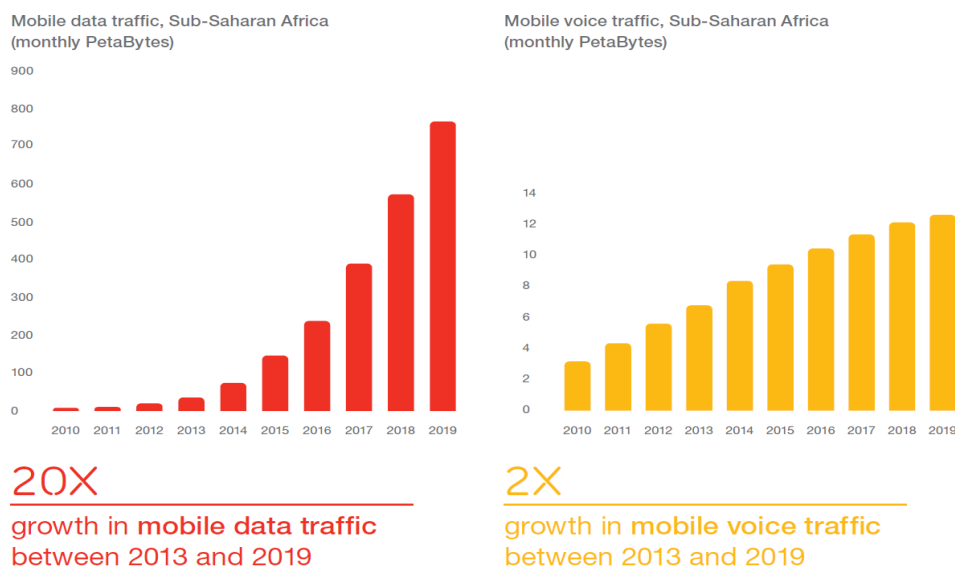
Penetration (relative number of users), coverage (area covered) and speeds (average and peak up/download speeds) vary considerably across the continent. Given the poor state of fixed-line infrastructure, according to the ITU the GSM (global system for mobile communications) network will continue to be the main form of internet connectivity (ITU 2013a).

It is worth bearing in mind that although penetration rates in developing countries are low (Figure 6.2), the absolute numbers of users, and mobile internet users in particular, is high. According to the GSMA, the number of mobile broadband connections in developing countries overtook the number in developed countries in 2013 (GSMA 2013b).

### 6.2.4 Increasing importance of data

Driven partly by increased use of voice and messaging services provided by internet companies (known as ‘over-the-top’ service providers, or OTTs), data usage is expected to increase rapidly in Africa. According to Swedish telecoms company Ericsson, data usage will double annually between 2013 and 2019 (see Figure 6.3).

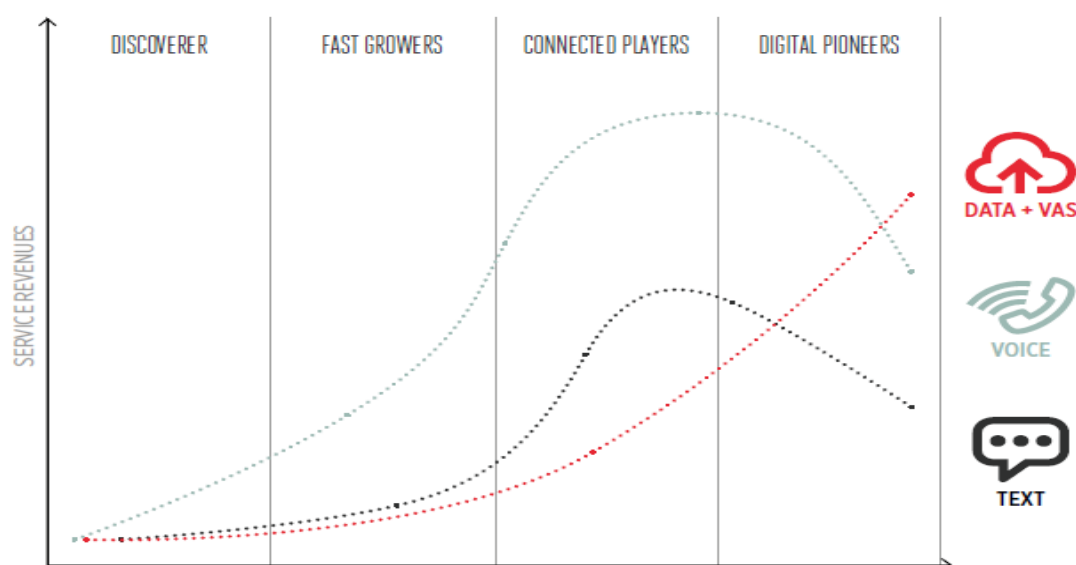
**Figure 6.3 Predicted growth rates in Africa – voice and data**



Source: Ericsson (2014). Reproduced with kind permission of Ericsson.

As markets mature, mobile penetration rates level out (at near saturation rates), and data services make up a greater share of revenue (see Figure 6.4). Forecasts suggest that even in Africa, the scope for growth in voice traffic is limited compared to rapidly expanding data consumption. The GSMA believes that data will account for the majority of phone revenue by 2018. According to Safaricom, 90 per cent of its revenue will come from data by 2016. Given the rapid spread of smartphones across developing countries, it is likely that the transition from voice and SMS revenue to a reliance on data revenues will accelerate in these markets.

**Figure 6.4 Changes in revenue mix with maturity of market**



Source: © GSMA Intelligence (2014d). Reproduced with kind permission of GSMA.

## 6.3 Attracting customers to data services

### 6.3.1 Competing for mobile customers

As MNOs seek to attract new users, they are bundling internet-based services such as Facebook with voice and SMS packages. Facebook, Google, and Wikipedia have entered into partnerships with MNOs to provide access to modified versions of these data services at low or no cost (GSMA 2013b). To make services as widely accessible as possible, the technology has been developed to make these internet services available on feature phones rather than smartphones. Low bandwidth data services use USSD to exchange data over GSM networks (e.g. Fonetwish,<sup>6</sup> Nokia Life).<sup>7</sup> The reduced bandwidth requirements of such services also helps keep costs down. biNu<sup>8</sup> makes cloud-based smartphone software available on feature phones by caching essential elements before downloading. In India, smartphones are loaded with the Opera Mini browser, which compresses webpages by up to 90 per cent.

In addition to providing a competitive edge to their service offering, making low bandwidth data services will also build consumers' capacity, familiarising them with data and internet services. Internet.org, a philanthropic partnership of multinational IT companies that aims to make internet accessible to the world's poor, has developed a smartphone app that 'provides free basic services in markets where Internet access may be less affordable'. It allows people to browse selected health, employment and local information websites without data charges.' (Internet.org n.d.). The business model seems to focus on building increased demand for apps and more lucrative services (Morozov 2014). Initially introduced through Airtel in Zambia, the app was subsequently rolled out in Tanzania and Kenya.

In the same way that MNOs have tailored prepaid tariffs to match the needs of low-income consumers, they are offering offer pay-as-you-go mobile data packages in smaller and

6 Fonetwish lets users to access Facebook without a mobile data plan, using a 'USSD-based interactive solution'.

7 Nokia Life is an SMS and USSD-based, subscription information service designed for emerging markets, which offers a wide range of information services covering healthcare, agriculture, education and entertainment.

8 biNu is an app platform that runs on a wide range of mass-market mobile phones, providing fast, affordable access to web-based apps and internet services.

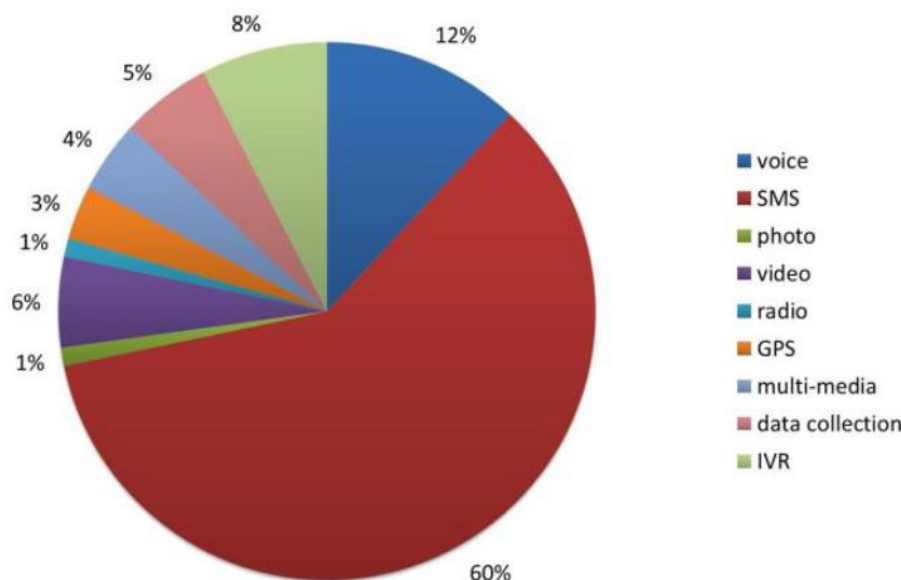
smaller denominations to reduce the capital outlay needed. Although data packages are typically valid for a period of a week, or a month, ‘sachet’ data tariffs offer small amounts of data (e.g. 55–500MB) for short periods lasting several hours (e.g. until 6am the next day) (GSMA 2013b).

