

# External evaluation of mobile phone technology-based nutrition and agriculture advisory services in Africa

Mobile phones, nutrition, and agriculture in  
Ghana: Cost-effectiveness endline report

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## Executive summary

### The mNutrition intervention in Ghana

mNutrition is a global initiative supported by FCDO, managed by GSMA, and implemented by in-country mobile network operators (MNOs) and third-party providers and aims to use mobile technology to improve the health and nutritional status of children and adults in low-income countries around the world. The potential to utilise mobile technology to change attitudes, knowledge, behaviours, and practices around health and agriculture for improved nutritional status has been recognised for some time, but to date there have been no rigorous evaluations of mAgri and mHealth Value-Added Services (VAS) at scale. mNutrition was implemented through existing mAgri and mHealth initiatives in 12 countries throughout sub-Saharan Africa and South Asia. The nutrition content aims to promote behaviour change around key farming practices and around dietary and child feeding practices that are likely to result in improved nutritional health within a household.

The mNutrition service that is the focus of the evaluation in Ghana and this report is the VFC service. GSMA partnered with and funded the MNO Vodafone Ghana through the mNutrition challenge fund. Vodafone Ghana partnered with local provider Esoko to launch VFC, which was a rebrand of Esoko's existing service with additional content provided. The service is a 'bundled solution', offering both agricultural and nutrition information through mobile voice and SMS services in addition to free calls to other VFC members. The objective of the VFC service is to create and scale commercially sustainable mobile services that enable smallholder farmers to improve the nutritional status of their household and increase their productivity. The VFC service is available to smallholder farmers across 71 districts in Ghana.

### Cost-effectiveness design

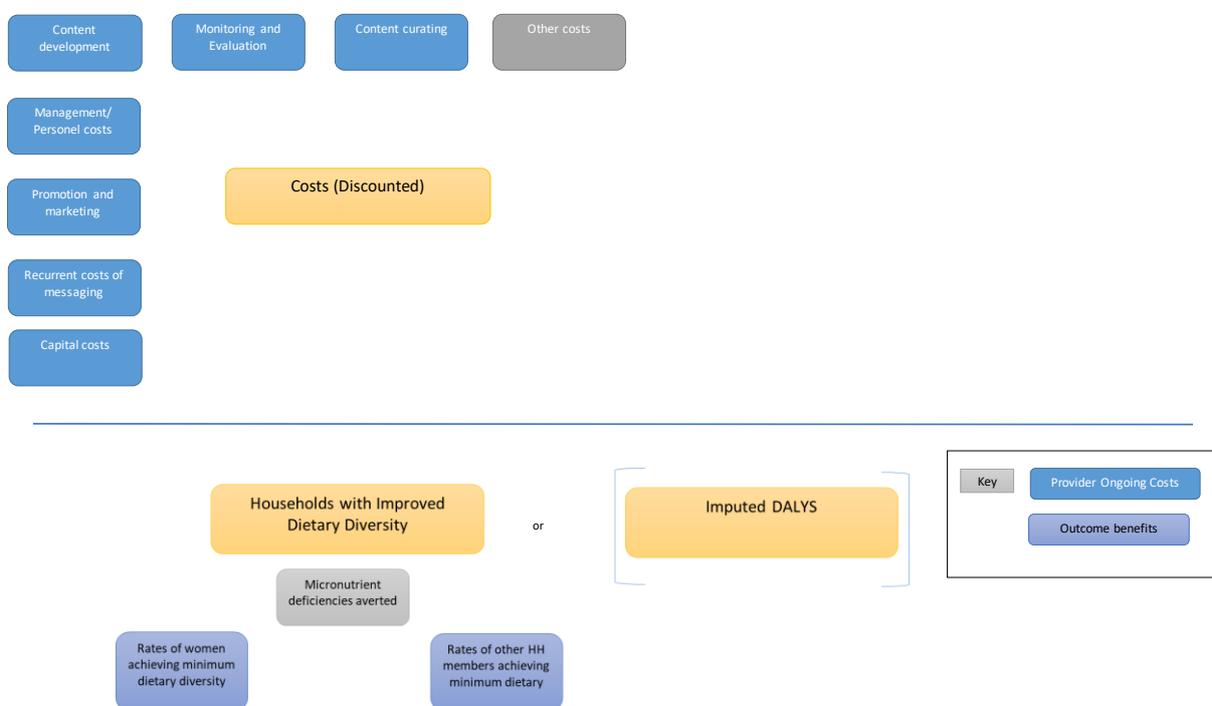
The aim of the impact evaluation is to assess the impact, cost-effectiveness, and commercial viability of two services within the broader portfolio of the GSMA mNutrition programme. The evaluation is being conducted by a consortium of researchers from Gamos, IDS, and IFPRI. The team draws on a number of methods and interlinked components to gather evidence about the impact of the mNutrition intervention in Ghana, including a qualitative component, a quantitative component, and a business model and cost-effectiveness component. The evaluation is being conducted in two regions of Ghana: the Central region and the Upper West region.

The baseline cost-effectiveness design proposed three scenarios for analysing the cost-effectiveness of the proposition, known as analyses A, B, and C. In Analysis A, it was proposed that the above-the-line costs in Figure 1 include only the ongoing implementation costs and those directly associated with the setting up of the specific service (e.g. the localisation of the content development). Analysis A does not attempt to allocate a proportion of the wider mNutrition programme costs, nor does it take into account the sunk and investment costs associated with building the asset value of the agriculture and market information system that Esoko brought to the partnership or the network infrastructure brought by Vodafone.

The effectiveness is held to be the measured change in dietary diversity from the quantitative component. The primary outcomes consist of households’ and women’s dietary diversity, agricultural income, and production.<sup>1</sup>

This analysis would be of primary use to stakeholders who may wish to replicate the service without further development costs and have a willing MNO in place with similar coverage to Vodafone Ghana. It is based on the assumption that the nutritional content, at least at the global level, will be available free of charge. This is indeed the case, given that all the factsheets and messages developed by the global content partners to the mNutrition programme are open access and made freely available through the CABI Knowledgebase. It assumes that any new service will also provide weather and market prices as part of the service, which will have to be generated locally. It also assumes that any future implementing agency will have access to the technical platform and capability needed to implement such a system, either as part of its own resources or by subcontracting the services of a company that does have such capability, such as Esoko.

**Figure 1: Costs associated with Analysis A of the Vodafone VFC, Ghana**



Source: Authors’ own.

Analysis B (illustrated in the baseline report) includes sunk costs or investments in the project development and the supporting infrastructure. The wider costs are difficult to apportion. One could argue that a portion of the wider project research and development should be assigned to VFC costs, since if donors were to invest in, for example, a next generation of mNutrition services, they would need an overarching programme of work similar to the mNutrition programme to stimulate MNOs to adopt new approaches, to coordinate learnings and effort, and to deliver wider programmatic benefits. The same argument applies to the global content developed as part of the overall mNutrition programme, and to the institutional infrastructure set up by GSMA (and others) in order to deliver the programme.

<sup>1</sup> As will be stated below, the quantitative report concludes that ‘being offered the VFC service or having used it at least once has minimal impacts on household and women’s dietary diversity, agriculture production, or nutrition or farming knowledge’, thus rendering the planned analysis moot.

Analysis B would be of most use to FCDO and other funders or policy actors to assess whether the mNutrition programme represents Value for Money (VfM). It would be of particular use if a similar programme was being planned for the future.

Analysis C proposed a comprehensive view of costs, taking into account not only operational costs and wider programmatic costs, but also societal costs. For instance, there is an argument that the real cost of the text messaging service should include sunk investment in the platform, including intellectual property from previous related projects. Esoko has a history of information provision and brings a wealth of learning on what works and what does not—the cost of that learning being sunk costs from previous projects (i.e. existing assets). An element of the societal costs was any cost associated with any behaviours that farmers needed to undertake in order to realise the benefits pursued by the project. For example, if the project aims to increase yields through the adoption of modern agricultural practices, such as the appropriate use of fertiliser, then success will require farmers to buy fertiliser. However, we shall see that there are marginal changes in practice such that this analysis is not possible.

## Effectiveness

The component relies for measure of effectiveness on the component that employs a randomised encouragement design to determine the causal effect of the programme on households' and women's dietary diversity, agricultural income, and production. The details of that component can be found in Billings *et al.* (forthcoming, 2020).

While the quantitative evaluation answers four research questions, this cost-effectiveness report is grounded on the answer to the question: 'What are the impacts of the VFC service on households' and women's dietary diversity, agricultural income, and production?' The quantitative component includes the research question: 'How effective is the VFC service at increasing the knowledge and changing the behaviour of farmers?' The methodology proposed for the cost-effectiveness focused on changes in impact (converted to disability-adjusted life years (DALYs)) and not on knowledge and behaviour.

The quantitative report concludes that 'being offered the VFC service or having used it at least once has minimal impacts on household and women's dietary diversity, agriculture production, or nutrition or farming knowledge'.

The quantitative component estimates the intent-to-treat (ITT) effect as the difference in average outcomes between the comparison group and those that were assigned to the randomised encouragement group. In addition to the ITT estimate, the quantitative component estimates the local average treatment effect (LATE) of the VFC service for households who were induced to register and use the service by the randomly assigned offer (compliers).

The quantitative component finds no evidence in the ITT to suggest that access to the VFC service had any impact on dietary diversity either for the household or for women, or on agriculture production and income. Point estimates in most cases result in precisely estimated zeros. The one exception to this statement is that the extended control model reveals similar results, although the impact on consuming dairy is now marginally significant. Similar to the ITT results, the quantitative component finds no evidence to suggest that registering and using the VFC service (LATE) had a significant impact on dietary diversity either for the household or for women, or on agricultural production and income. Point estimates, while three times larger than the ITT estimates, are not significant.

There are some small exceptions to these averages. The exceptions are that there are marginally significant increases in the probability that a household consumes dairy, marginally significant reductions in the area of cocoa cultivated for households that produce cocoa, and significantly higher maize prices received by the primary female. These exceptions cannot be 'translated' into dietary diversity or, within the proposed cost-effectiveness design, into DALYs.

