ANALYSIS

# Agricultural machine-to-machine (Agri M2M): a platform for expansion

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mAgri

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# Contents

# 1. Executive summary

**1. In order to feed over 2.5 billion more people and prevent widespread famine in the next few decades, it is estimated that food production will need to increase by 70% by 2050. This places significant pressure on agriculture, and individual farmers in particular, who will need to overcome rising energy prices, lowering of the water table through unsustainable groundwater extraction, the continuing loss of farmland to urbanization, and increased regulation to limit the environmental impact of agricultural operations.**

The demand for smarter and more efficient agriculture is therefore on the rise as farmers seek to maximise yields and minimise costs, and agricultural businesses seek to source quality agriculture produce, taken to market efficiently, and of sufficient quantity to sustain their profits, as well as to minimise the environmental footprint of their supply chain and operations. Mobile technology is increasingly leading to the creation of innovative services and applications that are used throughout the agricultural value chain to help farmers make the most of the resources available to them.

**2. M2M applications are particularly suited to the agriculture sector, enabling farmers and agriculture businesses to, amongst other activities, monitor equipment, precisely manage their crops and livestock, asses the environmental impact of production, and keep track of tractors, harvesters and other vehicles. Given the high pressure on agricultural resources, M2M (machine-to-machine) can serve as a way to help farmers make informed decisions and improve yields, as well as increase transparency and efficiency within wider agricultural value chains.**

There are, however, various barriers that need to be overcome in order for Agri M2M applications to achieve scale. These range from the cost of setting up and maintaining services, limited network coverage (particularly in rural areas in emerging markets), poor understanding of business cases and benefits of Agri M2M solutions, the need for highly resilient devices to cope with harsh conditions, and the fragmented nature of the agriculture sector (both overall and in terms of Agri M2M).

**3. Agri M2M represents a significant opportunity for mobile operators, as they are well positioned to influence, contribute to and benefit from the entire agriculture value chain. There is potential for mobile operators to carve out a much bigger piece of the Agri M2M sector for themselves, benefiting from an increased number of M2M connections on their network, the potential for additional revenue through value added services, and the prospect of reducing churn and increasing customer stickiness, if for instance M2M services are bundled with a voice/data offering for a rural enterprise customer.**

Mobile operators are in a unique position to target the key barriers to scale of Agri M2M solutions, and by exploring opportunities to expand their portfolio to services beyond just the provision of connectivity, capture a bigger share of the M2M pie, and increase the sustainability of their own businesses.

Striking partnerships can aid in the standardisation of Agri M2M services, reducing integration issues and costs of deployments, and help de-fragment the ecosystem. Mobile operator led innovation hubs and investment in entrepreneurs can lead to the development and deployment of compelling, innovative and scalable business cases to an underserved and poorly understood vertical of the M2M industry. Marketing campaigns to educate end users in the benefits of M2M to their agriculture operations can spur them on to invest in and use Agri M2M solutions. And in addition, through the development of their own end-to-end (E2E) services, large regional or global operators can leverage their purchasing power with suppliers, and spread investment costs over a larger potential addressable audience of farmers and agri businesses, helping lower the cost barrier.

## 2. Introduction

The world's population is growing at a rapid rate. Having grown from 1 billion in 1800 to 7 billion in 2012, it is expected to continue to accelerate and surpass 9.6 billion by 2050[1]. In order to feed over 2.5 billion more people and prevent widespread famine in the next few decades, the UN Food and Agriculture Organisation (FAO) estimates that food production will need to increase by 70% by 2050[2]. This places significant pressure on the agricultural sector that will need to overcome rising energy prices, lowering of the water table through unsustainable groundwater extraction, the continuing loss of farmland to urbanization, and increased regulation to limit the environmental impact of agricultural operations. The demand for smarter and more efficient agriculture is therefore on the rise, as farmers and agricultural businesses seek to maximise yields, minimise costs, and reduce their environmental footprint.

Mobile technology is proving to be increasingly useful to farmers and agri businesses in meeting this demand, and has led to the creation of innovative services and applications that are used throughout the agricultural value chain to help farmers make the most of the resources available to them. These mobile agriculture (mAgri) services are especially important in emerging markets, particularly in rural areas, where limited or even non-existent fixed-line infrastructure means that mobile is often the only way of accessing the information farmers need. Currently, GSMA Mobile for Development (M4D) tracks 98 live agricultural value added service (Agri VAS) deployments, among other mAgri services, throughout Africa, Asia, the Middle East and Latin America. The number of Agri VAS services has grown by 150% in the last 5 years, indicating an increase in interest both by the service providers, such as mobile operators and VAS providers, and farmers and agri businesses.

The mAgri services can be segmented into three broad categories based on the delivery mechanism and technology involved (see Figure 1). The first is Agri VAS, which refers to all services beyond standard voice-calls supplied either in-house by the mobile operators themselves, or by a third party VAS provider. These include information based services providing advice and support for farming activities and price matching information, delivered via SMS (short messaging service), MMS (multimedia messaging service), USSD (unstructured supplementary service data), voice channels such as IVR (interactive voice response), OBD (outbound dialling) and helplines, and data-based agriculture content applications. We discuss the market opportunity and business models used in Agri VAS in South Asia and Sub-Saharan Africa in our report Agricultural value-added services (Agri VAS): market opportunity and emerging business models.

The second category of mAgri solutions are Agri MFS – mobile financial services tailored for the agricultural sector. In emerging markets, nearly 60% of the population is unbanked, and those that do have a bank account mostly live in urban areas. This prevents farmers from having loans, payment facilities, savings and insurance for protection against crop failure.

[1] Source: World Population Prospects: The 2012 Revision, UN Department of Economic and Social Affairs, 2013
[2] Source: 2050: A third more mouths to feed, UN Food and Agriculture Organisation

While the VAS and MFS services are focussed on a machine-to-human interaction (services delivered via mobiles to farmers), the third category of mAgri services is focussed on M2M (machine-to-machine) services. M2M technology connects machines, devices and appliances together wirelessly via a variety of communications channels, including IP (internet protocol) and SMS, to deliver services with limited direct human intervention, transforming them into intelligent assets that open up a range of possibilities for improving how businesses operate. M2M is an integral part of the Internet of Things (IoT), which describes the coordination of multiple machines, devices and appliances connected to the Internet through multiple networks. These devices include everyday objects such as smartphones, tablets and consumer electronics, and other machines such as vehicles, monitors and sensors equipped with M2M communications that allow them to send and receive data.

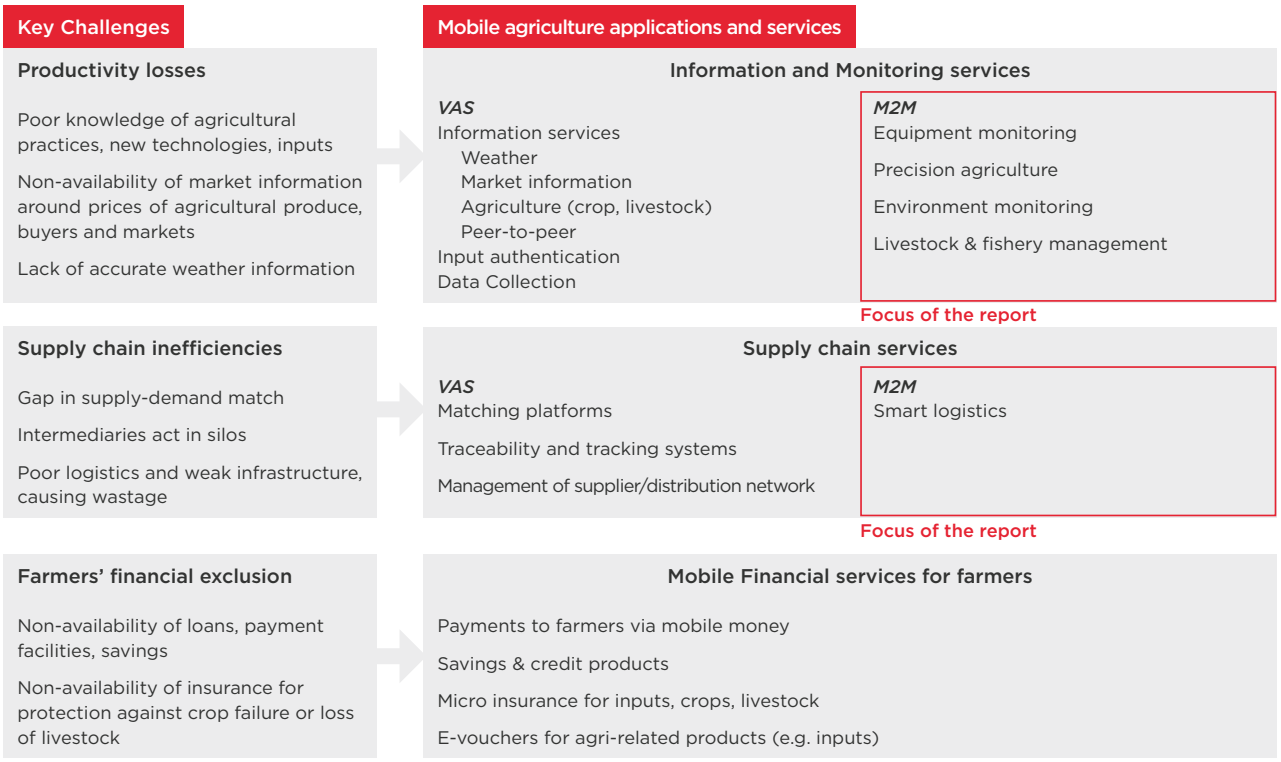


**Figure 1:** mAgri solutions – Mobile VAS and M2M
*Source: GSMA Intelligence*

There are several different types of M2M connectivity, such as cellular M2M, short-range (Wi-Fi, ZigBee, Ethernet), Powerline (PLC), satellite and fixed network (PSTN, ISDN, DSL, fiber, and cable). In this report, we focus on the cellular subset (wireless wide-area network connections), as in our view, M2M denotes communication between machines/objects on a point-to-point basis, utilising the mobile network either directly, or using a gateway device. For example, in a fixed, non-movable equipment monitoring deployment, if sensors are deployed using PLC and use the mobile network only at the point of aggregation, we count this as one cellular connection. Additionally, given the infrastructure limitations for Powerline and fixed network solutions in emerging markets, as well as the high cost

of satellite applications, we believe cellular M2M has the biggest potential in Agri M2M. Therefore, whenever M2M is mentioned in this report, we are referring to cellular M2M.