### 6.3.2 Opportunities beyond SMS

Most mobile phone users in developing countries simply use their phone to make and receive voice calls. Not all take advantage of commonly available features such as taking photos and playing music.

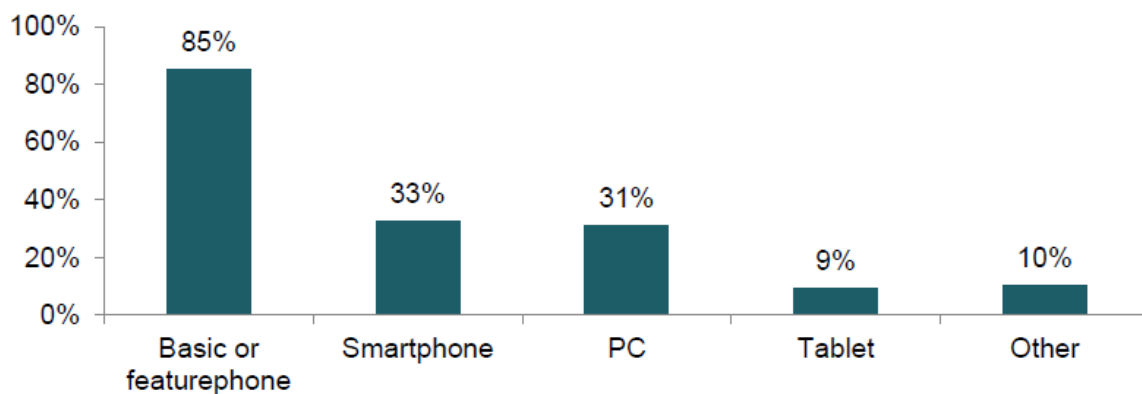
Despite recognising that low levels of literacy constitute a barrier to widespread use of SMS, this is the principal technology that most mobile services use (e.g. 60 per cent of m-agri services used SMS) (see Figure ). According to GSMA Intelligence, the majority of mobile for development (M4D) services were designed for basic or feature phones (GSMA 2013a) (see Figure 6.6).

**Figure 6.5 Breakdown of m-agri projects by principal technology**



Source: Batchelor *et al.* (2014); Qiang *et al.* (2012).

**Figure 6.6 What devices are services designed for?**



Source: © GSMA Intelligence (2013a). Reproduced with kind permission of GSMA.

The advent of cheap, affordable smartphones combined with low-cost (and reliable) broadband internet connectivity presents opportunities to exploit technologies that could help the poor overcome constraints, notably literacy. Video and voice-based services offer clear benefits. For example, Awaaz.De has a voice-based group messaging service where users can ring a number, leave a question and listen to answers. The networking nature of the service means group members can answer questions as well as any expert managing the group. Mobile Harvest (a small startup company in India) is piloting a similar type of service, but using video technology on smartphones. Other technologies address language barriers. For example, Google Translate<sup>9</sup> supports over 90 languages, and dictation apps such as Voice Recognition also support a number of languages.

However, it can take years from conception to launch for ICT-based services, so it is important to consider how technology (and users' capabilities) will change over the intervening period. M-Pesa is an example of a transformative mobile service that successfully scaled up to serve six million Kenyans. But it took five years to move from basic concept to the product that M-Pesa launched nationally (Batchelor 2012). Thinking five years ahead probably takes most developing countries well into the 'Connected Players' part of the development curve shown in Figure 6.4.

New platforms for disseminating information and services also bring new challenges. Digital Green has over 3,300 videos (Tejwani 2014), which have registered over 500,000 hits, but the company is not sure who its users are, which poses difficulties in assessing uptake and impact among target groups. Digital Green knows that 96 per cent of the users are from India, but they are almost certainly not from the core target demographic of farmers. Given that internet users tend to be young, urban males, it is likely that young migrant workers who have moved to the city for work may be looking up information for their families back in their home villages.

### **6.3.3 The rise of over-the-top services (OTT)**

Video and music are examples of OTT content that historically used to be broadcast but can now be streamed on demand over the internet. Messaging and voice services (e.g. WhatsApp, iMessage, Facebook Message, etc.) are also gaining importance as more people get smartphones and cheap data becomes more readily available, often included in pre-paid bundles. Users reportedly perceive such services as free, perhaps due to a lack of transparency in how costs are charged. OTT has already overtaken SMS as the main form of messaging globally and is expected to greatly increase its lead in the years to come (Informa 2014).

OTT services may be most attractive to consumers in developing countries. In mobile markets where contract payments are the norm, voice, SMS, and data transactions have no marginal cost to the consumer. This is in contrast to developing country markets where prepaid customers pay by the minute/text; in this context, OTT voice and messaging offer tangible cost savings. They also provide a convenient way for the overseas diaspora to circumvent costly international tariffs on voice services to keep in touch with friends and family.

OTT is clearly a threat to MNOs and subsequently affects their commitment to infrastructure investments. For example, 43 per cent of mobile operators view Skype as a major threat to their revenues. Skype now has 280 million active monthly users who spend a total of two billion minutes a day on Skype. Although each of these users on average spends just over seven minutes a day or 2,555 minutes a year using Skype communication services, it equates to 730 billion minutes a year. In 2013, Skype was estimated to be costing the telecom industry US\$100m a day, around \$36.5bn per year (Mobile Squared 2013).

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9 [https://translate.google.co.uk/about/intl/en\\_ALL/languages.html](https://translate.google.co.uk/about/intl/en_ALL/languages.html)

Developing countries regard this as doubly unjust. MTN CEO Ahmad Farroukh highlighted the problems foreign software companies pose, profiting from advertising on OTT services, while paying little or no tax in African countries, 'stealing profits' from the MNOs they rely on to provide the necessary infrastructure. At the same time, the regulatory environment puts added strains on MNOs that are working to upgrade their networks. According to Farroukh, building new cables 'costs more in licensing fees than the fiber and equipment, because costing models for government are outdated' (Oxford 2014). However, a global survey of mobile operators showed that 36 per cent were partnering with OTT providers in response to this threat (Mobile Squared 2013).

#### **6.3.4 Big data and new opportunities**

Mobile money services (e.g. M-Pesa), allowing users to transfer money using handsets, has grown rapidly. In 2013, more than 219 services were available across 84 different countries (Pénicaud and Katakam 2013). Moreover, in two-thirds of countries services are in competition with one another. Access to financial services and the ability to process micro-payments is a foundation for other services.

Commercial insurers have historically shied away from emerging markets, because low premiums could not justify the time and cost required to administer policies, collect premiums, and process claims. Mobile technology, however, offers cost-effective ways for customers to pay premiums, and for companies to pay out claims.

Cignifi, a big data start-up, has developed a platform that provides credit and marketing scores for consumers, based on their mobile phone data. The Cignifi business model is founded on the idea that: 'Mobile phone usage is not random – it is highly predictive of an individual consumer's lifestyle and risk'. Based on behavioural analysis of each mobile phone user – their phone calls, text messages, data usage and, by extrapolation, lifestyles – the company identifies patterns and uses them to generate individual credit risk profiles. This information could give many of the world's unbanked access to insurance, credit cards and loans. Scores are dynamic and respond to changes in customer activity as data are refreshed, usually every two weeks. In addition to updating customers' creditworthiness, the system also helps to identify their appetite for different products and inclination to churn, referring to subscribers moving from one network to another.  
(ITU 2014)

Life insurance is the commonest form of insurance, because it is the easiest to monitor and process; however health, farming and accident insurance are also being offered.

Besides mobile technology, companies are also exploiting big data to reduce the cost of processing claims. Agriculture and Climate Risk Enterprise (ACRE), previously Killimo Salma, a micro-insurer company serving Kenyan farmers, relies on data from regional weather centres to automatically trigger payments when conditions exceed predetermined thresholds. Farmers in affected areas receive compensation without having to file claims, or the company having to assess and process them (Syngenta Foundation n.d.).

#### **6.3.5 Mobile credit**

The ability to process micro-payments has been a boon to the microfinance and savings industry. E-wallets allows users to circumvent handling and processing fees that may in effect lead to negative interest rates on bank accounts for people on low incomes. Indeed, users in West Africa highlighted saving as one the key attractions of mobile money services (CGAP 2013). Sometimes this has been combined with big data. In Kenya, Safaricom has

introduced M-Shwari in collaboration with Commercial Bank of Africa. Customers who have been using the company's M-Pesa service for more than six months can check their creditworthiness and have loans quickly approved simply by sending a text. Loans, ranging from US\$1 to US\$230 are disbursed and repaid by phone. Automated actions remind users when repayment are due, or to allow users to request extended credit lines (Pénicaud and Katakam 2013).

This is an example of how customers' top-up history, and voice, message and data usage, combined with their e-money history can be used for a nominally independent purpose. Orange's Data for Development Senegal programme has explored innovative uses of big data such as tracking locust swarms, livestock movements, migration patterns of temporary workers, seasonal migration flows, health facility access, and epidemic hotspots (Orange D4D 2014).

## **6.4 Understanding consumers**

### **6.4.1 Gender**

Mobile phone ownership is lower among women than among men. A study published in 2010 showed that a woman in Africa was 21 per cent less likely to own a mobile phone than a man, and a woman in South Asia 37 per cent less likely (GSMA and Cherie Blair Foundation 2010). Social and structural barriers that limit women's access to and control over mobile phones (and ICT) include lack of financial resources, higher levels of technological and language illiteracy among women and girls, norms that discourage women from using technology, and lack of control over or ownership of technology such as mobile phones.