There are also a few differences in impact across the gender of the person targeted, the region, and poverty level. Those in the Central region consume more dairy, those below the 150% poverty line grow more maize, targeting the primary male leads to a significantly higher maize price received by the primary female, and although impacts across targeting the female or male are not significantly different, there is a suggestion that market price information is being shared from male to female. These results are not strong enough to identify the DALYs saved, but they can be taken as a positive contribution to the lives of the poor. These impacts are marginal, however, and do not address the key effectiveness measures chosen during the inception of the evaluation. It would not be possible to disaggregate the costs for a specific subset of the users (i.e. targeted women, the Central region, or households below the 150% poverty line). A cost-effectiveness analysis as proposed has not therefore been possible. There could have been an analysis using uncertainty bounds of parameters to estimate cost-effectiveness ratios, but the result would have been a large ICER with significant uncertainty. In light of the Terms of Reference from the funder, this has not been attempted.

**This report has therefore been completed as a contractual deliverable; however, it does not contain a cost effectiveness analysis as planned, given that the intervention gave no measurable change to household and women's dietary diversity or agriculture production and income.**

## Costs and cost sensitivity

The baseline report documented what costs were known as at March 2017, the end of that data collection phase. There has been an ongoing evolution of the service, with consequent changes in ongoing costs, and these are now documented as much as possible. Cost details for Analysis A are also covered in Section 0 and in the business modelling endline report (Scott and Batchelor, 2020). Cost details for Analysis B are presented in this report only. The costs supplied in various formats have been harmonised in a simple financial model, which is used for a basic sensitivity analysis. Cost details for Analysis C were not applicable given the minimal impacts on household and women's dietary diversity, agriculture production, or nutrition or farming knowledge.

The analysis of costs has not been straightforward. There have been three distinct phases in the VFC journey, each with a different revenue model. The journey resulted in an unusual profile of subscriber numbers. Financial data provided by Vodafone and GSMA have been used to create a financial model, which has been used to model the financial viability of each of the three iterations. The model calculates two key metrics: net present value of investment in the product and the internal rate of return (IRR). Key to the model is an estimated profile of subscriber numbers. The modelling considers the viability of the agricultural information service to the mobile operator. Therefore, it considers investment costs incurred in developing the product for roll-out in a specific country (Analysis A).

The sensitivity analyses show that the model is sensitive to the subscriber numbers, the revenue model, and the cost of sales, within which the two major costs are the cost assigned to SMS and the share given to the content provider (Esoko). Financial viability is highly sensitive to Average Revenue Per User (ARPU), and currently attracts a reported ARPU of 2.5 Ghanaian Cedis (GHS)

per month. At that level, the model suggests that if the revenue share to the content provider were reduced to around GHS 0.2 per subscriber per month, then the investment might start to look attractive. The other major cost centre is the assigned cost of SMS. There are arguments for assigning between zero and GHS 5.5 per SMS, and even at the highest figure there is still a positive IRR with a low subscription model, although for the freemium model the IRR becomes negative at an SMS cost above GHS 2.5.

The above analyses assume that Vodafone is gaining new customers. The sensitivity analysis shows that if the proportion of new customers is less than 90% for the low subscription model, the IRR becomes negative as existing customers are already providing revenue on another tariff.

In Analysis B, the IRR is also dependent on the combinations of the revenue, which in itself depends on the subscriber numbers and the revenue model, and the cost of sales, within which the two major costs are the cost assigned to SMS and the share given to the content provider (Esoko). With the added upfront Capex, the crossover into positive IRR is more challenging, although not impossible. The increase in ARPU does suggest that within the analyses the service could be commercially sustainable even taking into account the investment in the mNutrition initiative.

## Key findings

**It was not possible to carry out the cost-effectiveness analysis impact.** The quantitative study was unable to identify any impact of access to the VFC service on household dietary diversity, women's dietary diversity, agricultural incomes, or agricultural production (primary outcomes). The cost-effectiveness analysis methodology was intended to translate impacts on dietary diversity into DALYs but this was not possible given the absence of measurable impact on primary outcomes. Furthermore, there was no measurable impact on nutrition or farming knowledge (secondary outcomes).

**Measured outcomes.** Comparison group households had consumed 5.9 out of 12 food groups in the previous 24 hours (household dietary diversity score), the primary female had consumed 4.3 out of 10 food groups (women's dietary diversity score), and 50% met the minimum dietary diversity of consuming at least five food groups. These outcomes were not significantly different among the treatment group. The study was able to identify two areas of impact (based on LATE estimates):

- A marginally significant increase in the probability that a household consumes dairy foods; and
- A marginally significant reduction in the area of cocoa cultivated among farmers that produce cocoa.

**mAgriculture services in Ghana.** The mobile market in Ghana is relatively mature as mobile ownership has increased rapidly and ownership gaps have narrowed, such that, for example, 86% of households in the lowest wealth quintile now own a mobile phone. Widespread ownership has spawned a proliferation of tech start-ups, including several focused on the agriculture sector. In addition, MNOs are starting to roll out business-to-business services, deploying financial and transaction capabilities (e.g. enabling agribusinesses to pay farmers via mobile money).

**Reasons for low impact.** The quantitative study found low active usage rates of the VFC service among households in the encouraged group. Only 50% of those who registered for the service reported that someone in the household used the service in the previous 18 months. The main reasons for encouragement households not using the service was losing or not using the SIM, followed by not having access to a mobile phone (the latter reason being significantly larger in the Upper West region than in the Central region, as well as among primary females compared to

primary males). To a lesser extent, phone malfunction and bad network connectivity were other frequently reported reasons. Changes in the pricing plan will have led to confusion among users, and the study has highlighted shortcomings in the farmer profiling process. Adult literacy rates in rural Ghana are low (42%), which limits the appeal of an SMS based service. For weather and market price information, which was delivered via SMS in English, the main reasons for not reading all the messages were not being able to read or not knowing English. For agriculture and nutrition tips, which were delivered via voicemail in the local language, the main reasons were weak service and not having access to a phone. For speaking with an agriculture agent, the main reasons for not using the service were not knowing that it was available, followed by believing they would be charged for the service.

**VFC highly valued by subscribers.** Although active participation—and ‘effectiveness’ as defined by the nutritional outcomes among households—is low, respondents’ perceptions of the service are quite favourable for several service components. The majority indicate that they find the content of the VFC service useful, that it has changed their behaviour, and that they trust and feel confident in the information. Overall, quality ratings of the service were around seven out of 10. The highest quality ratings were given to agricultural and nutrition tips (7.1 out of 10 for males and 7.36 out of 10 for females).

**VFC viable as a VAS.** VAS business models rely on changes in ARPU and reductions in churn (users moving to other networks) to benefit the overall MNO bottom line without actually showing as a direct revenue from a service. Increased ARPU and reduced churn can indeed make the provision of even a freemium service ‘commercially justifiable’.

**VFC as a cost-neutral service.** Even with a reduced subscriber base of around 60,000 (end 2018), the contribution margin of VFC was 64%, which is within the target range normally expected for the mass market segment (60%–70%). This means the service makes a contribution to group costs (fixed costs) and profits, but it does not provide any insights into return on investment. Financial modelling suggests that a positive return could be achieved if a number of criteria can be met, e.g. increased subscriber numbers, low subscriptions, low revenue share with content provider, and low SMS price. In this case, the service could be considered cost neutral.

**Is cost effectiveness appropriate?** If a VAS has a commercial benefit, such that the MNO gets its investment back over time, then it can be argued that there is no net cost to the MNO. GSMA and Vodafone studies show that the product is appreciated; the perception among stakeholders is that the product or service is valuable. For an MNO, it is thus a viable service to consider offering. In this case, gross impact in terms of DALYs is not the be-all and end-all of effectiveness: even if one person is helped, the service can be regarded as ‘cost-effective’. Marginal effects on certain subgroups of subscribers could then be considered beneficial.

**Revenue-sharing mechanism.** The marginal effects on certain subgroups of subscribers could be considered beneficial, and this may speak to the FCDO agenda of ‘leave no one behind’. However, for this to be truly cost neutral, there would have to be a mechanism for recovering the public investment back into a public agency.

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## List of abbreviations

ARPU	Average Revenue Per User
DALY	Disability-Adjusted Life Year
DFID	Department for International Development
FAO	Food and Agriculture Organisation
FCDO	Foreign, Commonwealth & Development Office
FF4F	Family Farms for the Future (Cambodia)
GAIN	Global Alliance for Improved Nutrition
GHS	Ghanaian Cedis
GSMA	Groupe Spéciale Mobile Association
HDDS	Household Dietary Diversity Score
ICT	Information and Communication Technology
IDS	Institute of Development Studies
ITT	Intent-to-Treat
IFPRI	International Food Policy Research Institute
IRR	Internal Rate of Return
LATE	Local Average Treatment Effect
LCP	Local Content Provider
M&E	Monitoring and Evaluation
MDD-W	Minimum Dietary Diversity—Women
MNO	Mobile Network Operator
NDA	Non-Disclosure Agreement
OPM	Oxford Policy Management
SIM	Subscriber Identity Module
SMS	Short Messaging Service
UX	User Experience
VAS	Value-Added Service
VFC	Vodafone Farmers Club
VfM	Value for Money

WTP                      Willingness to Pay

# 1 Introduction

## 1.1 mNutrition

mNutrition is a global initiative supported by FCDO, managed by GSMA, and implemented by in-country MNOs and third-party providers that seeks to use mobile technology to improve the health and nutritional status of children and adults in the developing world. The potential to utilise mobile technology to change attitudes, knowledge, behaviours, and practices around health and agriculture for improved nutritional status has been recognised for some time, but to date there have been no rigorous evaluations of m-services at scale. A consortium of researchers from Gamos, IDS, and IFPRI were contracted to conduct a rigorous mixed-methods evaluation to estimate the impact of two mNutrition services on children and adults and to understand how the context and the components of the mNutrition intervention shape its impact.

mNutrition is being implemented through existing mAgri and mHealth services in 12 countries throughout sub-Saharan Africa and South Asia. The nutrition content aims to increase knowledge and promote behaviour change around key farming decisions and practices, and around maternal and other household practices that are likely to result in improved nutritional health within a household. The mNutrition initiative aims to lead to the following changes in outcomes: (i) increased adoption of new nutrition-sensitive agriculture practices, improved agricultural productivity, and greater use of post-harvest technologies; (ii) improvements in nutrition practices around women during pregnancy, infant and young child feeding, and micronutrient supplementation of children at risk; and (iii) increased demand for nutrition and agriculture extension services.