M2M applications are more sophisticated in nature than VAS services, and to date have mostly been implemented in developed markets. However, a number of use-cases are being experimented with in emerging markets as well, and are proving to be successful in improving productivity and supply-chain efficiencies. We discuss the opportunity and use-cases for cellular M2M in agriculture (Agri M2M) in detail in this report.

# 3. Agri M2M

According to GSMA Intelligence, cellular M2M connections (across all sectors) reached 146 million in Q4 2014, growing at a CAGR of 35% from 73 million in Q4 2010 (see Figure 2). M2M connections growth in the developing region stood at 50% (CAGR) over this period, compared to 25% in the developed region. This is partially due to a strong growth exhibited by China, but M2M services are also gaining traction in other markets across the developing world, such as India and Brazil. GSMA Intelligence research shows that at present, 468 mobile operators offer cellular M2M services across 190 countries[3]. Furthermore, the developing region overtook the developed economies in terms of M2M connections in Q2 2014, and now accounts for 52% of the global M2M base, up from 34% in 2010. While most of the growth has come from automotive, security, utilities and retail sectors, the use of M2M in agriculture has started to gain pace.

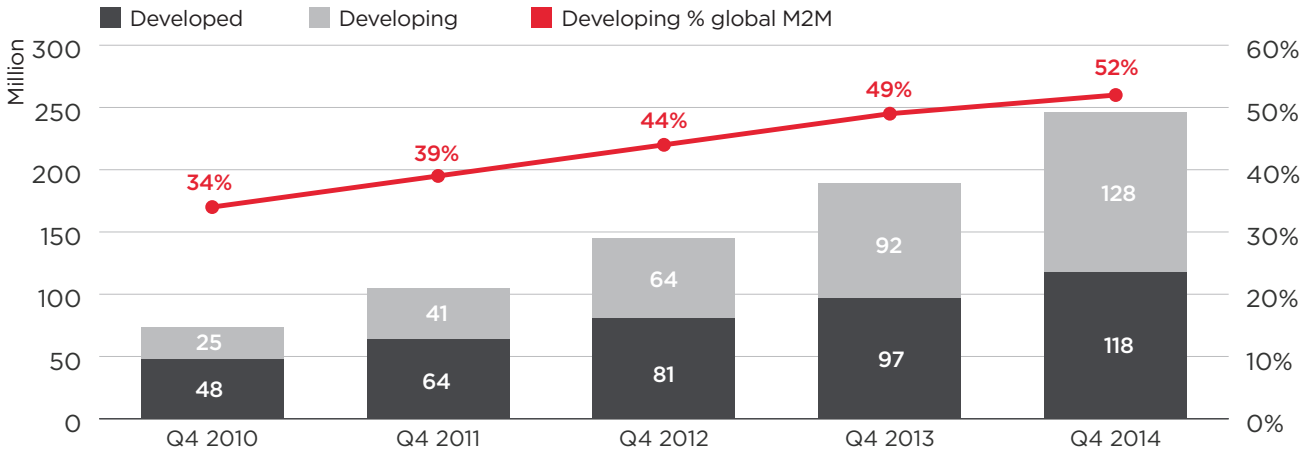


**Figure 2:** Global cellular M2M connections, 2010–2014, developed vs developing
*Source: GSMA Intelligence*

Given the high pressure on agricultural resources, M2M can serve as a way to help farmers make informed decisions and maximise yields from their resources (discussed in chapter 4). M2M applications for agriculture enable farmers to, amongst other activities, remotely measure soil conditions, monitor equipment, track the weather, and assess the health of livestock and crops, all via mobile phones, computers and other devices. M2M can be used to send and receive data about temperature, weight, location and any number of other agricultural factors, as well as requests to each other and to central management systems, autonomously. The stakeholders in the M2M value chain include module vendors, connectivity providers, M2M platform and application providers, device platform providers, mobile operators, aggregators and mobile virtual network operators (MVNOs) (see Figure 3). The information is collected through M2M modules mounted on the assets and transmitted via connectivity providers (mobile operators in this case). This information is then received by system integrators and solution providers which gather and process the data, to be finally displayed via mobile or web applications to the end users. We briefly discuss each of these in the following paragraphs.

[3] Source: Cellular M2M forecasts and assumptions: 2010–2020, GSMA Intelligence, September 2014

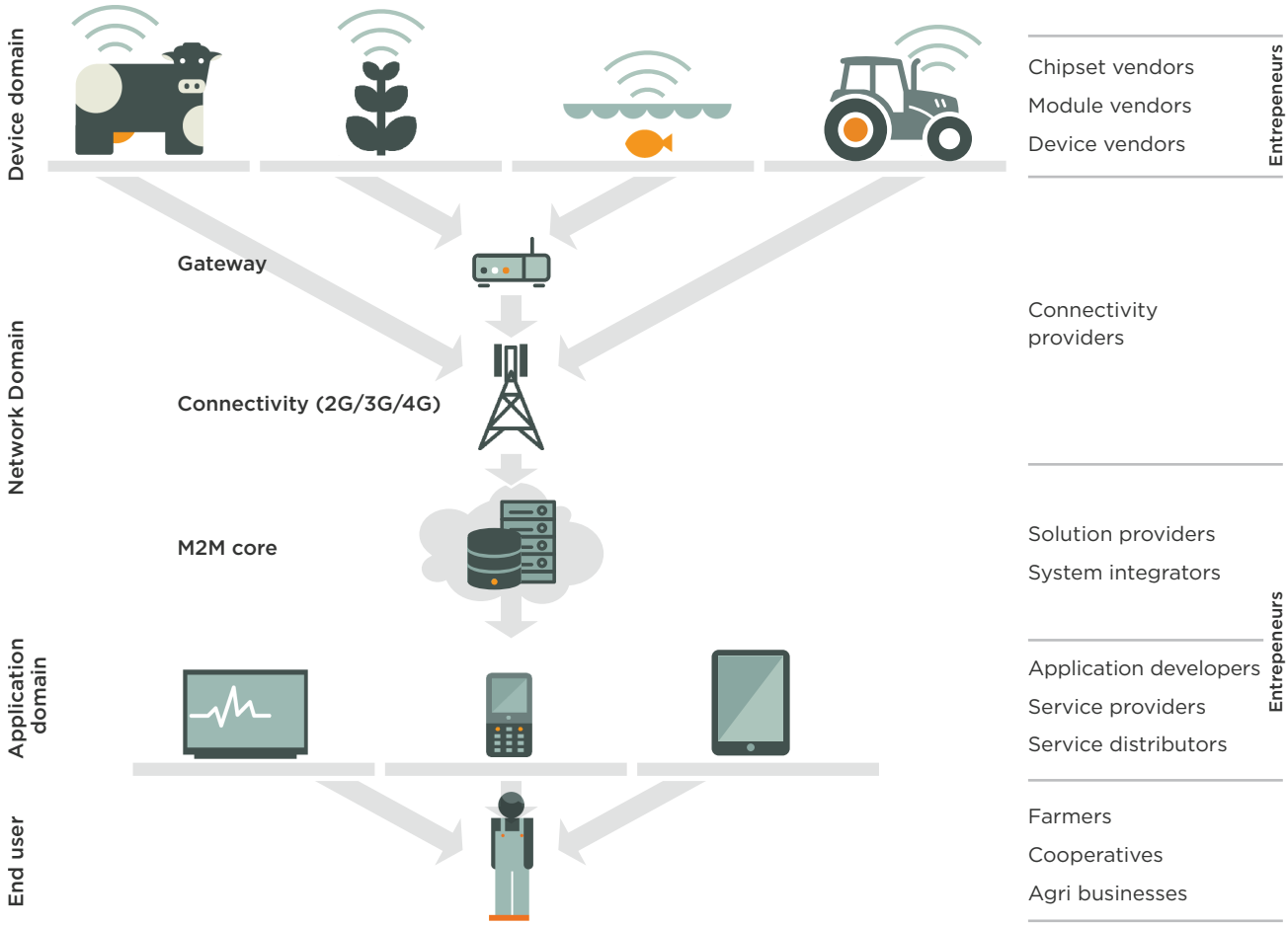


**Figure 3:** Cellular M2M in agriculture (Agri M2M) – value chain
*Source: GSMA Intelligence*

### *M2M device vendors and suppliers (M2M device domain)*

The flow of information begins in the device domain where the M2M devices attached to assets such as fields, crops, livestock and agricultural equipment (such as storage tanks, irrigation pumps tractors and fishing boats etc.) collect the required information through sensors on the M2M terminal. While devices which have SIMs (smart devices) do not need a gateway to send this data through to the networks, other devices with no SIM use gateways to interact with the mobile operator network. The **equipment manufacturers** (e.g. Claas, McCrometer, John-Deere etc.) and the **chipset and module manufacturers** (e.g. Qualcomm, Ericsson, Sierra Wireless) are active stakeholders in this domain.