Although the cost of handsets is cited as the main reason why women do not own a phone (*ibid.*), many women borrow mobile phones or receive handsets from spouses. This is consistent with earlier findings by Scott, Batchelor and Ridley (2003), which identified specific differences in how women used phones, although overall patterns of use (notably, frequency of use) were similar to those of men. However, the Cherie Blair Foundation research found wide variations in access to mobile technology across countries with different social norms regarding gender rights.

More work by GSMA has found that shared access to mobile phones is not necessarily without its own associated costs. Women who did not have access to a handset felt obliged to borrow phones from neighbours or friends. In Uganda, 48 per cent of non-owners used a neighbour's handset, but disadvantages surrounding this type of borrowing included feelings of obligation, risk of blackmail or payment of a 'borrower's premium', such as returning the phone fully charged and topped up (GSMA 2012).

The question is what can be done to reduce the gender gap. In Turkey, for example, Vodafone's Women First programme aims to attract women subscribers through a combination of promotional offers, value-added services designed specifically for women, and technical and business support (Vodafone 2014).

### **6.4.2 Multiple ownership**

A key feature of developing country markets is multiple SIM ownership. This is driven by high off-net tariffs, where callers are charged a premium to call subscribers on a different network. People carry multiple handsets, or multiple SIMs for different networks, to avoid paying premium rates. They also buy new SIMs to take advantage of promotions and offers. All of this results in high churn rates, and number replacement, which is a particular challenge for services that need users to register their phone number; for example, maternal



care services are compromised if women get a new phone number, because they will not receive texts sent to number they registered initially.

In developed nations, privacy is a major concern for users. 'Citizens' tend to lobby for and expect high standards in relation to institutions' use of personal data and the security applied to such data. However, 'consumers' (often the same people), also expose their personal data on social network sites and across the internet by accepting cookies and downloading apps. For various reasons, such privacy issues have yet to reach the same level of concern in developing countries. However, institutions that handle consumers' personal data have a duty to protect that data, and this may come to the foreground of m-services in developing countries in the near future. It has particular relevance in the context of multiple SIM ownership because where health data are concerned, it is important to target effectively, and also to ensure that privileged data (e.g. results of pregnancy tests) is accessed by the beneficiary only.

### **6.4.3 Specific needs of farmers**

To develop a good understanding of the information systems in which farmers operate it is necessary to identify the kind of information they are looking for and where they currently get it. This includes understanding who a farmer will decide to consult and when. Research suggests that agricultural information does not rank highly when compared with expressed needs for information on health or education. As mentioned in Section 4.2, research indicates that agricultural information needs to be context specific across the agricultural cycle if it is to be useful. The studies considered in this section reinforce the idea that face-to-face and farmer-to-farmer co-construction of knowledge is important in making agricultural information useful/relevant. This is particularly true in the case of sustainable agriculture, where practices can be particularly context specific.

According to a number of studies, there is an urgent need for health and education information among poor households, whereas agricultural information was needed less frequently (GSMA 2012). This is particularly true of women: a GSMA study found that 84 per cent of women from resource-poor households wanted better health-care information, and 64 per cent wanted specific information about children's health; however, agriculture was not mentioned (*ibid.*). A low perception of the need for agricultural information does not automatically imply a low potential impact. But given the tendency to prioritise information on health and education over agriculture, those apps or advisory services with integrated information about all three may be more popular than those which provide agricultural information alone.

A study conducted in India and Uganda suggested that information priorities arising from this kind of research are consistent with resilience-based household strategies that focus on risk reduction (at least in the short term) (Scott *et al.* 2009). Keeping in touch with friends and family is consistently regarded as the top communication priority: they can be relied on to help out in times of need. Sickness is potentially disastrous for households, especially when it debilitates the main earner.

Further work by Ndiwalana *et al.* (2010) confirmed the same overall ranking of priorities, but went on to identify specific gaps in information provision, particularly in relation to:

- Finding a medical expert;
- Learning about first aid, diseases, etc.;
- Introducing modern agricultural ideas;
- Fake drugs; and
- Expanding markets.

However, a study in Kenya found that despite increased development of ICT applications that addressed these issues, ‘none of these applications have yet been able to reach scale the way that mobile phone-based financial products have’ (InfoDev 2012). Thus the connection between information needs and uptake via mobile technology is not necessarily linear.

Low ranking does not mean that key agricultural information would not be transformational to farming practices. It is important, therefore, to understand the key decisions that farmers have to make, and whether they seek assistance in making these decisions.

In Lokanathan and Kapugama (2012), the study specifically explored farmers’ decision points in four countries, noting that: ‘Amongst smallholders, the main information needs over an entire crop cycle were information on fertilizers, market prices and pesticides. However, informational priorities varied depending on the stage of crop cycle and to a lesser extent across countries’. The study also mapped the communication channels used to ask for advice. ‘Face-to-face communication trumped all other modes of communication amongst smallholders. Calling people using phones was, however, the second most used communication mode with information sources’. It offered insights about how farmers make decisions across the cropping cycle, and the top three information requirements of farmers, again across the cropping cycle.

#### **6.4.4 Household economics and the costs and value of mobile tariffs**

Mobile tariffs have fallen in developing and developed markets, but the cheapest mobile plans are all to be found in developing countries (ITU 2014). Despite this, the cost of mobiles relative to household income is much higher in developing countries, making them less affordable (Figure 6.7). Differences between countries are considerable.

**Table 6.1 Cost of mobile sub-basket**

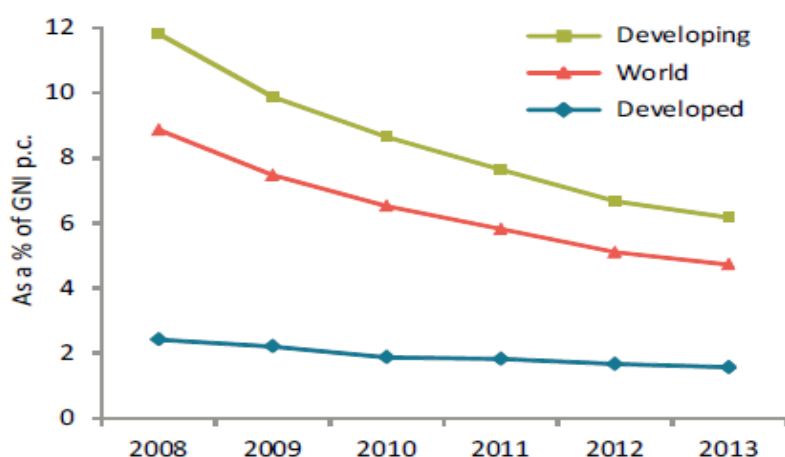
Country	Rank (by % of GNI p.c.)*	Mobile sub-basket as % of GNI p.c. (1=lowest cost)
Bangladesh	72	1.88
Ghana	104	3.51
Tanzania	151	17.85

Note: \* Low rank represents low cost as percentage of gross national income (GNI) per capita (i.e. more affordable).

Source: ITU (2014).

The affordability of basic mobile phone services is a major barrier to further adoption in several African countries: of the 20 countries with the least affordable prices in 2013, 16 were in Africa (ITU 2014).

**Figure 6.7 Mobile price basket 2008–13**



Source: ITU (2014). Reproduced with kind permission of ITU.

The rapid growth of mobile ownership suggests that despite relatively high expenditure, people regard their phones as providing good value for money. The foundational value is in maintaining and accessing social capital:

Multi-country studies across Africa have shown that mobile phones are primarily used to maintain social networks, although they are also used to maintain 'weak links' to business associates (Miller *et al.* 2013; Molony 2007; Souter *et al.* 2005). According to Slater and Kwami (2005), mobiles are used to manage local embedded reciprocities. Rather than being used to connect to the 'global economy,' the majority of calls in Ghana, for example, are 'used to maintain family relations' (*ibid.*). Adoption may also be part of a defensive livelihood strategy, given widespread poverty and the importance of extended family networks. (Carmody 2013)

Few studies have identified economic benefits at household level from expenditure on mobiles. A study in Nigeria concluded that mobiles yielded benefits in terms of employment generation through business expansion, but impacts at the household level were inconclusive. Other benefits included reductions in transportation costs, and reduced transaction and production costs (Lola *et al.* 2012).

A number of studies have examined the impact of more specific services, such as m-agri services. While many studies show benefits from mobile services, others are less conclusive. For example, a study in India found that agricultural information services had no significant impact:

We find no statistically significant average treatment effect on the price farmers received, crop losses resulting from rainstorms, or the likelihood of changing crop varieties and cultivation practices. Treated farmers appear to make use of the RML service and they associate RML information with a number of decisions they have made. But, based on available evidence, on average they would have obtained a similar price or revenue with or without RML [Reuters Market Light]. (Fafchamps and Minten 2012)

A study in northern Ghana, which examined farmers' sales transactions, found only a weak link between finding buyers and phone use. Phones were used to find market information in

33 per cent of transactions, mainly to get information from neighbours and extension officers (Zanello *et al.* 2011).

Rather than concluding that services have no impact, it may well be that the behaviours are more complex than expected at first. Burrell (2012) argues that market information loses its value when treated simply as a commodity that can be exchanged out of any kind of local context. This is not to say that agricultural information has no value, but rather that it is contextual and interdependent on other factors:

- Market information is not necessarily scarce; people regularly access other sources including radio, neighbours, extension workers.
- Farmers are used to getting information for free; for example, from extension workers, radio, or community groups and social networks.
- Existing relations with players in a value chain may be more important than the price information.
- Logistics are more important than prices; farmers save more money with improved coordination rather than better prices.
- Farmers prefer to learn from each other; extension experience suggests that progressive farmers, demonstration farms and exchange visits are all key factors in achieving behaviour change.
- Burrell (2012) and Batchelor *et al.* (2014)
- Understanding the complexity of decision-making may help in understanding willingness to pay for mobile services.