The evaluation design is expected to measure the impact, cost-effectiveness, and commercial viability of mNutrition, using a mixed-methods evaluation design. The evaluations are being conducted on two services: Ghana mAgri (the focus of this report) and Tanzania mHealth. In order to satisfy the objectives of the Terms of Reference, the evaluation is composed of the following components:

- A **quantitative impact evaluation**, employing a randomised encouragement design to determine the causal effect of the programme on dietary diversity, agricultural income, and production. A baseline survey occurred before the start of the encouragement activities, and an endline survey occurred 18 months later.
- A **qualitative impact evaluation**, which consists of three qualitative data collection rounds (i.e. an initial exploratory qualitative study, in-depth case studies at midline, and rapid explanatory qualitative work after the quantitative endline survey data collection) and aims to provide understanding of the context, underlying mechanisms of change, and implementation process of mNutrition.
- A **business model and cost-effectiveness evaluation** employing stakeholder interviews, commercial and end-user data, document analysis, and evidence from the quantitative and qualitative evaluations to generate a business model framework and estimate the wider imputed benefits from the VAS for the range of stakeholders involved.

The mixed-method evaluation design will address the following research questions specified in the Terms of Reference (see Annex A):

1. What are the impacts and cost-effectiveness of mobile phone-based nutrition and agriculture services on nutrition, health, and livelihood outcomes, especially among women, children, and the extreme poor?
2. How effective are mobile phone-based services in reaching, increasing the knowledge, and changing the behaviour of the specific target groups?
3. Has the process of adapting globally agreed messages to local contexts led to content that is relevant to the needs of children, women, and poor farmers in their specific context?
4. What factors make mobile phone-based services effective in promoting and achieving behaviour change (if observed), leading to improved nutrition and livelihood outcomes?
5. How commercially viable are the different business models being employed at country level?
6. What lessons can be learned about best practices in the design and implementation of mobile phone-based nutrition services to ensure (a) behaviour change and (b) continued private-sector engagement in different countries?

The primary target user of the evaluation results is FCDO, along with other key stakeholders including GSMA and its national members (including local MNOs implementing mNutrition services), national governments (in particular, the ministries of health and agriculture), international agencies and donors, and community-level health and agriculture extension workers. The reports from the evaluation will be publicly available on IFPRI and IDS's websites.

## 1.2 Research questions of the cost-effectiveness component

mNutrition within the mAgri programme aims to improve nutrition by promoting behaviour change around key farming decisions and practices, thus increasing the productivity, crop quality, and income of smallholder farmers.<sup>2</sup> The objective of mNutrition and mAgri is to create and scale commercially sustainable mobile services that enable smallholder farmers to improve their livelihood and nutritional outcomes. The stated GSMA targets are as follows (GSMA, 2013):

- at least 20% of registered households that act on information and advice report consuming at least **four food groups** on a daily basis for at least nine months of the year as a result of more diverse agricultural output, increased income, and/or behaviour change in terms of nutrition;
- at least 50% of registered households that act on information and advice report a 25% increase in **agricultural productivity**; and
- at least 50% of registered households that act on information and advice report increases in **agricultural income** of 20%.

In Ghana, mNutrition is being implemented as part of the Vodafone mAgri VAS, a mobile extension service called VFC. The service is a bundled solution offering agricultural and nutrition information including weather and market prices via voice and SMS services in addition to free calls to other VFC members (details on the service are provided in Section 2).

The business model and cost-effectiveness component of the evaluation is designed to contribute evidence to help answer the first of the broad research questions specified in the Terms of Reference (Annex A):

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<sup>2</sup> For a detailed landscape analysis on the context for implementing mNutrition and mAgriculture programmes, see Barnett *et al.* (2016).

- What are the impacts and cost-effectiveness of mobile phone-based nutrition services on nutrition, health and livelihood outcomes, especially among women, children, and the extreme poor?

The mNutrition intervention is being externally evaluated in two countries. In Ghana, the intervention is implemented via the GSMA mAgriculture programme in which nutrition information has been integrated with crop information as part of a package of agriculture support services. The target group is low-income farmers in rural areas throughout the country. In Tanzania, the research consortium is evaluating mNutrition service supported under the GSMA mHealth initiative, which promotes behaviour change around maternal and early childhood health and nutrition. The Terms of Reference refer to the impacts and effectiveness of mobile phone-based services, so the scope of the evaluation is the mobile phone-based service as deployed under the mNutrition programme, rather than the incremental impact of support provided through the mNutrition programme. We are therefore assessing the cost-effectiveness of VFC inclusive of the mNutrition content.

The intended audience for the cost-effectiveness endline report is FCDO, along with other organisations involved in mNutrition programme globally (including local MNOs and non-governmental organisations implementing mNutrition services), national governments, international agencies, and donors.

The cost-effectiveness analysis relies on other components in the evaluation study. To determine whether the service under the mNutrition programme in Ghana is meeting its stated objectives and targets, the quantitative impact evaluation has employed a randomised encouragement design to estimate the causal effect of the VFC. The quantitative evaluation has answered the following two primary research questions:

1. How effective is the VFC service at increasing the knowledge and changing the behaviour of farmers (intermediary or secondary outcomes)?
2. What are the impacts of the VFC service on households' and women's dietary diversity, agricultural income, and production (final or primary outcomes)?

### **1.3 Purpose and scope of the cost-effectiveness endline**

This report is the final milestone in the evaluation study; as an endline report, it presents the analysis of the cost-effectiveness of the VFC intervention. This report seeks to:

- build on the relevant comparative literature, enabling cost-effectiveness to be compared with programmes that have similar elements to the VFC;
- utilise the framework proposed for the analysis as presented in the baseline report;
- compare the nutritional impact as defined by the quantitative surveys to the costs, giving an indication of cost-effectiveness; and
- update the known costs.

The quantitative report concludes that 'being offered the VFC service or having used it at least once has minimal impacts on household and women's dietary diversity, agriculture production, or nutrition or farming knowledge'. These impacts are marginal, and do not address the key effectiveness measures chosen during the inception of the evaluation. A cost-effectiveness analysis as proposed has not therefore been possible.

This report has therefore been completed as a contractual deliverable; however, given that the intervention has minimal impacts, it does not contain a cost-effectiveness analysis.

The report is one of four endline deliverables on the VFC project. It should be read in conjunction with the endline business modelling report (Scott and Batchelor, 2020) and the cost-effectiveness baseline report (Batchelor *et al.*, 2018). The quantitative baseline report (Billings *et al.*, 2018) and the qualitative baseline report (Barnett *et al.*, 2018) give additional insights into the consumer environment targeted by the service.

## **1.4 Organisation of the report**

Section 2 presents a background to the project, while Section 3 discusses the evaluation design. Section 4 looks at effectiveness as captured by the quantitative component of the evaluation and Section 5 considers the cost data and presents a financial model through which to undertake sensitivity analyses. Section 6 discusses the findings, particularly commercial sustainability as modelled in Section 5. Section 7 presents some conclusions and learnings.

## 2 The mNutrition intervention in Ghana

### 2.1 Context

**Nutrition:** Ghana has achieved substantial progress in reducing malnutrition and is on course to achieve most of the World Health Assembly Global Nutrition Targets set for 2025 (Development Initiatives, 2018). Improvements have been seen in the reduction of stunting among children under five years of age, which fell from 28.1% in 2008 to 18.8% in 2014 (Ghana Statistical Service (GSS) *et al.*, 2015). However, geographic disparities in nutritional status persist, with stunting prevalence at 22.2% in the Upper West region and 22.0% in the Central region, well above the national average and more than twice the rate in the Greater Accra region (GSS *et al.*, 2015). Micronutrient deficiency is also a persistent challenge, with more than 35% of children under five years anaemic, and more than 20% vitamin A deficient (University of Ghana *et al.*, 2017).

**Literacy in Ghana:** Adult literacy rates in rural Ghana are quite low, with only 41.7% of adults able to read or write in English or any Ghanaian language (Ghana Living Standards Survey (GLSS) 6). Among rural women, rates are even lower, at 31.4%. These low literacy rates have implications for the design of the VFC service and its ability to change the behaviour of illiterate subscribers with text content delivered by SMS.

**Mobile penetration:** Use of mobile phones has increased dramatically in the last decade from 19% of households owning a mobile phone in 2005/06 to 94% in 2016/17 (GLSS 7). While there is still some heterogeneity in mobile phone ownership by geographic location and poverty status, these gaps are narrowing quickly with 86.4% of households in the lowest wealth quintile owning a mobile phone (GLSS 7). The market for mobile services in Ghana is dominated by three MNOs. MTN is the largest, with a 49.08% market share for voice subscriptions and 59.74% for mobile data subscriptions. Airtel/Tigo holds 25.14% and 23.21% market shares for voice and data subscriptions respectively, while Vodafone holds 23.97% and 16.09% respectively. Glo, a fourth MNO, covers less than 2% of the market share (Ghana National Communications Authority, 2018).

**Agriculture in Ghana:** Agriculture accounts for 22.2% of national gross domestic product (GLSS 7). A little over half (51.5%) of households in Ghana own or operate a farm. Farming is predominantly a rural activity, with 82.5% of rural households involved in agriculture compared to only 26.6% of urban households. The proportion of females involved in agriculture is 41.2%, and there is virtually no difference in the gender balance between urban and rural areas (GLSS 6).

Agriculture extension services are decentralised but provision remains poor due to low capacity and limited funds (World Bank, 2017). In 2014 there were approximately 3,500 agriculture agents under the Ministry of Food and Agriculture (Dia *et al.*, 2017). According to the Ghana Socioeconomic Panel Survey baseline report (2011), 51.7% of all households surveyed received agricultural advice from other households and the proportion of households receiving agriculture extension advice through radio varied from 13.79% in the Northern region to 0.26% in the Greater Accra region.

**mAgri services:** The widespread penetration of mobile phone use in Ghana has come with a proliferation of tech start-ups, several with an explicit agricultural focus (for example, [Anitrack](#), [Complete Farmer](#), [Ghalani](#), [Qualitrace](#), and [TroTro Tractor](#), many of which have started since 2014 when the project was conceptualised). The VFC, introduced in 2015, is one such mAgri service, described in greater detail in Section 2.2 of this report. [Farmerline](#) is a social enterprise company that develops information and communication technology (ICT) for rural farmers. In 2013, Farmerline launched the 399 Service in partnership with MTN, which connects

farmers to financial services, information, and agricultural inputs. [Agrocenta](#) facilitates smallholder farmer trade with AgroTrade (a platform for farmer registrations, inventory management, logistics, and tracking) and provides financial services with AgroPay (a platform for digital payments, micro lending, and crop insurance). Mobile services for livestock farmers include [Cowtribe](#), which enables subscribers to schedule and receive veterinary treatment for livestock and track the health statistics of each animal, and [Agro Innova](#), which provides software for poultry farmers including AkokoTakra for production management and AkokoMarket for connecting farmers to markets. A few services aim to support logistics, including [Ghalani](#), a platform for farmers to organise group deliveries, and [TruckR](#), which allows farmers to book a truck on a mobile app to take products to market. Viamo, a global social enterprise with origins in Ghana, developed the [3-2-1 services](#), a mass communication tool used for the delivery of information-based services (including mHealth services) in a number of developing countries. In Ghana, the 3-2-1 Service was launched in April 2016 and delivers a range of services on the Vodafone network.