Agriculture has traditionally been dominated by human-operated machines, and while the use of computerised systems has made it easier to manage, adapting to the rapidly changing technology is difficult both for the device/equipment manufacturers as well as the end users. Large agri-equipment manufacturers have been keen to adopt M2M technology, and have launched a number of applications, but often quote lack of expertise in M2M as a major barrier to the development of M2M based applications in agriculture. On the other hand, smaller vendors and device/module manufacturers with novel Agri M2M ideas

have trouble bringing their products to market, either due to cost, lack of a distribution channel, limited access to a connectivity platform, or any number of other reasons. In both these cases, partnerships and collaboration with network operators can help in bringing a number of innovative uses of M2M to the fields.

### *Mobile operators (network domain)*

The information collected at the device level is then transmitted to the M2M applications via cellular (the focus of this report) or non-cellular channels in real-time. The key stakeholder at this level is therefore the **mobile operator**. Whilst the main function of mobile operators is to provide connectivity, some, such as Turkcell, Deutsche Telekom and Orange, have formed partnerships (mostly with system integrators and application providers) in order to enable other areas of the Agri M2M ecosystem, whilst others, such as Verizon and Vodafone, are offering proprietary end-to-end M2M solutions to their customers themselves. In these cases (and in some other situations), the mobile operator also provides service integration, taking responsibility for both connectivity and the M2M core.

However, according to GSMA Intelligence data, there is an apparent lack of mobile operator involvement in Agri M2M, compared to more mature M2M segments such as Automotive and Retail. In the Automotive M2M vertical for example, 81% of deployments are mobile operator led, whilst in Agriculture, only 17% are mobile operator led (see Figure 4). This can partially be explained by the fact that Automotive was one of the first industries to use M2M solutions, business cases are well established, and the benefits for mobile operators to provide high-bandwidth telemetry connections are well understood. Meanwhile, high deployment costs, technical complexities, a fragmented market, limited understanding of potential business cases, and unexplored benefits of M2M solutions has, to date, limited operator involvement in the Agri M2M vertical. We discuss the role of the operator further in chapter 6.


**Figure 4:** Low participation of mobile operators in Agri M2M (data is indicative based on a sample of services)
*Source: GSMA Intelligence*

### *M2M platform players (application domain)*

After passing through the network domain, the data is transmitted to a M2M platform and applications server, which contains the middleware that connect the M2M platforms to business applications via APIs (application program interfaces). The stakeholders at this level are the **M2M solution providers** and **system integrators** such as IBM, Accenture and Logica, and **service providers** that provide bundled equipment as a kit in a service package, or recommend farmers to buy equipment from chosen original equipment manufacturers. Useful data and analytics solutions are then made visible in real-time to the end users through mobile applications.

The system integrators and solution providers primarily help the other sub-systems of the value chain speak the same language. This is essential because as the processes become more complex, the harmonisation of activities and processes between various stakeholders in the value chain becomes important. Moreover, the use of M2M goes far beyond providing remote connectivity between machines, to using the collected data to enhance business decision making through integration with customer relationship management (CRM) and enterprise resource planning (ERP) systems, hence optimising business processes. Thus the stakeholders in the application domain play a key role in integrating the various stakeholders, providing an intuitive interface to the end users and also in optimising business processes such as billing and supply chain management, and making sense of the large quantity of data to make informed decisions for the future. The challenge here however, is the lack of standardisation allowing various services and devices to interoperate, making it difficult for many M2M ideas to be trialled or prototyped using platforms that are both interoperable and highly scalable.

### *Entrepreneurs*

With the rise of IoT and M2M and an active participation from the likes of Apple, Google, Cisco, IBM, Samsung etc., a number of start-ups, accelerators and incubators have shown interest in implementing and investing in Agri M2M solutions, particularly in core services areas such as platforms and application development. However, some entrepreneurs are now beginning to show an interest in experimenting with innovative M2M solutions at the device and module stage as well. Since not all entrepreneurs come from a technical or agricultural background, the big challenges for them are to understand the market, find the right business model, and deal with a highly fragmented value chain where most of the stakeholders, despite investing across multiple segments, mainly focus on one portion, making service integration a key concern.

This makes the role of operator even more important. Since, barring a few, most operators do not have the in-house expertise and resources to offer end-to-end M2M solutions, they can benefit by partnering with various stakeholders, especially entrepreneurs, that are looking for springboards to bring their products and ideas to market. This would help the entrepreneurs and start-ups to better integrate with and benefit from Agri M2M solutions (see Hubs, entrepreneurs and grass-roots innovation in chapter 6).

### *End users*

It is the end users that want to make the best decisions in the shortest possible time to ensure optimal production, thus the whole M2M value chain exists to deliver the most relevant and accurate data to the end users in the most efficient and simple to understand manner. The end users for M2M applications include crop and livestock farmers, cooperatives and agri-businesses. The individual or small-hold farmers typically use Agri M2M solutions for equipment and fleet monitoring in their farms. However, given the high cost of M2M implementation (arguably the biggest barrier to the adoption of this technology), agri-businesses and cooperatives are better placed to make full use of the potential of M2M in agriculture (see Cost in chapter 5).

### *Other enablers*

In addition to the above mentioned stakeholders that have a clear involvement in the value chain, the government and regulators act as horizontal enablers in the process. It has been seen in other M2M verticals, such as automotive, health, smart metering and smart cities, that supportive regulatory frameworks can stimulate the deployment and adoption of certain M2M applications.

China is a good example of this, where the government has provided "strong guidance" and made special funds ($603 billion up to 2020) available to accelerate the development of the IoT market. Similarly, the government of Brazil passed a new regulatory decree which has significantly reduced the tax on all M2M devices, and the European Commission is targeting 80% smart meter penetration by 2020 as part of its Energy Efficiency plan. Supportive regulations like this enable a conducive environment for the growth of M2M, and serve to boost public awareness about M2M services. Also, the role of donors, impact investors, venture capitalists (VCs), incubators and accelerators is crucial in funding innovation within the agriculture sector, and innovation hubs are springing up all over the world (such as The GrowthHub in Kenya, the Grain Innovation Hub in Canada, and the Cereal Systems Initiative for South Asia).

# 4. Use cases of cellular M2M in agriculture

## 4.1 The Agri M2M market

M2M technology has opened up a range of innovative applications that can help to monitor and control a remotely located asset, reducing the need for direct human intervention, and also limiting potential human errors in the process. Whilst consumer-focussed applications like connected refrigerators that count eggs and electric toothbrushes that send alerts to the user's mobile phones garner the most media attention, the industrial applications of M2M can create a much bigger impact. Agriculture is one such industry that faces the challenge of feeding an ever increasing population, whilst struggling with a number of external factors such a weather fluctuations, supply-chain inefficiencies and rising costs on a regular basis. M2M in agriculture has the potential to increase efficiencies in the following areas:

- Improve availability of information about the condition of crops and livestock through real-time monitoring and alert services
- Maximise efficiency and longevity of agricultural equipment through real-time remote control and monitoring
- Reduce losses during transportation of produce through distributors and retailers to the end users by monitoring the logistics

According to Machina Research, developed countries account for just over 60% of cellular M2M connections in agriculture, with the biggest markets being Japan, the US and South Korea. However, there has been an increase in the adoption of cellular M2M in emerging markets, especially in China and India (see Figure 5). This is a reflection of the proportion of labour force in agriculture, and the need to increase productivity in emerging markets. According to the UN Food and Agriculture Organisation (FAO), almost 98% of the total labour force in agriculture lives in emerging markets. However, on average, the productivity yielded in terms of kg per hectare is greater in developed markets (4,805 kg/hectare versus 3,300 kg/hectare)[4] due to more advanced machinery, access to infrastructure, modern knowledge and capital.

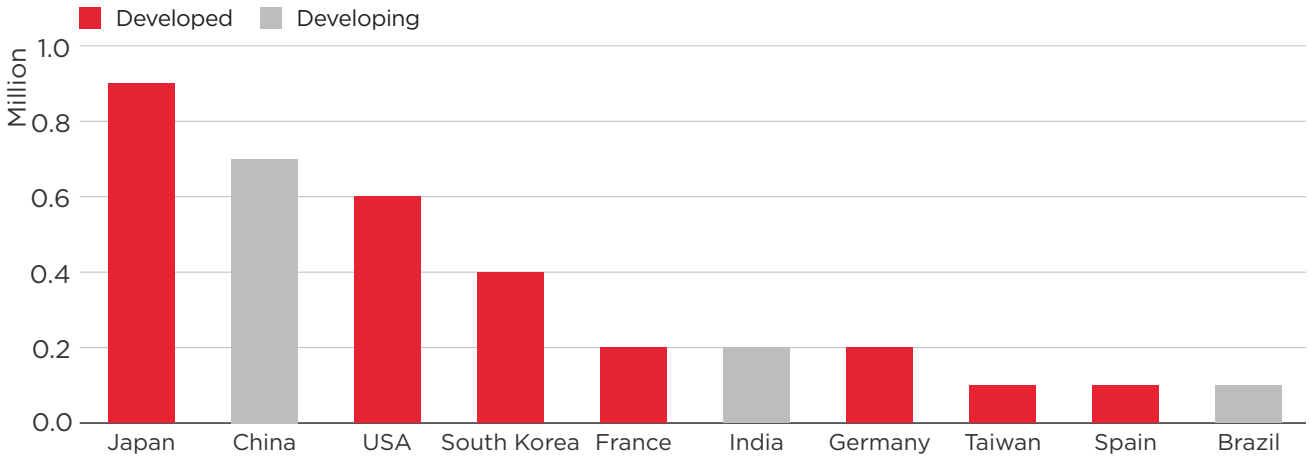


**Figure 5:** Cellular M2M connections, Agriculture and Environment, 2014
*Source: Machina*

[4] Source: World Bank

## 4.2 How and where can M2M add value

While a number of M2M applications such as fleet management or logistics management are generic and are being used in more than one industry, we have divided the possible applications of M2M in agriculture into five segments: i) equipment control and monitoring, ii) precision agriculture, iii) environment monitoring, iv) livestock and fishery management, and v) smart logistics.