#### **6.4.5 Customer loyalty**

Promotions and low-cost offers are the main reasons people switch operators (which is subtly different to holding SIMs for multiple networks). The average churn period varies from 20 months for high-value customers (high monthly top-up values), to 11 months for low-value customers. MNOs clearly believe that bundling services with other offerings, rather than simply competing on price, is the key to achieving customer loyalty (Mobile Squared 2013). This has been mentioned above in relation to OTT content and messaging services. Experience in Kenya confirms the power of value-added services in earning customer loyalty.

When mobile number portability (MNP) was introduced in Kenya [in 2011], some predicted that 1 million Safaricom customers would change to competitors. In the event, only 30,000 subscribers changed. Customer attachment to M-Pesa was quoted as a key reason for this success. (Slanina 2012)

Research based on customers' opinions, however, paints a slightly different picture. A study of South African mobile users suggested that quality of service is the key determinant of customer satisfaction (Molapo and Mukwada 2014). This is not to say that customers are not sensitive to price but, given that operators are clearly engaged in competing on price, there is little price distinction between companies.

Increasing attention has been paid to regulating mobile communications with regard to security and surveillance. One such policy is the requirement for MNOs to register SIM cards, requiring prepaid mobile users to provide personal identification information. In 2014, 49 African countries required registration or were in the process of introducing a registration policy (Donovan and Martin 2014). Although registration processes may only have modest effects on security, they increase the cost (in terms of time and convenience) to consumers of switching, which may tend to reduce churn. Churn itself is another area where big data analytics is already beginning to make an impression:

In the Republic of Korea, for example, SK Planet, a subsidiary of SK Telecom, uses big data to help its parent company reduce churn and generate new revenue. It has used data mining to achieve a fourfold improvement in churn forecasting. The operator found that customers who are planning to quit their current package tend to use specific search phrases, such as 'data plan' or 'operator benefits', at least three to seven days before taking action. When operators suspect that customers may be looking elsewhere, they may try to keep them by providing them with a tailored offer.

(ITU 2014)

## 6.5 Telecom markets

MTN, Orange and Airtel are the three Africa-wide operators with a presence in the largest number of countries. Other companies that operate across countries include:

- Millicom (majority owner): Ghana, Tanzania, Senegal, Rwanda, Congo, Chad;
- Vodafone (majority owner): Democratic Republic of Congo, South Africa, Tanzania, Lesotho, Mozambique. Also holds a minority stake in Safaricom (Kenya);
- Etisalat (majority owner): Benin, Burkina Faso, Togo, Niger, Central African Republic, Gabon and Côte d'Ivoire, Sudan, Tanzania. Also holds a 40 per cent stake in Etisalat Nigeria;
- Africell (majority owner): Democratic Republic of Congo, Sierra Leone, Gambia, Uganda;
- Glo Mobile: Nigeria, Benin, Ghana, Côte d'Ivoire; and
- Maroc telecom (majority owner): Mali, Gabon, Burkina Faso, Mauritania.

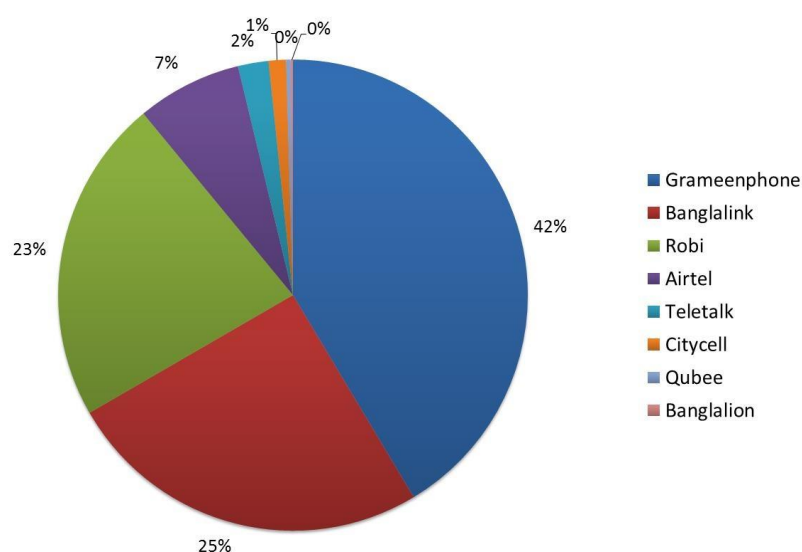
Companies largely seem to be divided into different national affiliate enterprises, with varying degrees of ownership by parent firms. Following a period of intense competition, which has focused on increasing subscriber numbers and lowering costs, business activity suggests that the African sector at least is entering a period of consolidation among the big players.

There are clearer signs of consolidation in (other) markets in the region. For example, Warid Group has rationalised its operations in SSA. The company sold its operations in Uganda to Bharti Airtel, and those in the DRC to MTN. Between them, Safaricom and Airtel acquired Yu Mobile (Essar) in 2015 at a cost of around US\$120m. Under the deal, Essar Group sold its Kenyan base stations and transmission infrastructure to Safaricom and then separately sold its customer base to Airtel Kenya (GSMA 2014d).

At the smaller end of the scale, new entrants have continued to innovate. For example, in 2014 Kenya granted three licenses to new mobile virtual network operators (MVNOs), the first of their kind in the country, bringing the total number of operators to seven. Among the licensees were Finserve Africa, a subsidiary of Equity bank, Tangaza's Mobile Pay Limited, and Zioncell Kenya. In 2014, South African retail group Mr Price launched MRP Mobile, the second MVNO in the country after Virgin Mobile SA (McLeod 2014).

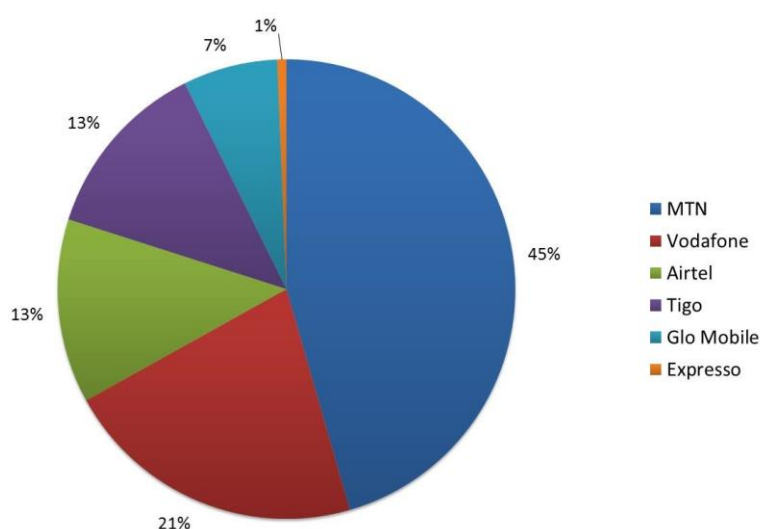
Figures 6.8 and 6.9 show that three or four major operators tend to dominate markets (National Institute of Population Research and Training, Mitra and Associates, and ICF International 2011).<sup>10</sup>

**Figure 6.8 Market shares (Q3 2013) – Bangladesh**



Source: Authors' own, based on GSMA Market Intelligence.

**Figure 6.9 Market shares (Q3 2013) – Ghana**



Source: Authors' own, based on GSMA Market Intelligence.

Some 97 per cent of subscribers in Bangladesh and 99 per cent of subscribers in Ghana are prepaid. The mobile telecoms industry is a major contributor to many developing economies.

Rapid growth in the mobile subscriber base and usage levels has meant that the sector makes a very large contribution to the economy of the region, totalling 5.4 per cent GDP in 2013. This overall impact includes a direct contribution from MNOs of US\$27bn (1.9 per cent of the region's GDP), and from directly related industries such as infrastructure service providers, retailers of mobile products and services, handset manufacturers and mobile content creators (the mobile ecosystem) of US\$8bn (0.6 per cent of GDP). The activity mobile operators and the ecosystem generate also has a knock-on effect on the rest of the economy, inducing further economic activity valued at US\$7bn (0.5 per cent of GDP). (GSMA 2014d)

### 6.5.1 Content providers

Across Africa, a growing number of companies provide access to music via mobiles. When it comes to music, MNOs focus on providing locally generated content:

- The Kleek – pan-Africa mobile music streaming service, developed by IMI mobile and backed by Universal Music, and specifically designed and built for the African market;
- Bozza – music sharing and streaming site for South Africa;
- Safaricom Live – music downloads tailored for Kenyans;
- MTN Play – a portal with a variety of downloadable local content, including videos and music. MTN has brought in local providers to create more content. It signed a deal with music channel Trace to provide younger customers with access to tailored local multimedia and news.

Some of the big players have been making group-wide deals. For example, music streaming company Deezer has made deals with MNOs across different countries and regions, including Vodafone in South Africa and Orange in West Africa (Sawers 2012). Video streaming services are also becoming widespread; for example, iROKO, a pay-per-view streaming site for Nollywood movies, and Mxit, which lets viewers to stream feature films in 5–6 segments. There are over 100 African video on demand (VoD) platforms and over 40 music on demand platforms (Balancing Act).