More recently, large MNOs are starting to roll out business-to-business services, enabling agribusinesses to pay farmers via mobile money for the product or services rendered (Loukos and Javed, 2018). There is also a growing interest in apps that enable the urban population to invest in agriculture either through the provision of finance and information services to farmers or by coordinating labour for urban landowners.

## 2.2 The VFC service

The VFC is a mobile extension service delivering agricultural and nutrition information to farmers via recorded voice and SMS messaging, targeted weather and market price information, and providing access to a call centre for agricultural advice. The objective of Vodafone's service is to create and scale commercially sustainable mobile services that enable smallholder farmers to improve the nutritional status of their household and increase their productivity. Smallholder farmers with access to mobile telecommunications are the primary target for VFC enrolment. The service includes access to a call centre for expert advice without airtime charges, free calls and SMS messaging to other VFC subscribers, and discounted calls and SMS messages to non-VFC subscribers, in addition to the following information-based services:

**Table 1: VFC's information-based services**

	Delivery mode	Frequency	Language
Local weather information	SMS	Three messages per week	English
Local market price information	SMS	One message per week	English
Agricultural tips for selected crop	Recorded voice message	Three per month	Local language
Nutrition tips (for selected crop and general)	Recorded voice message	Three per month <sup>3</sup>	Local language

Source: Authors' own

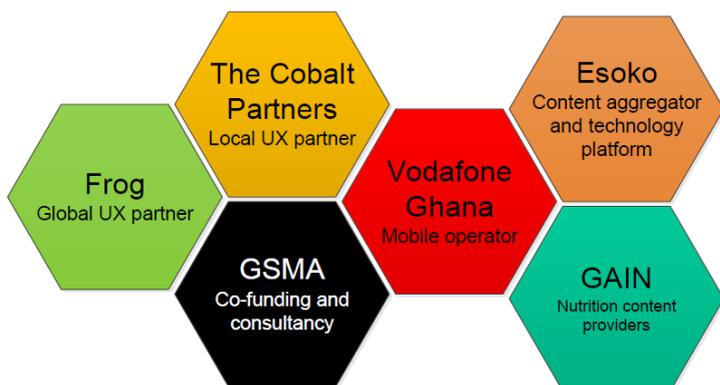
Key organisations involved in the VFC partnership are illustrated in Figure 2. The primary roles of each are as follows:

<sup>3</sup> Initially the VFC service sent one nutrition message per month, but this was increased to three nutrition messages per month in July 2017.

- Vodafone Ghana – lead partner, funding, marketing, and billing;
- Esoko – main partner, content, platform, and helpline;
- Cobalt – local user experience design research;
- Frog – global user experience partner;
- GSMA – co-funder, business intelligence, monitoring and evaluation (M&E) provided via contract with Agricultural Learning and Impacts Network (ALINe), and consultancy;
- GAIN – global content partner.

The contributions of the key partners to principal business activities are summarised in Table 2.

**Figure 2: Partners and other key players**



Source: GSMA, 2016. Reproduced with permission

**Table 2: Summary of activities conducted by key VFC partners**

	Vodafone	Esoko	GSMA / GAIN
Platform/network	Operate network Billing customers	Operate Esoko platform (distribute content)	Product feedback from users
Production		Create content Aggregate and localise content continuously (weather and market prices) Update advisory and nutritional content Maintain call centre	Create content
Marketing	Customer acquisition Customer retention	Customer profiling	Feedback from users

Source: Authors' own

Esoko Ghana, a mobile phone-based rural information service, curated the message content and operated the platform to send tailored SMS and recorded voice messages to member farmers and also operated the Farmer Helpline call centre. Esoko developed the content for the crop-specific agricultural tips for 24 widely cultivated crops in Ghana. These tips covered recommended planting time and information on best practices for cultivation and harvest. Messages were sent according to planting cycles for specific crops and agro-climatic zones based on farmer profile information. Supported by mNutrition programme funding, nutrition content was developed by GAIN in 2015. GAIN created 312 crop-specific messages (13 messages per crop for the 24 Esoko-supported crops) with nutrition information on topics including food preparation, food hygiene, safety and storage, and processing. In 2017, the Grameen Foundation developed 26 additional nutrition messages focused on animal-sourced foods including eggs, dairy, fish, and meat. VFC subscribers received both general nutrition tips and crop-specific nutrition tips according to their profiled crop.

Vodafone invested in the VFC service with the aim of increasing penetration in rural Ghana through new subscriber acquisitions. The VFC service was launched in June 2015 and promoted by Vodafone agents with a dedicated VFC SIM card. The monthly subscription fee for VFC was initially GHS 2 (US\$ 0.45). However, the agent-led model resulted in slow acquisitions and difficulty retaining active usership of the service. By November 2016 there were approximately 130,000 registered members, but fewer than 20% were active (GSMA, 2017). In December 2016 Vodafone added existing rural Vodafone customers to the service, increasing the VFC subscription rate to over 200,000. In addition, Vodafone made a strong push to increase acquisitions by temporarily dropping the monthly subscription fee from October 2016 to June 2017. In June 2017, the monthly service fee was reinstated at GHS 0.5. Monthly fees are automatically deducted from the subscriber's airtime balance when the balance is at least GHS 0.5.

The VFC service is designed to offer customised information to farmers based on their selected preferences. Initially, each new member was profiled by a Vodafone agent at the time of registration, indicating their preference of location for weather and market price information, their preferred language for receiving recorded voice messages, and their preferred crop choice for agricultural tips and price information. It became apparent that much of the profiling data was not being collected by agents at the time of SIM registration, however, due to the incentives placed on acquisition rather than quality of data collection. As a result, Esoko and Vodafone modified their strategy so that all profiling would be done through a follow-up call to new members by the VFC call centre after the SIM registration process was completed. However, when Vodafone suspended the monthly service fee and initiated a large push to increase the programme member base in late 2016 to meet the grant targets of 400,000 users, it became unfeasible for Esoko to follow up with each new VFC member individually. Instead, new members were given default profile options based on their district of residence, receiving agri and nutrition tips on the crop most widely grown in that district and in the language most widely spoken. Farmers were able to request modifications to the profile options through the call centre, but this was not widely publicised. As a result, new members were less likely to have customised options and may have received agricultural and nutrition tips for crops they did not cultivate.

Due to the challenges in building and maintaining a wide subscription base for VFC, Vodafone decided to bring one of their global services to Ghana to better meet the needs of rural farmers. This was the *Connected Farmer*, which includes financial services delivered through the Vodafone Cash platform such as a savings package and crop insurance offer and a platform for connecting farmers to agri-business services. This new offer was selected based on findings from market research conducted in 2018 that indicated farmers are most interested in services with immediate financial benefits (e.g. access to finance) and far less interested in information-based services, even if the information is also intended to ultimately boost production and income. However, Vodafone planned to continue offering the VFC services to *Connected Farmer* members with the aim of building greater demand for such information over time. *Connected Farmer* was supposed to be rolled out in 2018 and Vodafone planned to migrate existing VFC members to the new *Connected Farmer* service when it was launched, although study farmers would continue receiving the basic VFC service to maintain consistency in the mNutrition evaluation intervention. However, the launch was delayed and *Connected Farmer* had not yet been initiated at the time this report was written.

In January 2019, Vodafone paused its contract with Esoko (it is currently being renegotiated) to deliver recorded voice content for VFC, although Esoko continued to operate the VFC help line. IFPRI contracted Esoko directly to continue sending the content to study farmers from January through March 2019. There was a small interruption in the voice message service before Esoko resumed sending content to study farmers in the third week of January under the IFPRI contract.

## 3 Evaluation design

### 3.1 Study design

The aim of the impact evaluation is to assess the impact, cost-effectiveness, and commercial viability of mNutrition. The evaluation is being conducted by a consortium of researchers from Gamos, IDS, and IFPRI. The team draws on a number of methods and interlinked components to gather evidence about the impact of the mNutrition intervention in Ghana, including a qualitative component, a quantitative component, and a business model and cost-effectiveness component. The evaluation is being conducted in two regions of Ghana: the Central region and the Upper West region.

This report focuses on the cost-effectiveness of the proposition.

The baseline report proposed three scenarios for the cost-effectiveness analysis, designated analyses A, B, and C.

In Analysis A, it was proposed that the costs in Figure 3 (below) include only the ongoing implementation costs and those directly associated with the setting up of the specific service (e.g. the localisation of the content development). Analysis A does not attempt to allocate a proportion of the wider mNutrition programme costs, nor does it take into account the sunk and investment costs associated with building the asset value of the agriculture and market information system that Esoko brought to the partnership or the network infrastructure brought by Vodafone.