Looking at these different Agri M2M applications, the most common use case is equipment monitoring, particularly in emerging markets (see Figure 6). This is because monitoring is the easiest M2M application to deploy, and it is the most crucial, as it provides the opportunity to remotely control, track and look after expensive equipment. In developed countries, precision agriculture is more common than in emerging markets mainly due to high initial investment costs, and reflects the fact that big data analytics is at a more advanced stage in developed countries than in emerging markets. According to the tracked data, in both developed and developing countries, logistics management (e.g. smart logistics) is the least common application. This is because satellite technology is used quite often in cargo tracking (which it is out of the scope of this report) and fleet management is often grouped under mAutomotive. We discuss each of these application areas in detail below.

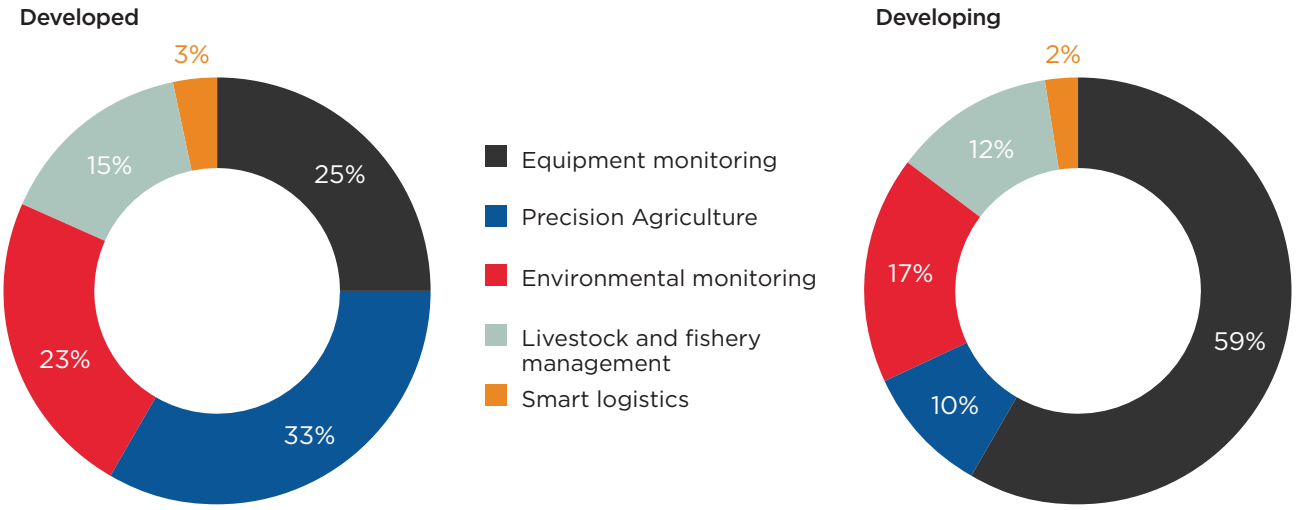


**Figure 6:** Agri M2M applications (data is indicative based on a sample of services)
*Source: GSMA Intelligence*

### *Equipment monitoring*

Today, agriculture accounts for approximately 70% of total fresh water use worldwide[5]. In addition, each year, agriculture wastes 60%, or 1,500 trillion litres of the water it uses[6]. This is equivalent to four trillion litres per day, equivalent to the minimum annual water

[5] Source: Precision agriculture: Using predictive weather analytics to feed future generations, IBM
[6] Source: Farming: Wasteful water use, WWF

requirement for a population roughly the size of Brazil (203 million people)[7]. The main causes of water waste are leaky irrigation systems, inefficient methods of distributing water to fields, and the cultivation of crops not suited to drier environments. Smart monitoring of irrigation systems can provide a solution to this problem by alerting the farmers in case of an equipment breakdown, and allowing them to remotely control the water pumps, which could lead to a significant reduction in water wastage. Other equipment that can be monitored through M2M solutions includes tractors, harvesters, tanks, and pumps, where location, condition, status of operation, and other diagnostics can be tracked remotely and automatically.

As an example of an M2M-based equipment monitoring application, irrigation sensors are used in blueberry farms in Chile. The sensors are inserted in the soil to monitor the plant's irrigation needs and demand for water, and optimise the use of water remotely. Researchers at Chile's Universidad Católica de la Santísima Concepción (UCSC) reported that the use of irrigation sensors in these blueberry farms could cut water consumption by about 70%[8]. This application is a blend of precision agriculture and water equipment monitoring, exemplifying the blurred lines between various segments in Agri M2M. Similarly in India, Ossian Agro Automation, a device manufacturer, launched Nano Ganesh, a mobile based remote control system for agricultural water pumps. Through the Nano Ganesh modem farmers can control the pumps remotely, check the availability of power supply, check the on/off status of the water pump, and, in some advanced modems, receive alerts in the case of cable or pump theft. Once the Nano Ganesh modem is installed, the farmer can simply dial a dedicated number and use the on or off code to control the pump. The estimated benefits per farmer/end user of the Nano Ganesh system are 1,000 litres of water, one litre of petrol and at least three hours of time saved per day.

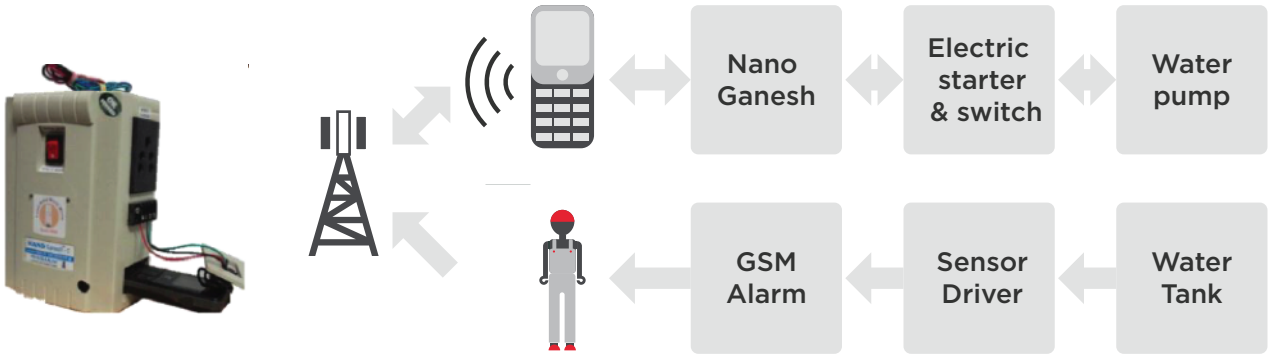


**Figure 7:** Nano Ganesh remote control system
*Source: Nano Ganesh, GSMA Intelligence*

[7] Assuming 50 litres per person per day, which is the water poverty threshold as defined by the UN Development Programme (UNDP)
[8] Source: Chile: wireless sensor irrigation cuts water use in blueberry production, FreshFruitPortal.com, March 2012

### *Precision agriculture (or crop management)*

Precision agriculture relates to remotely observing, measuring and monitoring crops and equipment, and using real time data on the weather, soil and air quality, and other factors to generate analytical models that can help farmers be more efficient in their operations, and make more precise decisions about planting, growing, harvesting and transporting crops, leading to better price points and a more stable supply chain. IBM has estimated that 90% of all crop losses are weather-related, and predictive weather measurement through the application of precision agriculture systems can reduce this crop damage by about 25%[9].

NEC Corporation together with Dacom (a Netherlands based agri-IT company) have trialled a precision agriculture solution in Romania that uses M2M sensors and big data analytics software to maximize yields at a reduced cost. The solution uses sensors that can measure the moisture and temperature of soil, speed and direction of wind, temperature, humidity, rain and sunlight across the farm. All this data, combined with local weather forecasts, is aggregated to provide farmers with accurate planting, fertilizer, irrigation, protection and harvesting guidance. The application is highly effective in reducing wastage due to untimely use of chemical fertilisers, or due to wind drift/rainfall wash-off. Results from the trial suggest that farmers can reduce their expenditure on chemical inputs by up to 40% per hectare by using these systems, leading to significant savings and improvement in crop quality whilst reducing harm to the environment[10].

M2M based crop management is also being used to control pests. An example is Semios, a pest management system launched in 2010 in Canada which combines precision agriculture, biological pest control and data management. The system monitors for insect pests, plant diseases and micro-climates. It is made up of weather stations, camera-enabled traps that monitor daily pest activity, and a remote-controlled aerosol pheromone dispenser to disrupt the pests mating (pheromones are a less toxic and more cost effective alternative to pesticides). All the collected data is transferred wirelessly to the Semios dashboard, and then transferred in near real-time to farmers via a smartphone or tablet. The ability to monitor and control pests reduces dependency on chemical pesticides, thus eliminating unnecessary spraying practices[11].

[9] Source: Precision agriculture: Using predictive weather analytics to feed future generations, IBM
[10] Source: NEC and Dacom collaborate on precision farming solution to maximize yields and reduce costs, NEC, October 2014
[11] Source: Semios: big data and digitizing the farm, Betakit, August 2013


**Figure 8:** Semios system

*Source: Semios*

The use of M2M in precision agriculture is gradually gaining pace in developed markets. In developing countries however, high deployment cost act as a major barrier, especially when seen in the light of cheap labour availability. Having said this, M2M connections growth is now being led by developing markets, indicating a strong demand and potential of scaling these applications in these regions. Use cases in precision agriculture in particular have a significant potential to be replicated in developing countries where agriculture is the mainstay of most economies.