Where content is accessible over the internet, pricing for streamed content is independent of the mobile operators. In developing countries, MNOs are in a much stronger position because they act as the portal for customers to access mobile-based music and video services. Historically, VAS has focused on SMS, where MNOs typically took 80 per cent of the revenues. Russell Southwood (editor of SmartMonkey TV) believes that MNOs need to adjust their thinking and take a much smaller percentage of revenues if the local content industry, selling low cost items, is to flourish (Smart Monkey TV 2014).

It should be noted that many studies suggest that pornography is a significant driver of content and channel development. Early studies of internet cafes noted pornography as a reason for using the internet, and studies on what people use the internet for include a significant use of pornography.

### 6.6 Business models

For mobile services to be successful, several stakeholders need to be involved. It is crucial that all of these stakeholders are presented with value propositions that lead to positive returns, whether financial or non-financial. The range of stakeholders in a given project varies, but generally includes a project initiator, funders, content providers, economic buyers and end-users. Projects invariably depend on some form of government support, either directly or tacitly, for the service to be launched, and the cooperation of network operators to provide the necessary infrastructure. Table 6.2 gives a general sense of the stakeholders involved in an app value chain.

**Table 6.2 Key stakeholders in the app value chain**

Stakeholder	Role
Project initiator/owner	Initiates and drives the project.
Funders	Provide the initial funding for the project. May be public, non-profit or commercial.
Content providers	Provide the content for the service.
Governments	Provides a regulatory framework. May also provide funding, or act as the economic buyer for a project.

(Cont'd).

**Table 6.2 (Cont'd).**

Stakeholder	Role
Hardware providers	Provides the hardware required to run the service. May or may not be an actively take part in the project.
Platform provider	Provides the necessary platform from which to market the service – such as Android Market or private app stores.
Channel partners	Provides intermediary services between service providers and end-users. May be local agents, extension workers or healthcare professionals.
Economic buyer	The person or organisation that buys the service. Often, but not always, same as end-user. A project may have several distinct buyer groups.
End-users	The people who will ultimately use the service.

Understanding each stakeholder is therefore an important part of understanding the dynamics of any m-project. The mHealth Alliance (2013) identified a number factors that are likely to influence their decisions:

- **Local or international organisations?** – Local organisations may be more likely to know how to adapt projects to local conditions and understand their requirements. International organisations are more likely to be able to provide value-chain support and components that are not location specific. They may also be better placed to scale up successful projects internationally.
- **Organisation size** – Larger organisations are more likely to become involved in projects once the initial phase has been completed and economies of scale become evident.
- **Commercial or non-profit** – Commercial actors are more likely to seek out projects that provide a financial return on investment. Non-profit or governmental organisations are assumed to prioritise improved social outcomes over financial gain.
- **Time-scale** – Organisations that expect a return on investment in the near term will be more likely to get involved in projects that have already reached sufficient scale, whereas organisations such as non-profits that operate on a longer-term basis may support projects in their early phases, where economic returns are still on the horizon.
- **New or repeat customers** – New customers or supporters of new projects will need to see project targets or similar business cases that support their involvement. Repeat customers of established projects are assumed to demand demonstrable returns, whether financial or in terms of improved outcomes.

From the point of view of a project initiator, reasons for getting a broad range of actors to support a project vary, and potential benefits have to be balanced against the increased complexity that a broader stakeholder network will entail. Figure 6.10 summarises the advantages and incentives for different stakeholders.



**Figure 6.10 Benefits of partnering and incentives for mobile network operators**



Source: Cooper, Ansulie and Kubzansky (2013), for the USAID-funded SHOPS project led by Abt Associates. Reproduced with kind permission.

However, these factors overlook the stakeholder group that is integral to any project: end-users. In addition to understanding the key stakeholders in a project's design and implementation, it is necessary to understand who the end-users will be, and the effects that their demands and behaviour are likely to have. End-users from poor households will have less money to spend, which will influence what prices can be charged, and how. Services targeting broader segments of the population may differentiate fees based on customers' ability to pay.

Low-income users are also less likely to have access to smartphones, which should lead services targeting this segment exclusively to limit their use of data technology in favour of simpler SMS, USSD or voice services (Qiang *et al.* 2012). Additionally, service providers must analyse end-users' information needs to build a convincing business case. Often, willingness to pay can be taken as an indicator of user demand, and should play a central part of the business model (*ibid.*). In some cases, willingness to pay may need to be enhanced through marketing or training to overcome barriers to use. As case studies of several m-services highlight, success is unlikely without maintaining a user-centric approach over the project cycle (GSMA 2014). Currently, end-users tend to be only indirectly involved in most project planning. However, as Qiang *et al.* (2012) highlight, more participatory processes are likely to emerge.

Analysing end-users' roles is further complicated where they are not also the economic buyers. Such situations may arise if end-users lack the purchasing power to use a service that delivers a social benefit, or where the value proposition for individual end-users is not convincing enough, despite systemic benefits. In these cases, a buyer may step in and purchase a service, before distributing it to end-users. An example of this is the MADEX m-health service in Nigeria, which aims to increase the overall efficiency of health service

provision by allowing health-care practitioners to register their data electronically. The government, represented by the Midwife Service Scheme, was the buyer, and distributed the app free of charge to affiliated health-care workers to ensure sufficient uptake for efficiency gains to become apparent (mHealth Alliance 2013).

Although understanding end-users is crucial to any project's design, they may not necessarily be the immediate beneficiary of the service. The SMSforLife case study is an example of an information management system with clear benefits for government and commercial stakeholders, as well as end-users.

#### **Box 6.1 Case study: SMSforLife (Novartis)**

**The problem:** SMSforLife was a response to persistent stock-outs at rural clinics where patients collected malaria drugs free of charge, rather than having to pay for them at pharmacies or private clinics. The source of the problem was traced to lack of managerial oversight of available stocks, inconsistent reporting of consumption and slow procurement processes.

**The solution:** SMSforLife is a free service that links central government drug stores with rural dispensaries, sending out weekly SMS messages to request updates on drug stocks. If the first message does not receive a reply, the service sends a reminder the next day. As part of the project, relevant users were given training in how to use the service.

**The results:** The project has been rolled out across Tanzania, Ghana, Democratic Republic of Congo and Cameroon. During the six-month pilot phase in Tanzania, reported stock-outs were reduced from 79 per cent to 26 per cent, and clinics that reported being without Novartis antimalarial medicine were reduced from 26 per cent to 1 per cent. The project may expand to cover additional diseases.

*Source:* Novartis, mHealth Alliance (2013).

Creating economic or business models that help services scale up, while remaining economically sustainable, is one of the most fundamental challenges to m-service interventions (Qiang *et al.* 2012). Economic models are understood here as broad conceptual models that outline how projects create and capture value. According to Shafer *et al.* (2005), business models encompass four pillars: value creation, value capture, the value network, and strategic choices. The term 'business model' is thereby expanded to include the principles that guide choices, and not just the choices themselves.

However, given that a large share of m-nutrition interventions do not aim to generate profits, *economic* models may be a more appropriate term in this sector, because *business* model could imply a commercial logic.

### **6.7 Categories of economic models**

Economic models can be categorised in several ways: by type of service (informational, transactional or market service), by source of funding (commercial, non-profit or governmental), or by revenue stream (free-to-use, transaction fees, premium services or through third parties).

One way of categorising projects is by examining the project initiators and *owners*. Based on Qiang *et al.* (2012), three categories of economic models emerge: non-profit, commercial and hybrid projects (see Table 6.3).

**Table 6.3 Types of mobile network operator economic models**

Economic model	Description	Example
Non-profit	Interventions financed through donor funds or philanthropic contributions Offering public goods May offer 'public goods' services or services that cannot recover the cost from end-users Does not necessarily need to cover all costs, but some revenue may indicate customer value Can potentially spur for-profit activities once established May struggle to scale up from pilot phase	Childcount+ in Kenya
Commercial	For-profit services, without donor funding Few examples (in m-health) in developing countries Dependent on buyers' ability and willingness to pay Charges may vary according to income to reach poor households May target businesses or institutions, not individual users Strong need to make convincing arguments for customer service value	Sale of TRACnet to government of Ghana
Hybrid	Non-profit and commercial actors cooperate For example, non-profit investors fund a service that generates social benefits and may later become commercial Donors may work to increase the social benefits of established commercial services Philanthropic capital may distort underlying business model, preventing sustainability beyond pilot phase	Sproxil developed drug-authentication app in collaboration with BIOFEM pharmaceuticals in Nigeria, increasing the company's sales, while reducing the risks counterfeit drugs posed

### 6.7.1 Non-profits

Non-profits' funding comes from non-commercial actors, such as NGOs, governments or philanthropic funds. They are generally assumed to provide public goods, combining individual benefits with improved societal outcomes. Given the nature of public goods, mobile services delivering such goods may have difficulty recovering the full costs of the service from their end-users. While achieving economic sustainability within such projects may not be necessary, provided the partners are prepared to keep financing activities, generating revenue could be interpreted as a way to demonstrate levels of customer satisfaction.

Given that services are not necessarily dependent on user satisfaction or uptake to secure funding, limited revenue generation often means that expanding projects beyond the initial pilot phase can be problematic. This may be exacerbated by donors' inability to provide the necessary funding for large-scale marketing or distribution (*ibid.*). However, if pilot phases are successful, non-profit projects can potentially spur additional commercial activities, attracting the attention of for-profit actors. For example, mPedigree, a drug authentication service launched in Ghana, started out as a non-profit project before being spun off as an independent commercial enterprise (de Carvalho *et al.* 2011).