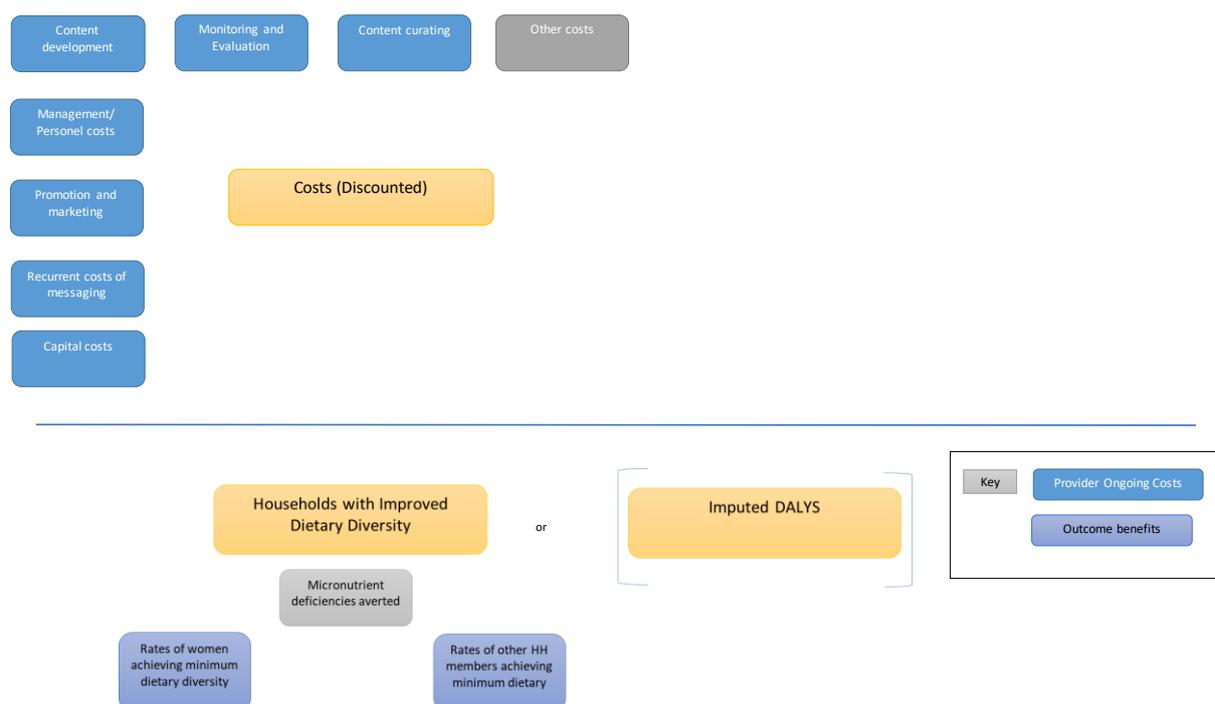
The effectiveness was held to be the measured change in diet diversity. This has been measured within the quantitative component of the overall study. It consisted of measures on households' and women's dietary diversity, agricultural income, and production.<sup>4</sup>

This analysis would be of primary use to stakeholders who may wish to replicate the service without further development costs and have a willing MNO in place with similar coverage to Vodafone Ghana. It is based on the assumption that content, at least at the global level, will be available free of charge. This is indeed the case given that all the factsheets and messages developed by the global content partners to the mNutrition programme will be open access and made freely available through the CABI Knowledgebase. It assumes that any new service will also provide weather and market prices as part of the service, which will have to be generated locally. It also assumes that any future implementing agency will have access to the technical platform and capability needed to implement such a system, either as part of its own resources or by subcontracting the services of a company that does have such capability, such as Esoko.

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<sup>4</sup> As will be stated below, the quantitative report concludes that 'being offered the VFC service or having used it at least once has minimal impacts on household and women's dietary diversity, agriculture production, or nutrition or farming knowledge', thus rendering the planned analysis moot.

**Figure 3: Costs associated with Analysis A**



Source: Authors' own.

Analysis B (illustrated in the baseline report) intended to include sunk costs or investments in the project development and the supporting infrastructure. The wider costs were difficult to apportion, however. One could argue that a portion of the wider project research and development should be assigned to the VFC costs, since if donors were to invest in, for example, a next generation of mNutrition services, they would need an overarching programme of work similar to the mNutrition programme to stimulate MNOs to adopt new approaches, to coordinate learnings and effort, and to deliver wider programmatic benefits. The same argument applies to the global content developed as part of the overall mNutrition programme, as well as to the institutional infrastructure set up by GSMA (and others) in order to deliver the programme.

Analysis B would be of most use to FCDO and other funders or policy actors to assess whether the programme of mNutrition represented VfM. It would be of particular use if a similar programme was being planned for the future.

Analysis C proposed a comprehensive view of costs, taking into account not only operational costs and wider programmatic costs, but also societal costs. For instance, there is an argument that the real cost of the text messaging service should include sunk investment in the platform, including intellectual property from previous related projects. Esoko has a history of information provision and brings a wealth of learning on what works and what does not—the cost of that learning being sunk costs from previous projects (i.e. existing assets). An element of the societal costs was any cost associated with any behaviours that farmers need to undertake in order to realise the benefits pursued by the project. For example, if the project aims to increase yields through the adoption of modern agricultural practices, such as the appropriate use of fertiliser, then success will require farmers to buy fertiliser. However, we shall see that there are marginal changes in practice such that this analysis will not be possible.

## 3.2 Data collection methods

This report is based on interviews with key stakeholders and access to secondary data. A list of contacts made during the baseline collection can be found in Annex B.

The endline report is based on information collected from multiple sources:

- qualitative interviews conducted with stakeholders and MNOs in Ghana;
- commercial data provided by stakeholders and MNOs (or brokered by GSMA);
- monitoring data gathered by ALINe (the M&E provider for the GSMA mAgri programme);
- data available in published literature;
- government stakeholders and alternative service providers as a source of additional, unpublished information on costs and business models;
- the quantitative component of the study led by IFPRI (Billings *et al.*, forthcoming, 2020); and
- the qualitative component that focused on consumer perceptions, led by IDS (Barnett *et al.*, 2019).

This report draws heavily on data analysis presented in the quantitative endline report (Billings *et al.*, forthcoming, 2020). This analysis highlights differences in outcomes across encouraged and comparison groups using data collected in the baseline and endline surveys. Full details of the sampling design and the analytical approach can be found in Billings *et al.* (forthcoming, 2020) but it is important to understand what the two groups represent.

To estimate the causal impact of the VFC product, IFPRI implemented a randomised encouragement design. The encouragement design does not restrict access to the VFC service (as with a control group in a randomised control trial), but instead works by randomly assigning some communities or households to receive additional marketing and promotion of the programme. Because the encouragement is randomly assigned, the variation in take-up of the service created by the encouragement is used to measure the causal impact of the programme as the difference in outcomes between encouraged and comparison communities at endline. The random assignment means that average differences in outcomes across the groups after the intervention can be interpreted as being truly caused by, rather than simply correlated with, the interventions.

The additional marketing and promotion to encourage take-up and continued use was informed by the qualitative study and involved a combination of price discounts and door-to-door marketing to households in selected communities throughout the evaluation period. During the door-to-door marketing, the product was promoted using a short advertisement script. Households in communities were randomly assigned to receive the encouragement. The experimental design included two refinements:

- Using 'sales' scripts that focused on the agriculture content of the product (Vodafone's current script) or scripts that augmented the agriculture focus with additional information on nutrition.
- Either a male or a female from the household was targeted to receive the advertisement scripts and free subscription to VFC.

### 3.2.1 Processing information

Evaluation activities carried out by Gamos to inform the endline reports included:

- field visits to establish and maintain relationships with key stakeholders; interviews conducted with key representatives of stakeholder institutions to gather additional data to populate the cost-effectiveness analysis framework; ongoing communication and field visits undertaken to monitor developments in services and to track the commercial justification for changes;
- working with IDS and IFPRI to contribute to the design of both qualitative and quantitative instruments (both baseline and endline) to incorporate indicators relating to non-financial attitudes of customers to services, and to MNOs in particular, such as customer satisfaction and brand loyalty. These instruments also explore attitudes towards alternative services offered by other providers (e.g. media, face-to-face extension, etc.); and
- analysing financial data with a view to creating a financial model to test key cost sensitivities.

The process of enquiry and information collection was flexible and responsive to events on the ground, given that the service offerings were constantly evolving. Particularly portentous times occurred following the end of GSMA grant with Vodafone. Other times coincided with the publication of significant outputs from the research project that informed product review decisions. This component of the evaluation is based on opportunistic data gathering from key individuals such as representatives of the core partners and other partners to the project.

### 3.3 Ethical considerations and approval

As an overall guiding principle, the research team sought to conduct themselves in a professional and ethical manner throughout the baseline phase of work, with strict respect for principles of integrity, honesty, confidentiality, voluntary participation, impartiality, and the avoidance of personal risk. These principles were informed by the Organisation for Economic Co-operation and Development (2010) Development Assistance Committee's Quality Standards for Development Evaluation and FCDO's 'Ethics Principles for Research and Evaluation', which were followed for the duration of the evaluation.

Overall, this component draws on the qualitative and quantitative data collected in the other two components of the evaluation. Other data sources were stakeholder interviews with MNOs, and data collection (commercial and monitoring data) from MNOs and other relevant organisations.

Although most research participants were familiar with the mNutrition programme, and the principle of an independent evaluation, we nevertheless sought the informed consent of participants. This was achieved by emails and briefing documents describing the research. In particular, it described the relationship between the consortium, FCDO, and GSMA, in order to avoid any possibility of deception. Research activities with participants involved interviews only; there were no observational activities.

While this evaluation component did not involve any primary data collection from human subjects at the community/household level, ethical considerations are still important for all work carried out under this component. In particular, GSMA remains highly aware of the commercial sensitivities of its partner MNOs, so the issue of commercial confidentiality is very important for this area of work given that it relies on sharing of sensitive commercial data. Therefore, the Gamos team has paid specific attention to this issue as part of its ongoing work.

The Gamos team is currently operating under the Non-Disclosure Agreement (NDA) signed by GSMA and OPM during the inception phase of the project. Where relevant, stakeholder respondents were informed that an NDA with their trade association had been signed, and that the interview would be bound by it. All the data that were gathered fell within the scope of this agreement (e.g. development, business plans, marketing, operations, and finances), although there is a provision that such information should be designated as proprietary or confidential.<sup>5</sup>

For the avoidance of doubt, all internal reports shared by Gamos were marked as confidential and were not to be circulated outside the evaluation team. Any outside reporting will not contain any detail that could be construed as proprietary or confidential information.

All external reports were and will be shared with key research participants in early draft form in order to establish principles of trust and reciprocity. This has been to ensure that participants will have an opportunity to confirm that their views have been reported accurately, and that publications do not breach their confidentiality requirements.

As this component draws on qualitative and quantitative data collected through the other two workstreams, appropriate measures were taken to ensure that the shared data are anonymised and there is no risk of a breach of confidentiality. For the quantitative data, a unique household ID has been assigned to each household that allows for following up with respondents as necessary without providing access to any personal information on datasets that are made available for analysis. Similarly, all qualitative transcripts are anonymised, pseudonyms given, and any information that can lead to personal identification has been removed.