### *Environmental monitoring*

While modern agriculture practices have increased yields over recent years, the overall impact on the environment is tremendously negative, with the greatest destruction caused by clearing land for agriculture. Around 50% of the world's habitable land has already

been converted to farming land, and a further 120 million hectares will be converted by 2050. In addition, unsustainable agricultural practices are seeing 12 million hectares of land lost each year to desertification. In many countries, agriculture is the leading source of pollution through the use of pesticides, fertilizers and agrochemicals, which can run-off from fields to rivers causing the contamination of the marine environment[12]. In addition, agriculture, forestry and other land use contributes to approximately 24% of all direct greenhouse gas emissions[13].

Agricultural processes are currently mostly monitored through periodic human inspection, which is hampered by time and cost constraints. Moreover, most of the potential environmental threats are often un-noticeable to the human eye and hence go un-checked. The use of M2M environmental monitoring solutions, able to be delivered in often hostile locations with low power devices, has the potential to reduce monitoring costs while increasing the amount of data that can be captured and transmitted. These solutions could be useful in the monitoring of water levels for flooding, the quality of air based on levels of various gases (e.g. sulphur dioxide, carbon monoxide etc.), photovoltaic and solar systems, and greenhouse monitoring. It is estimated that M2M solutions can save 1.6 billion tonnes of $CO_2$ emissions by 2020, and the impact varies depending on the type of applications; livestock management (0.7 billion tonnes), soil monitoring and weather forecasting (0.62 billion tonnes), precision agriculture (0.25 billion tonnes) and improving the efficiency in water use (0.03 billion tonnes)[14].

Mobile operators like T-Mobile and Tele2 offer M2M solutions aimed at monitoring various aspects of the environment such as air quality, water, soil and plant life, and are targeted at governments and local authorities so that they can better evaluate the effectiveness of environmental policies. With the use of cellular M2M, governments can lower their costs for field analysis and improve the data collection, and the benefits for the population are improved environmental policies, early warning systems and an improved environment.

### *Livestock and fishery management*

From tracking the location of livestock to monitoring health and habits, livestock management covers a range of issues that currently require a high degree of effort by farmers. M2M solutions can help farmers gain precise information about the health and well-being of their livestock that might otherwise be difficult to track and analyse. For example, farmers can monitor their herds remotely to know when their cows are in heat or about to calve, monitor their milking frequency, or track the movement of their sheep and determine their exact location anytime. Moreover, with a number of disease epidemics originating from animals, the need to monitor livestock health has increased substantially. A number of M2M solutions can help cow and poultry farmers get insights into the body temperature and eating habits to help in the early detection of diseases that are difficult to detect without a veterinary doctor's intervention. Similarly, M2M can also be used in aquaculture, for example to monitor the temperature and pH levels in aquariums.

[12] Source: Environmental impacts of farming, WWF
[13] Source: Climate Change 2014: Mitigation of Climate Change, IPCC, April 2014
[14] Source: GeSI SMARTer 2020: The Role of ICT in Driving a Sustainable Future, BCG & GeSI, 2012; Machine to Machine Technologies: Unlocking the Potential of a $1 Trillion Industry, Carbon War Room, February 2013

In the UK and France, Vodafone and Keenan have launched an M2M application to monitor livestock feeding machines. Real-time information allows farmers to provide more consistent food rations to animals, and this has lead to an increase in milk production of 1.75kg per cow per day, and an improvement in the quality of the milk and beef[15]. In another example, Ericsson collaborated with the China Agriculture University to launch an M2M based aquaculture solution that helps farmers use their phone to monitor the quality of water in crab ponds. This helped lower energy consumption, save labour and enhance productivity. Similarly in South Korea, SK Telecom has launched a smart eel farm management system that will be used to observe key indicators including water temperature, quality, and dissolved oxygen.

### *Smart logistics*

Over 40% of the total food produced globally is wasted every year, and just over 20% of this is due to transportation and storage-related wastage[16]. These losses can occur at various points in the agriculture supply chain, whether due to delays in transport (more so for highly perishable produce) or improper storage, which could include infestation by rodents or unfavourable storage conditions, or during many other stages from production to distribution. Wastage of produce is arguably a bigger issue than low productivity, since it indicates a waste of all the time and resources invested in the earlier stages of production.

The use of M2M to monitor transportation of agricultural produce through fleets, cargos and fishing vessels can provide effective solutions to this problem. An analysis by PwC has estimated that M2M solutions in fleet management can reduce food wastage by 10–15% per year, which is equivalent to feeding the whole population of Kenya[16]. This presents a significant opportunity for scaling M2M-based fleet management applications, especially in the agricultural sector in the emerging markets.

A number of operators are being involved in partnering with fleet management solution providers across the globe. For example, Telefonica partnered with Geotab – a leading provider of M2M fleet transport telematics technology – in November 2014. The solution offers real-time fleet management, the ability to develop alerts and notifications, and the review of driver trip and activity reports. The aim is to improve on-road productivity, on-road safety, and ecological efficiency. M2M based fleet management solutions are also being used in the cane industry in Costa Rica to deal with the issue of delays in transport of cane to processing plants, due to theft of gasoline from trucks. In addition, these M2M devices help prevent the theft of very expensive, heavy metal chains used to strap sugar cane onto flatbed trucks. This M2M solution – the module, application, Web portal and related systems – was supplied by a fleet management provider in Costa Rica and outfitted with a SIM from Grupo ICE/kölbi. Amongst other agriculture solutions used during the production process, Verizon Wireless offers wireless tracking devices that can be installed in storage silos and can help to monitor grain levels and livestock inventory by tracking the number of animals placed and shipped to the market.

[15] Source: Vodafone M2M adds the final piece to Keenan's world class service for farmers, Vodafone, February 2013; Case Study: M2M increases livestock feed efficiency by 10%, ComputerWeekly.com, August 2013

[16] Source: Connected Life. The impact of the Connected Life over the next five years, GSMA and PwC, February 2013

While some of these services are not specifically agriculture applications, they are good examples of how solutions from adjacent sectors can have an impact, demonstrating the blurring lines between services in different verticals.

# 5. Barriers to scale for cellular M2M solutions in agriculture

In the previous chapters, we have discussed some of the various value chain bottlenecks that are preventing Agri M2M applications from coming to market, which will need careful consideration by stakeholders throughout the ecosystem. However, there are also some additional challenges for the wider agriculture sector which will need to be addressed to allow adoption of Agri M2M services to accelerate, and for applications to achieve scale.

### *Cost*

Cost is the most significant barrier to the adoption of Agri M2M applications, particularly in emerging markets. Even in mature markets, unless done through government partnerships or in collaboration with universities or R&D projects, it is difficult to roll out cellular M2M services on a large scale due to the prohibitively high start-up costs. Depending on the use case, sensors can cost tens or hundreds of dollars, necessitating a large initial investment often out of reach of small farming operations. Even for large farms, where hundreds or even thousands of sensors may be required, the initial capital outlay is significant. This issue is exacerbated in emerging markets, where many farmers are individuals rather than large businesses, and are less likely to have the capital needed for such an investment.

There is, however, an opportunity for innovative business models to help overcome this barrier. While not yet seen in the agriculture space, there are examples of services in other verticals aimed specifically at reducing the financial burden on bottom of the pyramid (BOP) users. M-KOPA Solar[17], for example, sells solar energy systems to off-grid households in Kenya through an affordable one-year mobile money payment plan. All of the necessary equipment is provided for an up-front deposit of $35, followed by 365 daily payments of 43 cents, which can be made through the M-PESA mobile payment service. Once this repayment is complete, customers gain ownership of the equipment. This kind of business model could be very well suited to agriculture, where low income farmers are provided with a financial solution to purchase an Agri M2M application (including all of the necessary hardware and software) through a pay-as-you-go payment plan.

Alternatively, the Agri M2M solutions could be targeted at cooperatives or agri businesses, who can then, in turn, finance the solution out to the individual farmers. The key to affordability in low-income markets is very small daily or weekly payments in line with cash flow limitations. By reducing the large initial investment and simplifying/reducing the ongoing costs, BOP users can be given the opportunity to help invest in and grow their business, and maximise the potential of their farms.

### *Low wages for agricultural workers in emerging markets*

Low wages for agricultural workers in emerging markets are also a challenge. Value added per agricultural employee in the developed world is much higher than in the developing

[17] M-KOPA Solar

world (see Figure 9). In Asia Pacific for example, agriculture value added per worker in the developed markets ranges from $27,097 in South Korea to $49,723 in Australia. In these countries, Agri M2M applications are branded as cheaper, labour saving solutions. In developing countries however, value added per agricultural worker is much lower – the highest is $9,674 in Malaysia, and the lowest is $265 in Nepal. Likewise in sub-Saharan Africa, value added per agricultural ranges from $6,269 in South Africa to as little as $128 in Burundi. In such countries, where labour is relatively cheap and where agriculture is often the only source of employment available, it is harder to justify investment in Agri M2M applications. Until low-income countries are able to increase their incomes to levels at which they can generate sufficient savings to meet their investment needs, they will rely on external resources and investments for agricultural development.