### 6.7.2 Commercial

Commercial projects are those initiated by commercial, for-profit actors. Such projects need a clear and convincing value proposition for end-users or economic buyers, because they depend on revenue generation to become viable propositions. Commercial projects rely on customers' ability and willingness to pay for m-services, which is often low in developing countries, particularly among the bottom-of-the-pyramid (BOP) population. Accordingly, the spread of commercial projects has been limited in developing countries, particularly in the preventive health information sector where willingness to pay has been found to be particularly low (*ibid.*). To secure sufficient revenues, services that target the BOP segment may attempt to subsidise activities with a sliding fee scale or by introducing premium content for those who can afford it. An alternative approach is to seek out an economic buyer to

finance the service; for example, the TRACnet service in Ghana, which its implementer Voxiva sold to the government of Ghana to scale up the government's HIV programmes.

### 6.7.3 Hybrids

Strategic partnerships between commercial and non-profit actors may produce *hybrid* models. Projects can apportion responsibilities such as distribution, management, maintenance or training according to each partner's strengths. An example of a hybrid model would be for a non-profit organisation, such as a social venture capital fund, to provide start-up funding to a commercial enterprise to launch services with a clear social impact.

The difficulty in all three models is the potentially distorting effect that initial financial requirements may have on the underlying business strategy. Non-profit and hybrid models tend to rely on donor funding in the initial stages of development (Qiang *et al.* 2012). Therefore, a risk is that the security of donor funding leads to business models that are unsustainable in the long term, with too little emphasis on end-user satisfaction and revenue. Dependence on external funding to ensure continued activity could lead managers to divert too much attention to securing new funders, rather than focusing on expanding and securing the user base.

While donor dependency is not an issue for-profit projects face, they may experience similar difficulties due to early dependence on challenge funds or grants.

## 6.8 Revenue capture

All m-service projects invariably rely on models that delineate how projects are to capture value. For commercial projects, this relates most directly to how to generate revenue. Commonly, this means raising revenue from individual end-users through business-to-customer (B2C) models. Service providers can generate revenue from end-users in a variety of ways, most of which can be summarised into four different models, as Table 6.4 shows (*ibid.*).

**Table 6.4 Revenue generation models**

Operation model	Description	Example
Non-chargeable	Service is free to use. It is likely to be non-commercial, and not connected to embedded services or promotions.	Ushahidi in Kenya allows users to submit and review reports of violence and political unrest.
Transaction-based	Users are charged for each transaction (SMS/calls made or in-app purchases). Given that users must pay, services must provide sufficient value to justify cost.	Reuters Market Light in India. Virtual City in Kenya.
Embedded services	Services are provided free of charge to generate demand or increase loyalty to the providers' main services (outside of apps).	M-Pesa in Kenya is a leading example. The service is free of charge, but aims to increase the market position of its provider, Safaricom.
Freemium	Free access to basic services is financed by offering higher value premium features to customers who can afford them.	KACE in Kenya.

Non-chargeable services are free to use, and are not connected to affiliated services or promotions. In addition to providing the service free of charge, providers may waive normal tariff rates for SMS or data, or a third party may pay for them. Services that are non-chargeable to end-users are typically non-profit.

Transaction-based services include those where the end-users are charged for transactions made, and also pay-as-you-go and subscription-based models. Typical services charge users for SMS messages they send or receive, voice calls to contact call-centres or automated voice services, or for facilitating purchases through a service or app. Esoko in Ghana is an example.

Embedded services provide m-services free of charge to generate increased loyalty or demand for service providers' other services. While not generating revenue directly, this model rests on the assumption that economic benefits will arise from reduced churn or increase sales of other services. Two examples of such services are Sproxil, where a free service for authenticating drugs serves to increase the sale of branded products; and M-Pesa in Kenya, which has been credited with reducing customer churn for its parent company Safaricom (Slanina 2012).

Freemium services offer basic services free of charge to generate demand for higher-value added products within the service. Higher-value services include tailored advice or feedback, access to videos, or other additional features. This revenue model is similar to embedded services because a free service is introduced to generate demand for a revenue-generating product. The difference between an embedded service and a freemium model depends on whether the revenue-generating service is a separate product or an enhanced version, although it is sometimes hard to distinguish between them.

IKSL in India is an example of a freemium service. Farmers who have bought a 'green SIM' from Bharti Airtel receive five free voice messages each day, providing localised tips on agricultural practices. Farmers may call the service to get additional information through a call-centre, for which premium tariffs are charged (Jadhav *et al.* 2011).

In all these models (with the logical exception of free services), revenue needs to be distributed among service partners. How revenue is divided between stakeholders varies across countries, services and platforms. In most developing countries, the network provider that hosts a service will get the majority of the revenue generated. On average, MNOs in Africa collect up to 70 per cent of revenue generated through services for which they provide the infrastructure. Additionally, billing may incur a 50 per cent fee when users pay using their available airtime. Charges on transactions using mobile wallet systems may be lower, at around 20 per cent (*ibid.*).

Consequently, service providers in Kenya reportedly receive around 18 per cent of revenue from SMS-based services, roughly US\$0.016 per SMS message (Qiang *et al.* 2012). Services available through platform-based markets, such as Apple's Appstore or Google's Android Market, normally receive a larger share of revenue (as much as 70 per cent) (*ibid.*). In addition to the revenue services generate directly, all these models receive increased revenue as use of SMS, voice or data services increase, which is of particular interest to MNOs.

## **6.9 Ability and willingness to pay**

Generating revenue from customers depends on the end-users' ability and willingness to pay. These two concerns may be closely connected and ultimately have similar impacts on a service's economic model, but should still be considered as distinctive. Willingness to pay can inform a service provider whether it is addressing the needs of its market, and reflect the demand for its service(s).

Studies on ability and willingness to pay for m-agriculture and m-health services have found that consumers are willing to pay for services that are 'relevant, helpful and actionable' (Jadhav *et al.* 2011). How much individual weight is put on these factors, is less clear. For example, m-health services that offer advice on diagnosis and treatment of ailments attract a greater willingness to pay than preventive information services, which perhaps suggests a short-term utility evaluation (Qiang *et al.* 2012). A study of farmers in Bangladesh found that as many as 80 per cent of farmers were willing to pay for services that promised increased income; however, there is a strong correlation between education levels, farmers' income, farming experience and the ratio of crops sold at markets (Uddin *et al.* 2014). These findings match those of Hill *et al.* (2013), who concluded that education, in addition to wealth and risk

exposure, is a key factor that influences willingness to pay for agricultural insurance services in Ethiopia.

## 6.10 Alternative revenue streams

In addition to B2C revenue, service providers may seek additional income through third-party actors and business-to-business (B2B) sales. Not only do these models allow for increased or diversified revenues, they may also help alleviate problems of low willingness to pay or help expand services to the BOP segment where purchasing power is low.

Services can attempt to integrate other business or enterprises into their revenue streams in various ways (Table 6.5).

Through advertisements or public service announcements, services can raise revenue by allowing others to send targeted information to its users. M-services that have large user groups, and detailed information about users, can allow advertisers to narrowly target those who are most likely to be persuaded by their information. While clearly of interest to commercial actors, such as farm input retailers or pharmaceutical companies, reaching broader groups efficiently and conveniently can also be valuable to government agencies and NGOs. Based on a consumer survey by Inmobi on people's perceptions of mobile advertising, 70 per cent of Africans had a positive view of mobile ads, higher than on any other continent, which suggests great potential for this type of activity (Lamberti 2010).

Large-scale services that connect third parties to large or targeted user segments can monetise the information asymmetry present in many developing countries by allowing others to conduct market surveys or research among the services' users (Qiang *et al.* 2012). Again, this could be of interest to commercial and non-profit actors, combining narrow targeting with efficiency and low costs. The attraction of such alternative services may even extend beyond actors involved in the specific field the m-service is focusing on (such as health or agriculture), provided useful market information can be extracted. Alternatively, services with detailed information about users and their consumer patterns can also attempt to monetise this by selling the information to third parties. However, careful consideration is needed to maintain customer trust, and respect user privacy and confidentiality.

**Table 6.5 Alternative mobile network operator revenue streams**

Revenue stream	Description	Risks
Sale of user information	Services that collect information from users may sell this to interested third parties such as insurance companies, banks, governments, NGOs, or retailers. Information may be collected through normal operation of the service or by getting users to complete targeted surveys.	Raises concerns about commercialisation of personal data, and privacy.
Conducting surveys	Services with a large or broad user groups can conduct or facilitate market research surveys for third parties. Users potentially receive small incentives in the form of airtime or cash rewards.	Surveys must be targeted appropriately, and be relevant to respondents. Should not conflict with values or goals of the service.
Advertisements and promotions	Third parties may pay to send information to users. They may pay for users to receive referrals to their business. Apps may feature advertisements on user interface (app or web-portal).	Care should be taken so that information sent out is accurate and does not reduce users' trust in the service. The initial threshold for generating advertising revenue from subscribers through Apple and Android markets is high: 500,000 downloads or 75,000 daily users.
Other	Fees for informing third parties about user needs, such as insurance or farming inputs. Fee for customising existing webpages or apps for third parties.	

Services that predict the behaviour or needs of users, such as farming input requirements, or health, insurance or finance needs, may attempt to increase their revenue by referring users to specific service providers, or informing the service providers directly of potential customers.