### **3.4 Limitations**

The methodology depends on the willingness of key stakeholders to share their data and their thoughts. In a commercial environment this is not always forthcoming, and a limitation of the report is that it relies on this shared data. Risks associated with this transfer of data have been mitigated as much as possible by clear communication and follow-up with stakeholders. The degree of engagement to date with stakeholders is reflected in the insights and level of data presented in the report. Changes in relationships and personnel (among all stakeholders) were the principal threats to the mitigation strategy.

The risks associated with the evolving nature of the business model have been mitigated as much as possible by setting milestone data points, and the subsequent phases have informed the changes between baseline and endline.

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<sup>5</sup> The agreement permits Gamos to share confidential information among the team if they need to know, they have entered into a confidentiality agreement, and they are not a competitor.

## 4 Effectiveness

In this chapter, we present the impact of the VFC on primary outcomes identified as measured by the quantitative component, and which provide the basis of effectiveness within the cost-effectiveness analysis. These findings are drawn from the quantitative component report (Billings *et al.*, 2019) and more detail can be found in that report.

The analysis of impact and effectiveness from the quantitative study follows the empirical specification detailed in that report. Using an analysis of covariance model, they estimate the ITT effect as the difference in average outcomes between the comparison group and those that were assigned to the randomised encouragement group, regardless of whether they actually participated in VFC. That is, they are measuring the impact of treatment assignment (in this case encouragement to participate in VFC) on outcomes of interest. For the outcomes, they present the endline mean of the comparison group and the ITT estimate with basic controls and extended controls. Basic control variables include an indicator for region and the value of the respective outcome at baseline. Extended controls include household size, whether household head is female, whether household head is literate, a poverty index, whether the household owns a mobile phone, and the order of survey modules. The coefficients reported in the impact estimate columns, together with their standard errors, indicate both the magnitude of the estimated impact of being offered the VFC service and whether the estimated impact is statistically significant.

The primary outcomes of the study are households' and women's dietary diversity, agricultural yields, and income from agriculture. Improvements in these outcomes are the main objective of the mAgri programme under mNutrition. The secondary outcomes are changes in participants' knowledge; however, these were not taken into account for the cost-effectiveness.

### 4.1 ITT impact estimates: Primary outcomes

#### 4.1.1 Households' dietary diversity

The quantitative component constructed a household dietary diversity index using information collected on the food the household consumed in the 24 hours prior to the survey. For 21 different food items, respondents were asked: 'Yesterday (during the day or the night) did anyone in your household eat or drink any [*food item*]?' This information is used to construct a Household Dietary Diversity Score (HDDS), which combines responses to the 21 food items consumed into the following 12 food groups: cereals, roots/tubers, vegetables, fruits, meat/poultry/offal, eggs, fish/seafood, pulses/legumes/nuts, milk/milk products, oils/fats, sweets, and spices/condiments/beverages. The HDDS indicates a household's economic access to food; therefore, the score includes items that require household resources to obtain, such as condiments, sugar and sugary foods, and beverages (Kennedy *et al.*, 2011).

The quantitative component reports the comparison group's mean score and the ITT impacts on HDDS. Households, on average, had consumed 5.88 out of the 12 food groups in the last 24 hours. Condiments, cereals, and seafood were the most commonly consumed groups (91.9%, 90.1%, and 85.5% respectively), while the least common were eggs, dairy, and sweets (10.7%, 13.0%, and 17.8% respectively). Under the basic control model, there are no impacts of being offered the VFC service on the HDDS or the individual food group indicators. The extended control model reveals similar results, although the impact on consuming dairy is now marginally significant.

### 4.1.2 Women's dietary diversity

Individual food consumption of the primary female was also collected and used to construct the Minimum Dietary Diversity – Women (MDD-W). The MDD-W is a dichotomous indicator that equals one when women consume at least five out of 10 food groups, something that reflects the greater likelihood of women meeting their micronutrient needs than women consuming foods from fewer food groups (Food and Agriculture Organization (FAO) and FHI 360, 2016). Similar to the HDDS, the survey instrument collected information on 21 different food items consumed by the primary female in the last 24 hours. For each food item the primary female was asked: 'Did you, (name of primary female respondent), eat or drink any [food item] yesterday (during the day or night)?' Responses from the 21 food items were used to create indicators on the primary female's consumption of the following 10 food groups: grains/white roots/tubers, pulses, nuts and seeds, dairy, meat/poultry/fish, eggs, dark green leafy vegetables, other vitamin A-rich fruits and vegetables, other vegetables, and other fruit. In contrast to the HDDS, the MDD-W does not include oils/fats, sweets, or spices/condiments/beverages, but instead is only composed of 10 food groups intended to reflect the micronutrient adequacy of the diet (Kennedy *et al.*, 2011).

The quantitative component reveals the comparison's group mean score and the ITT estimates of being offered the VFC service on MDD-W. At endline, the primary female, on average, consumed 4.3 food groups out of 10, and only 50.0% of women met the minimum dietary diversity of consuming at least five food groups. Similar to the household results above, almost all women had consumed tubers and grains (98.3%) in the last 24 hours and most had consumed meat, fish, and poultry (88.3%), while very few women had consumed eggs (8.5%), dairy (10%), or nuts and seeds (10.1%). Under both the basic control and extended control model, there are no impacts on the MDD-W or on individual food groups of being offered the VFC service.

### 4.1.3 Agricultural production and income

The measure of effectiveness was intended to be based on the changes in dietary diversity as it translates into DALYs and can be used for comparison across other nutritional interventions. However, Analysis C would have drawn on differences in agricultural yields and income. The quantitative component analysed for agricultural production and separated outcomes into crop diversity, area cultivated, and yields, and the value of production, input costs, and profits. It constructed indicators for total agriculture production in addition to crop-specific agriculture production. The crop-specific indicators are for maize, which is grown both in the Upper West and Central regions; cocoa, which is grown in the Central region; and groundnut, which is grown in the Upper West region. Most of these indicators were also constructed at baseline and exact details on how they were constructed can be found in the baseline report (Billings *et al.*, 2018). For indicators on areas cultivated and yields we take the log value, which transforms these indicators to a normal distribution and lessens the impact of outliers. For indicators on value of production, input costs, and profits, we take the inverse hyperbolic sine instead of log values because it is able to transform negative numbers. The analysis is conducted on all households that report owning or managing agricultural land, which makes up 98% of the sample.

The quantitative component reveals that households on average cultivated 2.77 crops in the last major season and the total area under cultivation was on average 1.7 log acres, which is 6.7 acres. Most households grow maize (72.4%), 30.6% of households cultivate cocoa, mainly in the Central region, and approximately 32% of households cultivate groundnut, mainly in the Upper West region (see Chapter 8 for results across region). With the exception of a marginally significant decrease in the area of cocoa cultivated, there are no impacts of the VFC service on crop diversity, area cultivated, or yields.

Although there are no impacts of the VFC service on yields, the quantitative component tested for impacts on income from agriculture production assuming that farmers may be able to obtain better market prices, thereby increasing the value of production or increasing value by decreasing the input costs as a result of advice given. However, the quantitative component reveals that there are no statistically significant impacts of being offered the VFC service on either the total value, input costs, or profit. This applies to both outcomes for individual crops as well as to aggregate indicators, and the outcome is robust to adding extended controls to the model. The average total value of production in the last major season has an inverse hyperbolic sine of 7.5, which translates to GHS 4,081.2 (approximately US\$ 760 or £578). The production of cocoa has the highest value, input costs, and profits across the three crops.

## 4.2 Summary of effectiveness

The quantitative component using the ITT approach finds no evidence to suggest that access to the VFC service had any impact on dietary diversity either for the household or for women, or on agriculture production and income. Point estimates in most cases result in precisely estimated zeros. The exceptions are marginally significant increases in the probability that a household consumes dairy and marginally significant reductions in the area of cocoa cultivated for households that produce cocoa. Consistent with the null results on primary outcomes, we find no evidence that access to the VFC service led to significant improvements in secondary outcomes related to nutrition or farming knowledge of the primary male or female. Together these results suggest that providing access to the VFC service is not sufficient to lead to significant changes in knowledge or primary outcomes of interest.

## 4.3 LATE impact estimates: primary outcomes

In addition to the ITT estimate, the quantitative component estimates the LATE of the VFC service for households that were induced to register and use the service by the randomly assigned offer (compliers). As detailed in the quantitative component, it used two-stage least squares to estimate LATE, and in particular the random variation in encouragement as an instrument for registering and using the service in the last 18 months preceding the endline survey. Approximately 68% of encouraged households who were provided with the free offer of the VFC service registered for the VFC service and of these 50% used the service in the last 18 months (see Section 5.1). Under the two assumptions discussed in the quantitative component report, two-stage least squares estimates identify the causal impact of having received the mNutrition content for complier households.

### 4.3.1 Households' dietary diversity

The quantitative component reveals the LATE estimates on household dietary diversity. The point estimates are simply the ratio of the ITT point estimate over the first stage coefficient presented in the quantitative report, implying that they are about three times the size of the ITT treatment effects. Similar to the ITT estimates, the quantitative component finds no impact of the VFC service on households that were induced to use the service as a result of the randomised encouragement. As expected, the LATE estimates are larger in magnitude than the ITT estimates, but none except the indicator for consuming dairy are significant.

### **4.3.2 Women's dietary diversity**

The quantitative component presents the LATE estimates of using the VFC service on women's dietary diversity. Similar to the ITT estimates, no impact of the VFC service is found on any of the indicators listed.

### **4.3.3 Agricultural production and income**

The quantitative component report also reveals the LATE estimates on agriculture outcomes. Similar to the ITT, it finds no impact of the VFC service on households that were induced to use the service as a result of the randomised encouragement. As expected, the LATE estimates are larger in magnitude than the ITT estimates, but none except the indicators for the area cultivated for cocoa are significant. The LATE estimates suggest that complier households who grow cocoa reduce the area of cocoa cultivated by 24%.

## **4.4 Summary of LATE effectiveness**

Similar to the ITT results, the quantitative component finds no evidence to suggest that registering and using the VFC service had any impact on dietary diversity either for the household or for women, or on agricultural production and income. Point estimates, while three times larger than the ITT estimates, are not significant. The exceptions are marginally significant increases in the probability that a household consumes dairy and marginally significant reductions in the area of cocoa cultivated for farmers that produce cocoa. Consistent with the null results on primary outcomes, no evidence is found that registering and using the VFC service led to improvements in secondary outcomes related to the nutrition or farming knowledge of the primary male or female. Together these results suggest that the VFC service did not lead to any changes in knowledge or primary outcomes of interest even for compliers.