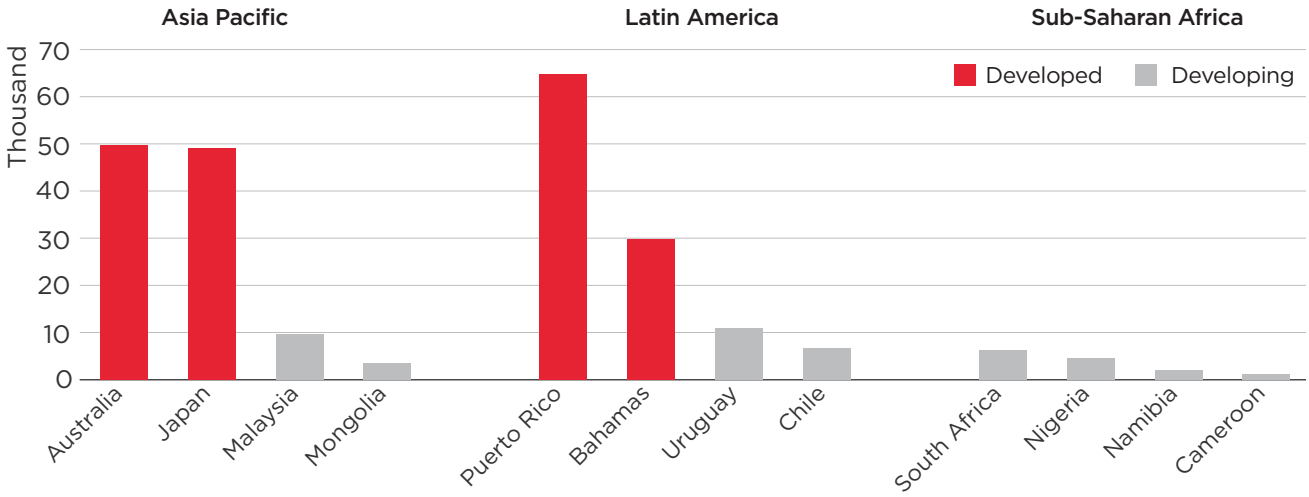


**Figure 9:** Agriculture value added per worker[18], 2013
*Source: World Bank, GSMA Intelligence*

### *Limited knowledge*

Little or no understanding of the benefits of Agri M2M applications is also a barrier. Service and applications developers need to understand the business cases and revenue opportunities in order to create the solutions, and end users will be unlikely to invest in relatively expensive solutions when the benefits to them are not clear. It is therefore essential to educate end users, whether they are individual farmers, cooperatives or agri businesses, as well as the rest of the value chain, in how Agri M2M is indeed a business opportunity that could bring significant improvements in yields and revenues, and fulfil the potential of their operations.

Lack of technical knowledge could also pose a problem for the rollout of services, as the end users would need to know how to set-up, maintain, and use the applications. While most people in the developed world are familiar with basic technology, this may not be the case for some users in the developing world. As such, advanced technological solutions

[18] Selected countries: top developed (where present) and developing countries by region

may struggle to achieve scale where they might not be used to their full capabilities. However, this does present the opportunity for other stakeholders to take on the role of setting-up and maintaining the systems, as well as providing the analytics based on which the farmer can make informed decisions about his/her crops or livestock. For example, NEC and Dacom have trialled a Crop Decision Support System (DSS) in Romania (with plans to expand to Europe, Middle East and Africa), which provides farmers with accurate planting, fertilizer, irrigation, protection and harvesting guidance via a user-friendly application using data from in-field soil sensors and weather stations, combined with local weather forecasts and aggregated, regional multi-year agronomy datasets. The physical technology and the data analysis is handled by the application, leaving the farmer to just follow simple instructions on the best course of action.

In both these cases, knowledge could be improved through initiatives to educate the end user and other stakeholders in the benefits and applications of Agri M2M. However, additional marketing budget would be required, so the return on investment would need to be significant in order to justify such a campaign.

### *Network coverage*

85% of the world's population is covered by a mobile network. However, coverage is heavily focused on densely populated urban areas, leaving the rural locations, which are of course primarily where agriculture is based, underserved. For Agri M2M applications, human coverage is not the most relevant, and this figure underestimates the number of square kilometres of open countryside left without any signal. This is especially the case in the developing world, where the urban-rural split is much more pronounced (see Figure 10).

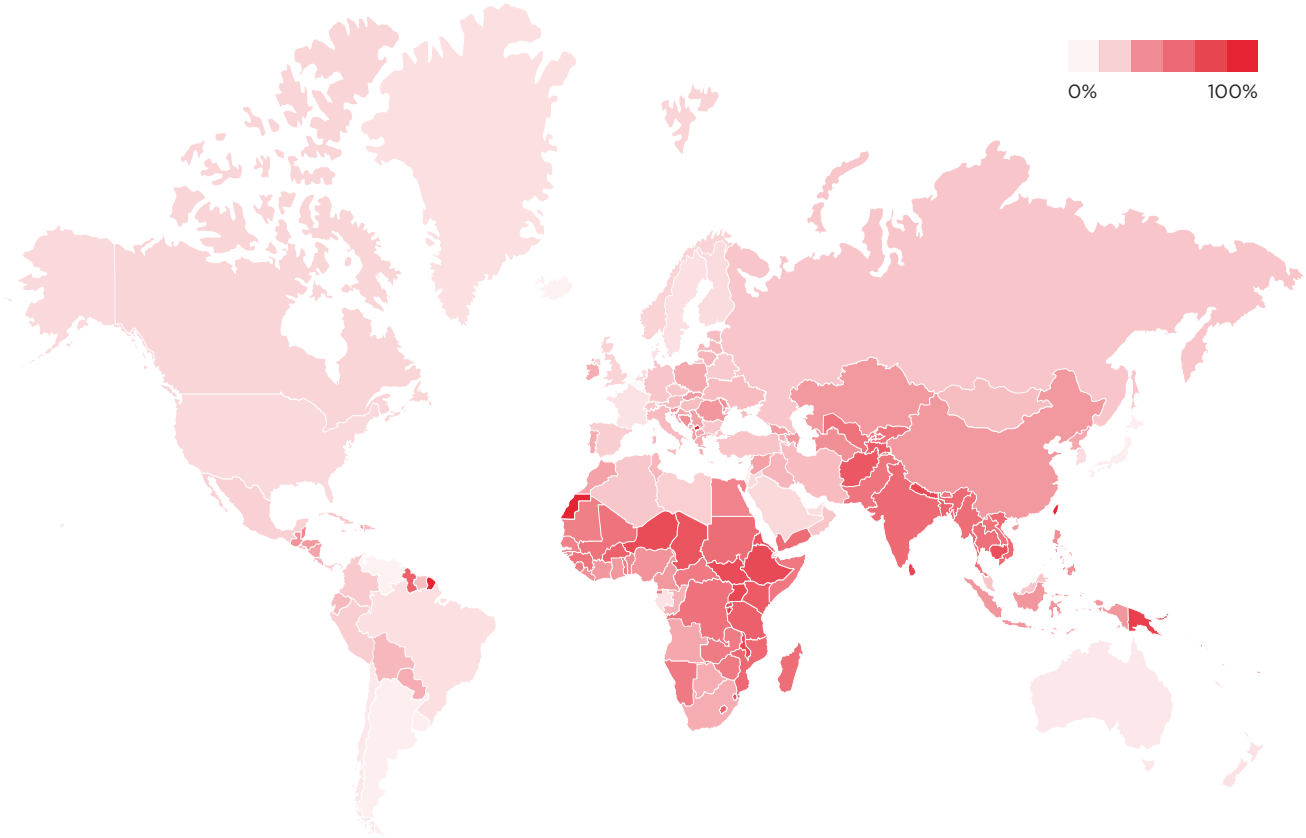


**Figure 10:** Many countries with large rural populations, 2013
*Source: World Bank*

One way to address this issue is through low frequency spectrum. Since 2010, the majority of spectrum assigned to mobile operators has been in higher frequency 'capacity' bands (above 1 GHz)[19], which are not ideal for providing coverage into rural areas. These higher frequencies are typically used in priority by mobile operators to cover urban and suburban areas where data traffic is dense, and substantial network capacity is required. However, based on their propagation characteristics, lower frequencies (below 1 GHz) provide extended coverage at lower cost, as fewer base stations are required to achieve greater geographic coverage, making these 'coverage' bands ideal for use in rural areas. Additionally, the Digital Dividend (DD) band is key for expanding mobile broadband into the rural areas, enabling the widespread rollout of Agri M2M services.

There is also a case for low cost low power solutions in Agri M2M. M2M sensors deployed on farms and used on livestock need to be very reliable and have a long battery life to avoid placing extra strain on farmers, and since operating margins are very low, inexpensive systems with low power usage are critical. A number of industry players have come together to create the LoRa Alliance, in order to drive the global success of Semtech's proprietary LPWA (low power wide area), LoRa (long range) protocol, by sharing knowledge and experience to ensure interoperability between mobile operators. The LoRa technology enables public or multi-tenant networks to connect multiple applications to the same network infrastructure, targeting devices and services that require a very long battery

[19] Source: Spectrum allocation and distribution: coverage vs. capacity bands, GSMA Intelligence, March 2015

life at a low price point, and enabling new applications for IoT, M2M, smart cities, sensor networks and industrial automation applications[20]. Mobile operators see the technology as complimentary to cellular networks for connecting low-power applications and battery-powered sensors, and the alliance aims to ensure interoperability with existing systems. FastNet, a leading M2M operator and part of the Telkom SA Group, announced in November 2014 that it will be launching the first network based on this technology in South Africa[21].

### *Reliability of equipment*

M2M applications in an agriculture setting impose new demands on available technology. Standard modules may not be suitable for all applications due to possible frequent or continuous exposure to moisture, heat, cold, dirt, as well as vapour from chemicals used in farming operations. As such, the agricultural environment requires a specialised module with extreme resilience to hostile conditions to maximise the lifespan of device and minimise maintenance costs. While such devices are available, deployment costs tend to increase as standard M2M devices are not always suitable for Agri M2M applications.