Service providers may also attempt to increase revenue by offering services to other businesses or organisations through bulk sale of subscriptions or a licence to distribute a service. Depending on the type of service, some organisations may have an interest in securing access to the service on behalf of their employees, customers or members. Insurance companies may want to provide customers with access to health or agricultural information to reduce their premium reimbursement. Businesses may want to provide their workers with health information to reduce sick-leave. Agribusinesses may seek to increase the productivity of contract farmers by providing access to mobile extension services (Jadhav *et al.* 2011).

### **6.11 Ensuring value propositions**

While alternative revenue streams may increase services' profitability, careful consideration needs to be made to ensure that the value propositions of existing stakeholders are not negatively affected, and that the quality of the service is not irreversibly decreased. Due diligence should be undertaken whenever a new partner enters a project, to ensure their values match the project and that they provide information or services that are relevant, useful and of sufficient quality. Providing users with information that is erroneous or misleading can have a significantly detrimental effect on users' confidence in a service, and reflect badly on all parties involved. Restoring user confidence can take significant time and effort, if at all possible.

Ideally, new revenue streams should be integrated in ways that increase the perceived value or outcomes for all relevant stakeholders, including end-users. Provided the necessary due diligence and quality assurance have been conducted, advertisements can enhance end-users' perception of the value proposition by increasing their knowledge of available options, while also being beneficial for the advertisers. Facilitating access to retailers or service providers can similarly add value for all parties involved. For example, the sale of user information can potentially increase value propositions, because the collected information might result in better public service provision. User surveys or research can be combined with small monetary reward or distribution of airtime.

### **6.12 Finance models**

Most m-service projects feature some form of donor funding, because most apps are non-profit or hybrid models. Even those services/projects that aim to be commercial may rely on grants, challenge funds or angel investment from socially aware investment funds, such as Acumen, to get started (Qiang *et al.* 2012). This dynamic is ascribed to the persistent problem of obtaining private finance in the range of US\$50,000–1,000,000, sometimes referred to as the 'valley of death' of lending (Zavatta 2008). It also reflects generally poor access to and development of local venture capital or equity investors in many developing countries.

Several problems, on the demand and supply sides, reinforce problems of inaccessible finance. In addition to the high transaction costs, increased risk and collateral requirements associated with loans to small and medium enterprises, information asymmetries between ICT entrepreneurs and commercial lenders may prevent accurate calculation of project risks, and increase the perceived risk of investments, because few banks or commercial lenders have the necessary expertise to fully appreciate and assess the technicalities of ICT projects (*ibid.*). Meanwhile, lack of firm clustering or underdeveloped ICT sectors provide commercial lenders with little incentive to obtain the technical expertise to fully service the segment.

At the same time, commercial lenders highlight the often poor quality of received prospects and lack of viable or bankable investment opportunities, which reflect the limited commercial experience of many ICT entrepreneurs. In addition, firms that are looking for private funding, particularly equity finance, need to be prepared to give up complete ownership to take advantage of opportunities.

As the result of these combined barriers, commercial lending markets in many developing countries are largely non-existent (Brookings 2014). Most private investors tend to focus their attention on larger, established enterprises, which present lower risks and are more likely to submit high-quality proposals, and proven revenue models (Divakaran *et al.* 2014). Based on average fund fee structures and investment return predictions, a US\$50m investment fund targeting seed funding for investments in small and medium enterprises in the range of US\$500,000–2,000,000 would have to fully assess around 500 firms, and finalise 30 investments over a 4–5-year period, an almost insurmountable challenge (*ibid.*).

### **6.13 Technical assistance for start-ups**

The lack of private equity or venture capital available to ICT start-ups in developing countries may have wider implications than lack of funding. Equity and venture capital investors that participate in the management and operation of their investees' firms often bring invaluable expertise and advice that can help firms grow and propel projects to expand beyond initial pilot phases.

A World Resources Institute study of institutional investment funds that focus on emerging markets found that all the surveyed investor groups provided some form of technical assistance to the ventures they participated in, and reports of wider attention to the benefits of active equity ownership and support (Divakaran *et al.* 2014). The assistance took place both pre- and post-investment, and covered such areas as financial literacy, business plan development, marketing and legal support, and access to international supply chains.

According to a study conducted on behalf of the African Venture Capital Association, private equity investors contribute to significant economic growth within the firms they invest in, and average returns for investors were twice that of Johannesburg Stock Exchange (Ernst & Young and AVCA 2013).

### **6.14 Finance for start-ups**

Despite the difficulties in securing funding for start-ups, trends suggest that access to finance may be improving. Business conferences, such as the US–Africa summit in Washington DC in August 2014, illustrate the growing attention paid to investment opportunities in developing countries. More than 200 investment funds that exclusively target Africa have been set up, with many more focusing on emerging markets more broadly (*The Africa Report* 2014).

Technology hubs and incubators have been launched in several African and Asian countries, to spur increased innovation and nurture start-ups. Along with offices, access to computer equipment and collaborative spaces, these technology incubators may provide technical assistance or financial support.

MNOs stand out as one of the few types of organisation that have the necessary funds and incentives to embark on commercial mobile VAS projects; however, little evidence exists to show that MNOs are undertaking such projects (M-Pesa may be an example, but even this developed out of seed funding from donors). Some MNOs have moved into the e- and m-health sectors; however, based on GSMA reports, these mostly seem to be in developed countries, and largely aimed at B2B and healthcare professionals (GSMA 2012b). Several technology hubs and incubators have received support from large MNOs, such as Orange.



While still at a very early stage, crowdsourcing might grow to become a viable option for new firms that are seeking investment. Pioneered by sites such as Kickstarter and Indiegogo in the US, HSBC in 2013 estimated the global crowdfunding economy to worth more than US\$5.1bn, with vast potential for growth envisioned in emerging markets (Broderick 2014).

Domestic crowdsourcing sites that have been launched in Africa include SliceBiz in Ghana, M-Changa in Kenya and Thundafund in South Africa. Around 100 Thundafund projects have been initiated with funding from more than 4,000 individual donors. The size of projects funded through these sites is currently relatively low; for example, the highest-earning project on Thundafund raised just over 550,000 rand (around US\$50,000). However, with increased popularity crowdsourcing could improve entrepreneurs' access to finance.

## 7 Conclusions and implications for impact assessment of m-nutrition interventions

A number of conclusions can be drawn from the previous sections, each of which has implications for m-nutrition impact assessment:

1. Behaviour change models in nutrition and agriculture are dynamic and multifactorial. This reflects scientific advances and trends, but it is also driven by the search for more effective models that address resistance to change and complex environmental, social, economic, and cultural barriers. Behaviour change is not easy. The studies cited have had modest success. Mobile technology interventions need to have realistic expectations about how far they will change behaviour and how sustainable it will be.
2. While agriculture may appear further ahead in mobile-facilitated behaviour change than nutrition, most early interventions improve the efficiency of behaviours that farmers already think are important (e.g. maximising productivity and profit). Changing behaviours more fundamentally, especially if it concerns gender norms or negatively affects profits, is much more challenging. Experience of interventions that improve the quality of price, intermediary and weather data may do little to inform the prospects of interventions that aim to change farmers' behaviour more fundamentally.
3. The number of sources of nutrition- and agriculture-related information available to mothers and farmers is expanding rapidly. But how they sift and evaluate that information is unlikely to change quickly. To compete with tried and trusted sources, new services must invest in face-to-face engagement and remote interactions. Push models do not work well without mobile technology, and there is no evidence that accelerating them with mobile technology will make them work any better. The importance of interactions was repeatedly highlighted as a key factor in successful behaviour change in nutrition and agriculture.
4. The mobile technology market is complex and in flux. New markets experience a great amount of churn: customer switching, new providers entering and leaving, new hard and soft infrastructure, new types of content, and new ways of receiving and sharing it. Impact evaluation in such a context is challenging. Identifying treatments is as much of a challenge as identifying counterfactuals. Continual improvements and modifications to mobile phone apps add further complexity to the impact assessment.
5. The sustainability of business models that incorporate nutrition-related behaviour change is far from clear. Nutrition-related interventions that governments and NGOs run do not have to align with the incentives and interests of so many stakeholders. Nevertheless, the latter are subject to political and institutional shifts, while consumer needs and the regulatory regime drive the former. If a business model can be found, it may well be more sustainable than a public-only model.
6. The impact of a mobile-based nutrition service on nutrition-related behaviours is unlikely to be high on MNOs' list of priorities without evidence that it increases and sustains profits. Impact evaluators will need to be patient, creative and flexible.

# Annexe A Core nutrition-specific interventions for the improvement of child nutrition

## Core nutrition-specific interventions

1. Folic acid supplementation
2. Multiple micronutrient supplementation
3. Calcium supplementation
4. Balanced energy protein supplement
5. Exclusive breastfeeding promotion
6. Complementary feeding promotion
7. Vitamin A supplementation (6–59 months)
8. Preventive zinc supplementation
9. Management of Severe Acute Malnutrition
10. Management of Moderate Acute Malnutrition

Source: Bhutta *et al.* (2013).