## **4.5 The effect of primary outcomes on the cost-effectiveness analysis**

Given that the quantitative report was therefore unable to identify measurable changes in the primary outcomes, which were the basis for the effectiveness, a cost-effectiveness analysis as planned has not been possible. There could have been an analysis using uncertainty bounds of parameters to estimate cost-effectiveness ratios, but the result would likely have been a large ICER with significant uncertainty. In light of the Terms of Reference from the funder, this has not been attempted.

There are learnings from the programme, and the evaluation as a whole is rich in data and learning. The qualitative component has unpacked the views, drivers, and barriers of the consumer, and the business modelling documents the VFC journey and provides insights into the commercial sustainability of the product. Indeed, the quantitative component gives insight into willingness to pay (WTP) and other features of the programme. However, given the absence of measurable primary outcomes, a cost-effectiveness analysis for Ghana as proposed in the inception and baseline reports has not been possible.

## 5 Cost analysis

This chapter presents the costs collected that would have been used for Analyses A and B should there have been measurable effectiveness. The section undertakes a sensitivity analysis on the key costs. These costs have relevance to the business modelling component and can be found in the business modelling report (Scott and Batchelor, 2020).

### 5.1 Costs for Analysis A

Costs were collected from project budgets, expenditure reports, and key stakeholder contacts from multiple organisations as available from inception to July 2019. If another MNO in another country were to consider setting up an agricultural information service, it would need to consider the costs associated with establishing a localised information database, along with the capital expenditure and operational expenditure required to get such a system up and running.

Where possible, the team has collected and collated costs for the VFC service. The service is being treated as a whole, meaning any effect is the combination or synergy between livelihood messages and the nutritional messages. We have therefore at this stage taken the costs for the whole.

In the framework, the set-up and ongoing costs include the following:

- **Capital costs:** the cost of any infrastructure created to support VFC. In order to provide the service, some extra equipment was required. For instance, while Vodafone did not have to make any particular purchases, Esoko servers needed to be upgraded and the grant provided finance for new computers. A service offering in a new country might also require some capital equipment.
- **Management/personnel costs:** the ongoing service requires expenditure on staff and management. MNO overheads could be incorporated here. In particular, VFC has a call centre associated with it, and this therefore includes the training and employment of responding agents. Personnel costs need to include any engineers required to maintain the platform. In each case, the staff costs stated in the budget and reporting documents are attributed to the associated activity.
- **Promotion and marketing:** this includes the training of in-country personnel, transport for trainers, hours of labour, etc. VFC has already taken a number of different approaches to marketing. After considering an Ambassador model, the marketing was conducted through a network of agents and resellers. The Ambassador model would have used influential local people who are well respected within their communities to promote VFC among target groups of farmers and rural communities. However, incentive schemes failed, and the concept was not pursued. The initial service was targeted at new users, i.e. those with no phone or those using a SIM card from another MNO. VFC was intended to attract users from other networks to Vodafone. Latterly, in order to achieve the numbers required for uptake, SMS blast messaging invited existing Vodafone SIM card holders to join the VFC tariff. The cost of acquisition is, by definition, higher for new users than migrating existing customers. These nuances need to be taken into account.
- **Recurrent costs of messaging:** on the face of it, one of the simplest costs is the price assigned to the text messaging. Each message has a cost associated with it, while message scheduling and despatch platforms will also incur ongoing maintenance costs. Who pays these costs is a more complex question. For the duration of the grant, costs were covered in part by

donor financing (Esoko content and call centre costs). The service was a pay-monthly model in which costs are at least partly recovered from users. For the cost-effectiveness equation, one could argue that revenue recovery is irrelevant—each message costs someone (donor, MNO, or user) an amount to be sent and received. However, this revenue question will be revisited below in the more complex Model C.

- **Localisation content development:** mNutrition as a whole has been funded to develop and collate a global repository of nutrition information. In order for this to be applied to VFC Ghana, there had to be a localisation process, which involved taking the global fact sheets and making them relevant to the clientele of VFC. This involved a number of partnerships that will be discussed below.
- **Content curating:** there is an ongoing need to update the content of the messages. Information can get out of date and, while this is more likely to happen with medical information, there is nevertheless a need to ensure that the agricultural information remains relevant. In the case of VFC, there is real-time messaging on market prices and weather, and to obtain this information incurs a cost.
- **User experience, baseline, and M&E:** this refers to the resources and personnel needed for user experience surveys and feedback (often called UX by the industry), baseline surveys, and M&E. We include here the baseline surveys and UX surveys required to design the specifics of the service, and the ongoing mechanisms of feedback to keep the service relevant to the farmers and to keep stakeholders apprised of the service's effects (both financial returns and public good impact). It could be argued that the UX surveys are a part of the product research and development, which we have modelled as a societal cost. However, if a similar service utilising the experience of VFC Ghana and the global content created by the mNutrition were to be set up in another country, there would need to be further UX surveys to inform the service shape and form, and contribute to the localisation of the content.

## 5.2 Costs for Analysis B

As discussed briefly above, if a cost-effectiveness study is not just used to inform thinking on replicating an agricultural information service (forward thinking) but also for a wider, retrospective assessment of what can be achieved for a given level of investment, then actors might need to understand the full cost of setting up the VFC, inclusive of the wider programmatic costs. This is typically the kind of approach that would appeal to donors and policy actors interested in assessing whether the programme represents VfM. In order to include this wider perspective, in addition to those costs included in Analysis A, the following costs also need to be explored:

- **Research and development for the mNutrition programme as a whole:** the expanded nutritional messages sent out by VFC are only one particular output from the wider mNutrition programme. The mNutrition programme as a whole has spent time strategising, planning, co-creating global content, etc., leading to 14 specific in-country services in 12 countries. While it is impossible to extract the specific costs of mNutrition related to the new nutritional content of VFC, it could be argued that 1/14th of the overall programme costs (minus specific grants) should be imputed to the mNutrition component of VFC. While this of course is open to question, for Analysis B we consider this cost. This should capture the research and development behind the mNutrition project after the project's inception (e.g. hours of labour devoted to the project by larger organisations, the amount paid to external researchers, costs of rent, vehicles and other transport costs associated with the project, costs of office supplies, electricity, and other expenses necessary for research and development tasks).
- **Global content development:** the mNutrition programme paid for a global content generation process that was carried out by a consortium, comprising CABI, GAIN, Oxfam, the International

Livestock Research Institute, and the British Medical Journal. The Global Content Partnership was responsible for identifying relevant content, creating content structures, and specifying content validation and quality control processes. The content developed by the consortium was then made available to local content partners in each country to adapt for local consumption, and these costs are included as the localisation content development in Analysis A. A proportion of costs associated with the work of the global content consortium should be imputed to VFC in Analysis B.

- **Programme-related infrastructure:** in order to implement a complex programme across 14 projects in 12 countries and two continents, GSMA had to set up substantial infrastructure at substantial cost. This includes institutional management structures, personnel, offices, IT networks, etc. for GSMA as a whole. A proportion of these costs, paid for through the wider mNutrition programme, are included in Analysis B.

### 5.3 Costs for Analysis C

As discussed briefly above, for a more complete picture of the costs involved in the VFC service, Analysis C proposed considering a number of additional costs:

- indirect, variable costs incurred as a consequence of users taking actions to implement new practices advocated by the VFC service; and
- sunk costs involved in building the assets that each partner brings to delivery of the VFC service.

The benefit or effectiveness of VFC was, in theory, potentially dependent on other costs to be met by the household. Offset against this, however, is the potential for the household to earn extra income and/or make savings on expenditure through their improved farm management. For example, they could have been expending more on fertiliser and achieving greater diet diversity, and also gaining extra income or reducing their irrigation costs. Similarly, Analysis C was intended to consider costs associated with implementing changed behaviour, as well as establishing intellectual and infrastructure assets that are employed in some way as part of achieving nutritional outcomes. However, given that no changes in farming practice were identified by the quantitative data and the impact of the VFC project in Ghana was marginal, Analysis C was not attempted.

## 5.4 Cost data utilised for the financial model

### 5.4.1 Capital expenditure

**Table 3: Capital expenditure**

Item	Estimate (GBP)	Source	Description
<b>Vodafone investment</b>			
Funding for integration and technology upgrade (content provider)	25,000	VFC financial report	Actuals: 23,300
STK set-up	10,000	VFC Financial report	Actuals: 6,786
Localisation of content	85,000	CABI budget	Half of all local content provider (LCP) payments allocated to Ghana (it has both mAgri and mHealth projects)
Staff costs (Global Content Partner)	30,000	CABI budget	Half of all LCP payments allocated to Ghana
Direct costs	9,000	CABI budget	Half of all LCP payments allocated to Ghana
<b>mNutrition programme (country specific)</b>			
Product development			
Formative evaluation (international)	78,000	GSMA communications	See average country breakdown below
UX expert and design consultants	150,000	GSMA communications	See average country breakdown below
<b>mNutrition programme (global)</b>			
<b>Global content development</b>			
Global content partners	250,000	CABI budget	255,910 (per country programme)
<b>Programme management</b>			
Business intelligence and programme management (GSMA)	550,000	GSMA communications	See average country breakdown below

Source: Authors' own

GSMA mAgri total project budget average per country<sup>6</sup>: £1,422,550.

Breakdown of above cost per country (using Ghana specifics where available):

- M&E/business intelligence £78,000
- UX £148,600
- Global content £255,910 (from CABI budget for Ghana)
- Local content £123,698 (from CABI budget for Ghana)
- Grant amount (VF) £262,500

The remainder covers GSMA contributions to business intelligence and programme management: £553,843.

<sup>6</sup> Personal communication.

## 5.4.2 Operational expenditure

The following estimates are based on an assumption that the subscriber base was acquired over an eight-month rapid growth period.