In addition, the sheer number of devices required to create a fully connected agricultural application is also a challenge. Even a medium sized farm of a few hundred acres may need thousands of devices to set-up and maintain, not only increasing costs, but putting an even bigger emphasis on reliability. However, this does provide an opportunity for mobile operators. Not only could they play a role in helping to set up and maintain these applications, but it would also mean, providing they could cope with the increased data traffic, many thousands of devices connected to their networks, and the potential for extra revenue through value added services.

### *Market fragmentation*

Agriculture is not well suited to standardised M2M solutions at present due to the fragmented nature of the sector. Many different players are involved in many different areas, meaning that development costs per solution are higher, sales cycles are longer, and some applications may require only a small number of devices. Furthermore, in emerging markets, the majority of farms are small operations, particularly in densely populated and intensively cultivated states such as areas of India (e.g. Kerala, West Bengal, Bihar and parts of Uttar Pradesh) where the average size of land holdings is less than one hectare, and sometimes even less than 0.5 hectare[22]. This limits economies of scale for M2M solutions.

[20] Source: Semtech Wireless Products
[21] Source: FastNet launches SA's first purpose-built IoT network, BiztechAfrica, November 2014
[22] Source: About UNDP in India, UNDP

# 6. The role of the mobile operator in shaping a scaled ecosystem

## 6.1 The Agri M2M opportunity for mobile operators

The agricultural sector provides an important opportunity for operators to develop and deploy M2M products and solutions. Agri M2M use cases are also receiving more recognition from key players (such as Cisco and the UN) and media attention as the driving force in increasing production and reducing wastage. Mobile operators stand to benefit from an increased number of M2M connections on their network, offering the potential for additional revenue through value added services, and, due to the longer device lifecycles, the prospect of reducing churn and increasing customer stickiness, if for instance M2M services are bundled with a voice/data offering for a rural enterprise customer.

According to Machina, in 2014, mobile operator addressable revenue (including device, installation and service components) from M2M land agriculture and fishing applications reached $137 million, forecast to increase to $553 million by 2020 (an annual growth rate of 26%). Mobile operators have an opportunity to stake their claim in this rapidly growing Agri M2M ecosystem, providing M2M services and products to agriculture companies and farmers in need of these solutions, and increase their potential revenue.

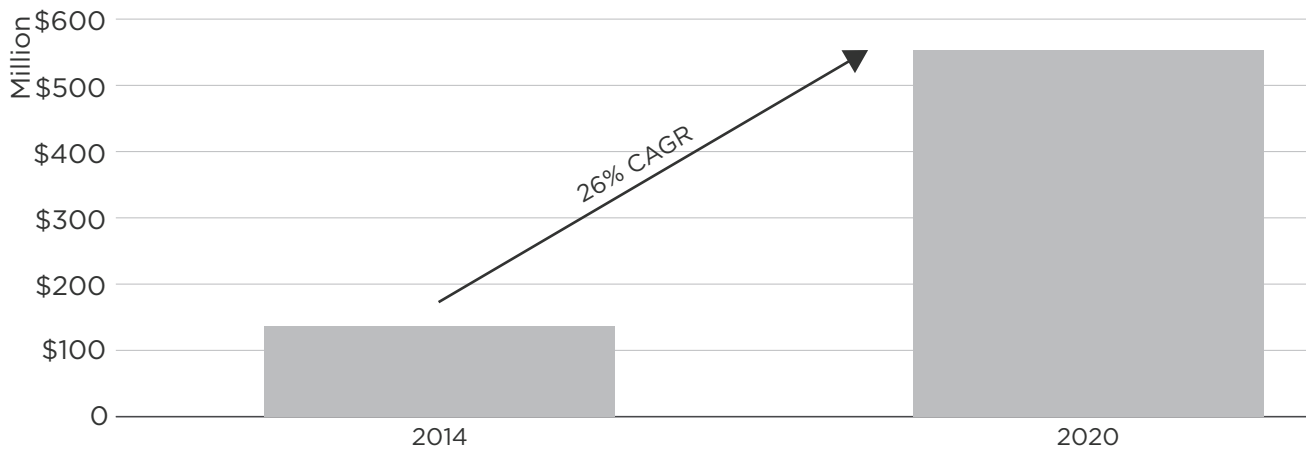


**Figure 11:** M2M mobile operator addressable revenue in Land Agriculture and Fishing
*Source: Machina*

## 6.2 Role of mobile operators in scaling Agri M2M

Based on GSMA Intelligence research, mobile operator M2M offerings in developing markets are usually limited to connectivity only (telemetry tariffs, data plans etc.). As discussed in a recent GSMA Intelligence report (see Mobile operator's global M2M footprint), Mobile operator M2M revenues are dependent on application type and scale, but also on the mobile operator's approach to M2M service delivery. For example, offering connectivity-only garners ARPU of around $2-5 depending on the market, while the ARPU generated from fleet management solutions can vary between $10 and $25. Connectivity therefore accounts for a relatively small proportion of the overall revenue opportunity in M2M, estimated by several mobile operators at only 10-20% of the total revenue opportunity

from M2M services (see From concept to delivery: the M2M market today). Feedback gathered from M2M operators reveals that ARPU from end-to-end solutions is at least 3 times greater than from connectivity-only, which makes this approach more attractive to mobile operators. As an example, Turkcell showed that its end-to-end (E2E) M2M ARPU was four times greater than its connectivity-only revenue in the case of its fleet management solution.

In other M2M verticals, such as automotive, mobile operators started off as connectivity-only providers, moving towards providing value added services on top and partnering with service providers. This vertical was one of the first to see M2M applications deployed, and thus sparked the interest of the mobile operators, who, responding to the customer need of tracking expensive assets, and seeing the revenue potential of the large number of high bandwidth connections required for telematics, were quick to get involved. Servicing this industry vertical generally requires a global footprint (with low-cost roaming capabilities), and this is a driving factor for regional mobile operators to form cross-border partnerships to expand their global footprints. Telecom Italia, for example, has partnered with players in adjacent industries to provide country specific products such as insurance telematics for automobiles.

However, due to the relatively nascent stage of the Agri M2M vertical, the fragmented nature of the agriculture industry, and poorly understood business cases, most mobile operators are yet to look beyond providing purely connectivity in Agri M2M applications. As discussed above, connectivity is a relatively small proportion of the overall revenue opportunity in M2M, so mobile operators should therefore explore opportunities to expand their portfolio to services beyond just the provision of connectivity in Agri M2M.

Aside from being connectivity-only providers, we believe there are 3 additional scenarios that can help mobile operators capture a bigger share of the Agri M2M pie, and help stimulate the growth of the Agri M2M ecosystem (see Figure 12):

1. **Connectivity only:** the role most mobile operators are currently fulfilling, which is limiting their revenue potential as well as the growth of the Agri M2M industry
2. **Partnerships:** actively partner and collaborate with other players across the entire ecosystem, including solution providers, system integrators, application developers and service providers, as well as entrepreneurs and start-ups, to enable E2E Agri M2M solutions and help stimulate innovation
3. **Partnerships and marketing:** enter partnerships as before, but also provide marketing support, leveraging brand and other assets to help educate the end users on the benefits of Agri M2M
4. **Vertical integration:** develop and deploy end-to-end Agri M2M services

We discuss scenarios two, three and four below.

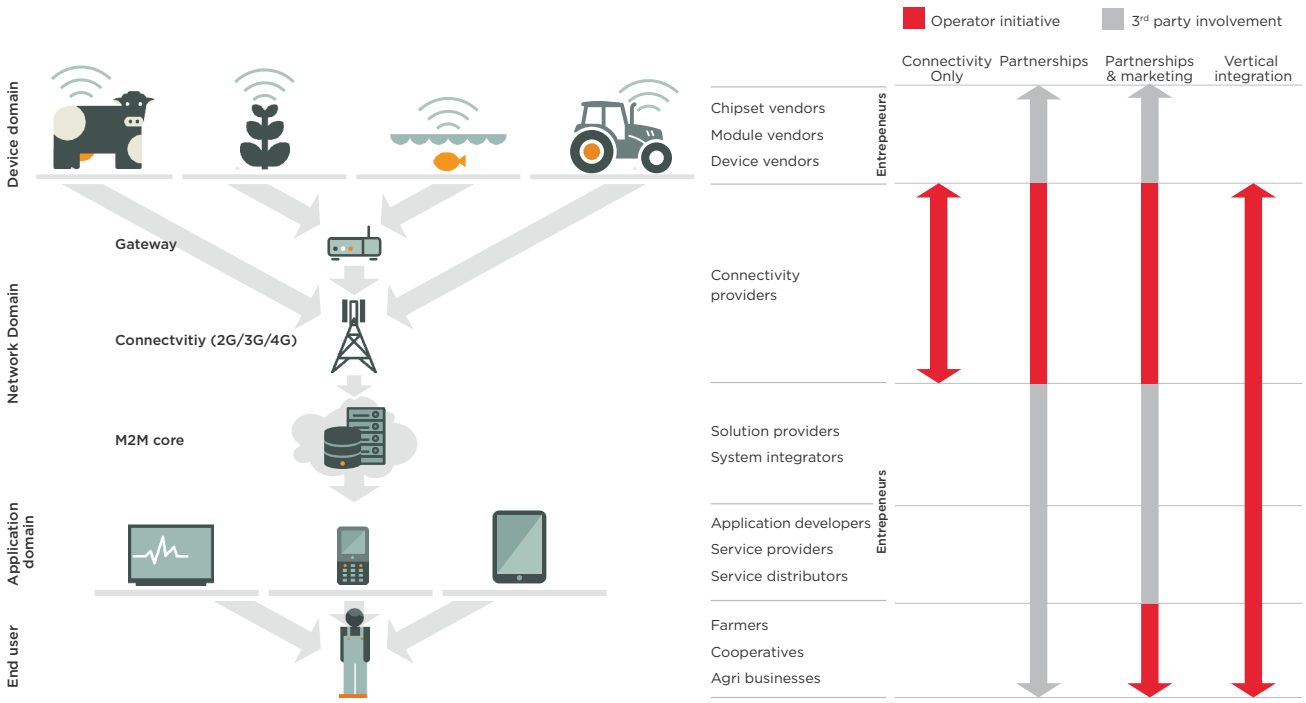


**Figure 12:** Potential mobile operator roles in Agri M2M
*Source: GSMA Intelligence*

### *Partnerships*

There is a potential for synergies in the Agri M2M space. Mobile operators can strike partnerships with other ecosystem players, governments and non-profit organisations to subsidise/reduce costs or share the initial investment into an E2E M2M platform. This could take a form of vertical partnerships – collaboration with other players across the value chain – and/or horizontal – alliances with other mobile operators/CSPs (connectivity service providers).