## Annexe B Detailed information on the retrieved m-nutrition studies

Reference	Country	Behaviour change goal and technique	Underlying theoretical framework	Target population	Intervention description	Outcome	Challenges and recommendations
<b>Infant feeding and complementary feeding practices</b>							
Jiang <i>et al.</i> (2014)	China	Improve breastfeeding practice and complementary feeding Provide information, social support via communication with research team SMS (two-way)	None	n=582 pregnant women	Quasi-experimental design with 2 community health centres as intervention and 2 as comparison Intervention: weekly messages on infant feeding tailored to women's specific situation (e.g. child age, whether mother went back to work), interactive SMS communication with rapid response to mothers' questions (e.g. problems of breastfeeding initiation, breastfeeding after caesarean section), regular SMS messages that require women to enter data on current situation, routine ante-and postnatal care. Comparison: only routine ante-and postnatal care	Intervention group had significant higher odds of exclusive breastfeeding for 6 months (OR: 2.67, 95% CI:1.45–4.91), despite increased likelihood only 15% of mothers in the intervention group exclusively breastfeed for 6 months and 6% in comparison group No effect on prolonged breastfeeding after 6 months Significant improvement in knowledge about optimal complementary feeding behaviours, but no difference in actual practices between intervention and control group	Environmental and social barriers may have prevented behaviour change (e.g. maternity leave regulations, peer pressure, traditional beliefs about optimal length of breastfeeding and introduction of food at 4 months, conflicting advice from community health workers) Importance of tailored and relevant messages
Flax <i>et al.</i> (2014)	Nigeria	Increase early initiation and exclusive breastfeeding Provision of information, social support from other beneficiaries and small-scale media SMS and voice messages (one-way)	None	n=390 Beneficiaries of microcredit programme	RCT, intervention: monthly breastfeeding group sessions, weekly text and voice messages to groups (1 mobile phone for 5–7 women), beneficiary-generated drama and songs based on messages Control: breastfeeding group sessions only	Intervention group had significantly higher odds of exclusive breastfeeding (OR:2.4, 95% CI:1.4–4.0) and timely breastfeeding initiation (OR: 2.6, 95% CI:1.6–4.1)	SMS just one of several behaviour change techniques
Datta <i>et al.</i> (2014)	Tamil Nadu, India	Increase knowledge about child health (including breastfeeding and complementary feeding)	None	M=120 (male or female, preferably head of household)	Pre- and post-assessment in 6 study sites. Participants received 10 standard text message on child health and infant feeding, 1 message per day	Significantly higher levels of knowledge about length of exclusive breastfeeding and best time for the introduction of complementary foods after interventions	Generic messages often perceived as irrelevant and/or were ignored Only literate household members (often men) could read messages

		Provision of information only SMS			Messages were in English and Tamil Assessment of knowledge at baseline and after intervention	No assessment of changes in attitude or actual practices	Messages were difficult to understand or it was unclear how recipients should react
Jareethum <i>et al.</i> (2008)	Thailand	Promote healthy pregnancy behaviours (incl. information on breastfeeding and infant feeding) Provision of information, social support SMS (one-way)	None	n=68 pregnant women who attended antenatal clinic in Siriraj Hospital	RCT, intervention: 2 text messages a week from week 28 onwards and routine antenatal care Control: only routine antenatal care	Significantly higher satisfaction and confidence, and less fear at end stage or pregnancy in the intervention group More confidence in perinatal period (non-significant)	SMS messages as additional support for pregnant women (not replacement of one-to-one counselling and guidance)
MHSM SMS Toolkit, (Datamation Foundation 2013)	Uttar Pradesh, India	Increase pregnant and lactating females' knowledge about child health and reproductive health (incl. behaviour change messages on breastfeeding, complementary feeding) Provide information, social support and community mobilisation SMS (one-way)	None	Local health workers recruited and registered pregnant and lactating women in project area	Formative evaluation, lessons-learned document 2 messages a week starting from week 40 of the pregnancy Messages tailored to baseline data provided during registration and reinforced messages provided by government of Uttar Pradesh	Authors claim knowledge of mothers and their families on child health and nutrition improved; however, no details on how this was assessed	Importance of providing behaviour change messages in local language Involvement of whole community, including husbands, increases likelihood of uptake of the intervention
Crawford <i>et al.</i> (2014)	Malawi	Increase knowledge about maternal, newborn and child health care (incl. optimal feeding practices) and initiate change in rural Malawi Provide information (via call centre, pushed SMS, pushed voice message or retrieved voice message)	None	Subscribers to Airtel (mobile phone operator) use free hotline to speak to call centre adviser about pregnancy, child health and nutrition. Call centre adviser promotes subscription to regular maternal and child health	Pre- and post-assessment based on routine monitoring of subscribers via telephone survey Three self-selected groups: pushed information and behaviour change SMS, voice messages or retrieved voice messages SMS subscribers received more messages because it was cheaper than voice messages or retrieved voice messages	SMS messages most likely to be received by subscribers, followed by voice messages and retrieved voice messages. 75% of subscribers said they had learned something new from messages Subscribers to SMS messages most likely to report intended or actual behaviour change in response to messages	Women often did not own mobile phone and could not access messages Voice messages might be more appropriate for illiterate populations (problem: higher costs of data transfer)

		SMS or voice message (mainly one-way)		messaging service			
MAMA (Rajan <i>et al.</i> 2013)	Bangladesh	Increase pregnant women and new mothers' knowledge on maternal and child health (incl. child nutrition and breastfeeding) and improve their behaviour Provide information SMS and voice messages (one-way) Since June 2013, call centre for mothers' additional questions (two-way)	None	n=1403 subscribers (survey with n=161 and qualitative interviews with n=89) Women subscribe via SMS, customer centre or directly via local outreach agents ('health workers') Outreach partners include outreach partners, namely BRAC, Smiling Sun Franchise Program (SSFP), MCHIP's MaMoni Program, Info Lady of Fair Price International Pvt. Ltd. and Blue Star Service Promoters (BSPs) of Social Marketing Company (SMC)	Formative evaluation lessons learned document (mixed method research) Pregnant women receive 2 messages (voice or SMS) a week for 37 weeks of pregnancy. New mothers receive 2 messages a week for 52 weeks until child is 1 year old Some messages address father or other family members. Messages are targeted at the stage of pregnancy new motherhood (no further tailoring) Since June 2013 mothers can talk to health worker via call centre	94% of subscribers satisfied with service (based on telephone survey with n= 161) (but as authors highlighted this could refer to the content, service in general, etc.) In structured interviews 46% (n=25) of women said they exclusively breastfeed for 6 months in response to the messages or made positive changes to other healthcare behaviours	Messages sometimes perceived as too generic, not novel enough, too unspecific Message repetition perceived as disappointing More interactive services would have been preferred Trust in messages could be increased by more frequent presence of MAMA outreach staff Messages often did not reach women but were picked up by husband
MAMA, (Mobile Alliance for Maternal Action 2014)	South Africa	Increase pregnant women and new mothers' knowledge on maternal and child health (incl. child nutrition and	None	n=200 subscribers (50 each at different stages of pregnancy or motherhood)	Formative evaluation, lessons learned document Different services for subscribers with different profile (SES, literacy and language skills):	High satisfaction with service; no details on effect on behaviours	

		breastfeeding) and improve their behaviour Provide information 4 different communication channels: SMS and voice message (one-way) USSD, Mxit and Mobisite (interactive content with connection to social web community)		Women subscribe themselves, different marketing strategies used (with differences in rural and urban areas)	SMS – 2 a week until child is 1 year old Voice message – weekly 30 sec. voice message pushed to subscriber (most expensive technical set-up; not clear whether already in use) USSD – one two-stage interactive quiz once a week, accessed by dialling USSD line Mxit – daily text message in Mxit social network Mobisite – no details		
Mobile Midwife, (Grameen Foundation 2011)	Ghana	Promote healthy pregnancy behaviours (includes information on breastfeeding and infant feeding) Provide information, small media (e.g. songs), possible social support by family SMS and voice (99% choose voice) (one-way)	None	Not available	Formative evaluation Lessons-learned document Behaviour change messages specifically target each pregnant woman based on her baseline characteristics, with some messages specifically designed for fathers or other household members	42% of people who listen to primary message also listen to secondary message; 36% listen to the tertiary message	Importance of tailored and targeted content of messages for uptake Voice messages preferred to SMS due to high illiteracy Messages for entire household may help to create supportive social environment for behaviour change
<b>Hygiene practices</b>							
Text to Change, (Jalameso <i>et al.</i> 2013)	Uganda	Promote water-and sanitation-related hygiene behaviours Provide information, media (radio, spots, posters), social support as parallel campaigns in communities SMS, call centre (two-way)	None	n=mobile phone subscribers in three regions in northern Uganda	Formative evaluation Lessons-learned document Intervention period: 10 weeks; participants receive 10 interactive text messages with multiple choice questions If correct answers are given, participant receives free communication services and is entered in weekly prize draw Radio shows and 2 radio spots; a day on hygiene behaviour Posters, T-shirts, flyer distribution in intervention area	No details given on whether behaviour changed, but author mentioned interview study with participants that found 'the campaign is changing the life of people'	Importance of using different delivery channels and behaviour change techniques, and repeat messages frequently

## Annexe C Glossary

App	Software application downloaded to mobile device
Cookie	Data on user's website activity, stored in web browser
e-health	Application of electronic processes and communication in health
e-wallet	Money preloaded into an electronic account
Feature phone	Phone with limited features in addition to voice and SMS (e.g. music, email, internet)
M4D	Mobile for development
m-agri	Application of mobile phones in agriculture
m-health	Application of mobile phones in health
MNP	Mobile network portability
m-nutrition	Application of mobile phones in nutrition
OTT	Over the top
SIM	Subscriber identification module
Smartphone	Phone that can download apps, with functionality of a computer
SMS	Short message service
USSD	Unstructured supplementary service data
VAS	Value added services
VoD	Video on demand
Wi-Fi	Wireless technology for networking computers

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