Mobile operators can partner with distributors who then resell the services (most major mobile operators in the UK for example partner with Wireless Logic, who deliver a range of value-added M2M managed services including CLAAS, a telemetry based connected agriculture system[23]), or can partner with M2M platform providers such as Jasper Wireless or Ericsson, which enable mobile operators to develop and launch their own M2M applications. Another partnership route is where mobile operators partner with specialised M2M MVNOs to offer Agri M2M services, such as Rogers Wireless in Canada partnering with KORE Telematics[24] to deploy M2M solutions throughout the entire value chain. Mobile operators and specialised vendors can also enter a revenue-share model, whereby the vendor provides the hardware and software, the mobile operator bills users for the service, and the total revenue from services is shared between the partners. For example, Turkcell has over 33 such partnerships in place, and it relies on its partners for an in-depth understanding of the market. Further, mobile operators can partner with device vendors

[23] Source: CLAAS reaps benefits of M2M, Wireless Logic
[24] Source: Furthering the M2M Eco-system Through Strong Partnerships, Kore

to help lower the cost of modules, such as AT&Ts 3G Access Program[25], which is investing in lower cost, high performance M2M solutions, offering module vendors access to a more efficient path to production. Likewise, certification programs help to speed up time to market of devices – as in the case of the Orange Module Certification Program[26] – making it easier to launch new services.

One example of a partnership between a mobile operator and a service provider in the Agri M2M space is the agreement between Orange Business Services and Dacom to provide M2M connectivity services to improve the efficiency of farming operations[27]. Orange provides the connectivity for a range of devices and sensors, including weather stations and soil moisture sensors supplied by Dacom, who also develop and deliver software and online advisory services to arable farms and agri businesses in over 30 countries worldwide. And in 2012, Deutsche Telekom signed a deal with MEDRIA Technologies that saw 5,000 farms across Europe equipped with the Vel'Phone calving detection system[28] that notifies farmers automatically when calving begins, and HeatPhone[29], which alerts farmers when their cows are on heat and ready for insemination.

In addition to partnering with existing players, mobile operators can help to lower the barriers of entry for start-ups and entrepreneurs into the Agri M2M space. By setting up innovation hubs, accelerator programs or providing venture capital funding, mobile operators can nurture grass-roots innovation and help to get innovative solutions off the ground and to market. Innovation hubs such as kLab in Rwanda and The GrowthHub in Kenya give mobile operators the opportunity to find start-ups and entrepreneurs with innovative and cutting-edge Agri M2M solutions.

Mobile operators have many relevant assets and capabilities than can greatly assist in the development and deployment of Agri M2M solutions, reducing the need for start-ups and entrepreneurs to reinvent the wheel and bring all these assets to the table themselves. These assets include technical capabilities, APIs, entrepreneur toolkits, customer relationships, retail channels, and a recognisable/trusted brand. Hence, there is an opportunity for mobile operators to act as channels to market, mainly leveraging small-business relationships.

Partnerships, cooperation and knowledge sharing between mobile operators and other parties (including trade organisations) could play a pivotal role in stimulating the adoption of Agri M2M services. Striking partnerships can simplify the route to market for mobile operators and start-ups, and can reduce the costs necessary to develop a solution from scratch. Moreover, partnerships can aid in the standardisation of Agri M2M services, reducing integration issues and costs of deployments, and help de-fragment the ecosystem. Mobile operators can be key in bringing everyone together, and could even host seminars or convenings to increase visibility and cooperation across the value chain. Further, innovative business models in Agri M2M are key, particularly those that

[25] Source: AT&T Introduces 3G Access Program for Emerging and M2M Devices Manufacturers, AT&T, October 2010
[26] Source: Orange Module Certification Program, Orange
[27] Source: Smart Agriculture: Orange Business Services delivers M2M connectivity services to Dacom, Orange, May 2014
[28] Source: Vel'Phone, Deutsche Telekom
[29] Source: HeatPhone, Deutsche Telekom

reduce the cost burden on small to medium agriculture operations. Through innovation hubs and investments in entrepreneurs, mobile operators can help in the development and deployment of compelling and scalable business cases to an underserved and poorly understood vertical of the M2M industry.

### *Marketing support*

As well as partnering with other players in the ecosystem, operators can become involved in the marketing of Agri M2M services. As discussed in chapter 5, one of the barriers to the uptake of Agri M2M is lack of knowledge, where end users are unlikely to invest in expensive M2M solutions if they do not see the potential upside. Mobile operators are in a good position to be able to spearhead an educational push due to their marketing power, brand recognition and distribution outreach, and either via existing customer relationships or through partnerships with key stakeholders as well as governments, non-government organisations (NGOs), regulators or other industry bodies, educate end users in the benefits of investing in and using Agri M2M solutions.

An example of such a campaign is Safaricom partnering with M-KOPA Solar[30] to deliver solar energy solutions in Kenya. M-KOPA develops the equipment, and Safaricom handles the marketing and distribution. The devices are dual-branded, which will increase familiarity with end users and help uptake. This is a good example of how a mobile operator can leverage its assets as described above (its brand in particular) and work with a solution provider to successfully get a product to market, and this could be replicated in an Agri M2M scenario. And another example is SingTel, which has set up a Customer Advisory Council to promote M2M adoption.

It should be noted though that additional budget would be required to provide marketing support, and mobile operators would likely require a significant return on investment in order to justify such a campaign. Marketing would therefore be more successful if done in parallel to other initiatives as discussed in this section, such as partnerships with other stakeholders or in-house Agri M2M developments.

### *Vertical integration*

M2M needs a different level of expertise and technical know-how from standard mobile operations in order to efficiently address business needs, and a number of mobile operators have restructured their M2M business activities to reflect the strategic importance of M2M to their organisations. Vodafone, for example, promoted the M2M business unit to the group level, while Ooredoo is taking serious action toward M2M by developing group level strategies for their regional operating companies. Meanwhile, Telecom Austria's M2M unit, which is a spin-off from its marketing and sales department, was created to speed-up the launch of M2M services. In other cases, mobile operators are seeking to bring in the market "know how" through acquisitions, as in the case of Verizon Wireless' acquisition

[30] M-KOPA Solar

of Hughes Telematics[31] or Vodafone's purchase of Cobra Automotive Technologies[32]. Investing in building the expertise to design and develop Agri M2M solutions can allow mobile operators to make inroads into generating greater revenue from the ecosystem.

Mobile operators have the ability to tap into their existing client base and expand customer relationships further to include additional services. Based on the feedback we have received from the market, the majority of M2M deals happen on the back of existing business subscriptions (voice/data). Business clients usually reach out to their existing mobile service provider with a specific issue that they would like to address, and expect a tailor-fitted solution to address their need. In the case of Agri M2M, the end users (which could be either individual farmers, cooperatives or agri businesses), could build on their existing mobile subscriptions and create a bundled service of, for example, voice and M2M connectivity. This would simplify finances for the end users (bringing everything together under one bill), and would result in more connections and reduced churn for the mobile operators.

Developing an Agri M2M service in-house brings increased efficiency through economies of scale, and gives the mobile operator total control over the development, deployment, maintenance and marketing of a solution. Additionally, by going end to end, large regional or global operators can leverage their purchasing power with suppliers, and spread investment costs over a larger potential addressable audience of farmers and agri businesses, helping lower the cost barrier as described in chapter 5. And for those mobile operators that may not have the resources, technical capabilities, manpower or global reach to become fully integrated across the entire Agri M2M value chain, partnerships with other operators can be forged. The Bridge Alliance[33], for example, is a business alliance of 36 major mobile telecommunications companies across Asia, Australia, Africa and the Middle East, providing seamless service connectivity (including M2M), roaming and a suite of integrated VAS for all alliance members' subscribers. Through the sharing of knowledge and best practices, and by leveraging each other's solutions, mobile operators can collaborate to develop innovative E2E Agri M2M services.

The mobile operators are, therefore, in a unique position to enable every stage of the value chain and, through partnerships and collaboration, their own operations, grass-roots innovation and education programs, target the key barriers to scale of Agri M2M solutions. Furthermore, enabling Agri M2M services could come under the umbrella of Corporate Social Responsibility (CSR), whereby the mobile operator can give back to the society and fulfil its responsibility towards the environment, increasing the sustainability of its own business.

[31] Source: Verizon Completes Acquisition of HUGHES Telematics, Verizon, July 2012
[32] Source: Vodafone completes acquisition of Cobra Automotive Technologies S.P.A., Vodafone, August 2014
[33] The Bridge Alliance

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**About Mobile for Development:** Serving the underserved through mobile

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mAgri

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For more information, visit gsma.com/mobilefordevelopment/programmes/magri

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