**Table 4: Operational expenditure**

Item	Estimate (GBP)	Unit	Source	Description
<b>Fixed costs</b>				
<b>Product development</b>				
UX expert	4,000	GBP/qtr in rapid growth stage	VFC financial report	Actuals: 19,373 (deliverable payments) Budget: 25,594 (in four instalments) Actuals: 12,480 (UX peak salary) Budget: 10,969 Total: 31,853
UX expert (T&S)	200	GBP/qtr in rapid growth stage	VFC financial report	Actuals: 1,321 (single claim)
UX misc. (data, airtime and smartphone, feature phone, dongle)	200	GBP/qtr in rapid growth stage	VFC financial report	Actuals: 1,273 (over eight quarters)
User testing	0	GBP/qtr in rapid growth stage	VFC financial report	No actual expenditure
Project M&E	3,000	At launch, then 50% during rapid growth	VFC financial report	Actuals: 6,462 Budget: 21,755 (over seven quarters) Grant application: 1,500 per quarter
Content curation (LCP)	34,000	GBP/year (after launch)	Esoko sustainability plan	Lump sum estimate for keeping content up to date
<b>Marketing expenses</b>				
Marketing events	5,000	GBP/qtr in rapid growth stage	VFC financial report	Actuals: 38,707 (over three quarters) Budget: 149,909 (in six instalments)
Local radio slots and production	15,000	GBP/year during rapid growth stage	VFC financial report	Actuals: 26,634 (spent in two instalments)

SIM branding and customisation	14,000	Launch only	VFC financial report	Actuals: 13,938 (spent in first year)
Ambassador merchandising/sales activation	48,000	At launch, then 50% during rapid growth	VFC financial report	Actuals: 211,070 (approx. 200,000 over two years, drops to approx. 22,000 per quarter in second year)
<b>Administration expenses</b>				
Working group travel	2,000	GBP/qtr in rapid growth stage	VFC Financial report	Actuals: 15,688 (over first seven quarters)
Staff cost: PM	3,000	GBP/qtr rapid growth stage, then 50%	VFC Financial report	Timesheet: 60 day/qtr (£50/day)
Support staff	5,000	GBP/qtr rapid growth stage, then 50%	VFC Financial report, interviews	Personnel listed in timesheet, levels of effort from interviews, our estimates of charge rates
Training	1,000	GBP/qtr	VFC Financial report	Actuals: 2,016 (over two quarters) Budget: 8,227 (over eight quarters)
<b>Variable costs (cost of sales)</b>				
Cost of SMS	5.5	GH p/SMS	Website	Prevailing market rate for individual customers
Taxes and fees	1.5	% of revenue		
Content provider	0.46	GBP/qtr/subscriber	Interviews	Original contract paid around GHS 0.85 per subscriber per month to Esoko. Based on original subscription of GHS 2 per month, this is 42.5% revenue share
Call centre	0.02	GBP/qtr/subscriber	VFC Financial report	Call centre costs are listed as variable cost. Average of actuals cost over four quarters = 0.143 GBP/subscriber/qt but this gives unrealistically high costs. Use budget average of 34,454, equivalent to average of 0.022 GBP/sub/qtr
Cost of scratch	0.007	GBP/qtr/subscriber	VFC Financial	Budget figures are

cards			report	consistently based on 0.007 GBP/subs/qtr. Actuals are higher; average is -0.015
Sales commission	0.15	GBP/qtr/subscriber	VFC Financial report	Actual expenditure averages out at 0.15 over a six-quarter period. Budget values give average of 0.18

Source: Authors' own

The variable costs of sales are, of course, defined by the subscriptions, the subscription model, and the combination thereof. The following section can also be found in the business modelling report (Scott and Batchelor, 2020).

### 5.4.3 Global content development

The CABI budget outlines costs associated with the local content generation process, which includes both payments to local content partners and consortium staff costs (these are included in Analysis A). However, additional costs are allocated to the consortium partners for direct costs and staff costs, which amount to over £3.5 million. A crude assumption can be made that these are spread evenly across all 14 projects, giving a total of £256,000 per country or £128,000 per year if split over two years. The cost of content development for mNutrition was particularly high, as it was premised on building capacity within local institutions. It has been argued that it would be possible to develop content cheaper had the capacity building mandate not been in place.

### 5.4.4 mNutrition programme as a whole

GSMA has provided an estimate of the average total budget per project of £1,423,000 for those countries running mAgri projects as part of mNutrition. We have identified direct expenditure items that are included in Analysis A (local content development and product development, including M&E, UX experts and design consultants, and business intelligence), and the proportion of global content development (Section 4.2.1). When these items are deducted from the average budget spend, the balance is £443,000. This has been split evenly over two years. This does not take into account whether GSMA has costed its overheads commercially. It is more than likely that some other parts of GSMA are subsidising the mNutrition initiative.

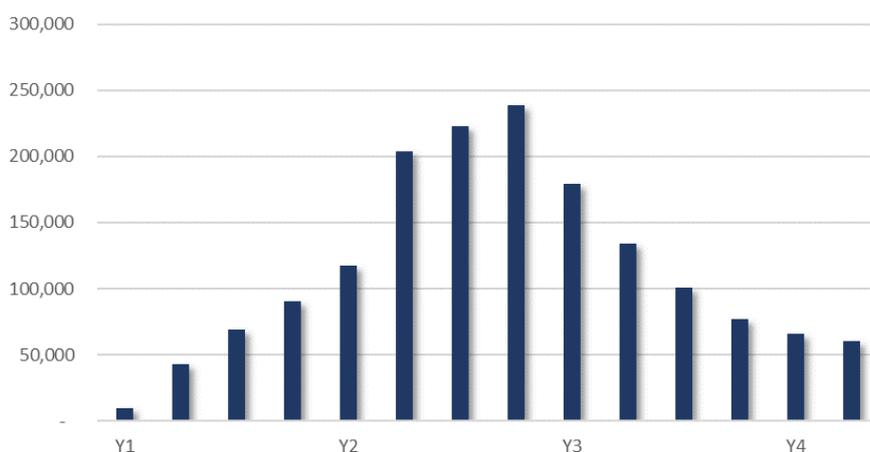
## 5.5 The VFC journey

It can be argued that, although VFC went through three iterations, these represent only two distinct models. When first launched, the monthly subscription rate was relatively high at GHS 2 per month, and this revenue was shared more or less equally with Esoko, the content provider, under the commercial revenue share agreement. Toward the end of 2016, when the subscriber numbers were well short of the initial target of 400,000, negotiations with GSMA resulted in a revised target of 200,000 subscribers, which was achieved (among other measures) by eliminating the subscription fee altogether. A much reduced subscription fee of GHS 0.5 per month was then introduced, but under a revised contract agreement with Esoko in which almost all of this revenue was passed on to the content provider.

The first and third iterations represent subscription models, with differing degrees of revenue share between the MNO and the content provider. The second iteration represents a freemium type model: customers were able to access the VFC features for free, but then had to pay for additional mobile phone services, i.e. airtime, which represents the revenue stream for Vodafone.

Because of these three distinct phases in the VFC journey, it does not really make sense to conduct any financial analysis based on actual costs—for example, the journey resulted in an unusual profile of subscriber numbers (see Figure 4).<sup>7</sup> Instead, financial data provided by Vodafone and GSMA have been used to create a financial model, which has been used to model the financial viability of each of the three iterations.

**Figure 4: Estimated subscriber numbers profile, Quarter 3 (2015) to Quarter 4 (2018)**



Source: Authors' own.

## 5.6 The financial model

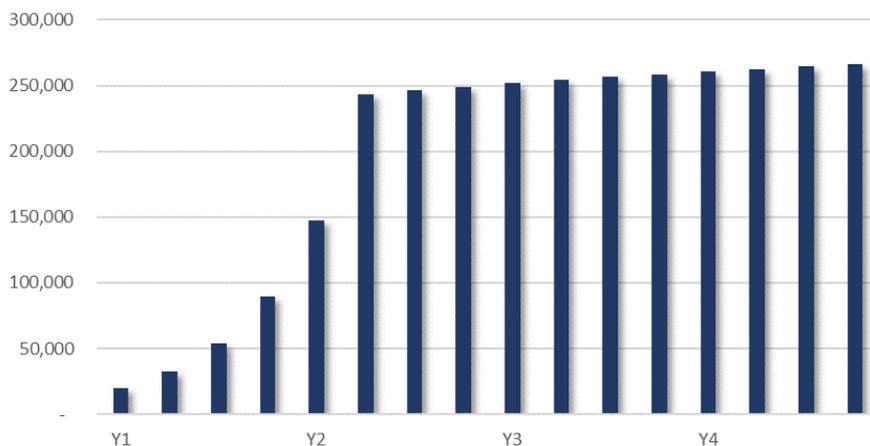
The model calculates two key metrics: net present value of investment in the product and the IRR. It is based on the cost structure and cost data provided by Vodafone to GSMA in the final financial return,<sup>8</sup> supplemented by data gathered through interviews.

Key to the model is an estimated profile of **subscriber numbers**. An analysis of subscriber number profiles among all agricultural projects within the mNutrition programme is presented in the business model report (Scott *et al.*, 2019). This suggests that expenditure on customer acquisition activities during the early stages of product launch can achieve exponential growth during a rapid growth period. Thereafter, growth can continue on a straight-line basis as the product enters a more mature phase. The following analysis is based on the profile presented in Figure 5, which results in a subscriber base of 270,000 after a four-year period.

<sup>7</sup> This profile has been generated to reflect subscriber numbers reported by Vodafone at different points in time over the duration of the evaluation project.

<sup>8</sup> Internal document.

**Figure 5: Estimated subscriber numbers profile for four-year period**



Source: Authors' own.

**Cash flow** is calculated from estimates of revenues and variable costs, which depend on the customer numbers profile, as well as fixed costs. Details of cost components and estimates are based on financial records from VFC.

$$\text{Cash flow (Operating profit)} = \text{Revenue} - \text{Cost of Sales} - \text{Fixed Costs}$$

Revenue:

- subscription fees; and
- airtime expenditure.

Cost of sales:

- cost of SMS: nominal value to MNO of text messages sent to customers;
- taxes and fees: any product is expected to make a contribution to group taxes;
- content provider: revenue share of subscription fees with content provider;
- call centre: contribution to cover cost of call centre operator (third-party);
- cost of scratch cards: branded airtime scratch cards; and
- sales commission: paid to agents.

Fixed costs:

- product development: in-house UX design, M&E, and content curation;
- marketing expenses: merchandising, field presence; and
- administration expenses: project management, support staff, and training.

This analysis considers the viability of the agricultural information product to the mobile operator. Therefore, it considers the **investment costs** incurred in developing the product for roll-out in a specific country. The following investment costs have been included in the model:

- technology: integration of content provider into operator network, STK set-up;<sup>9</sup>
- localisation of content: developing appropriate messages, seeking necessary approvals; and
- support service provided by GSMA: M&E, UX consultants.

<sup>9</sup> The SIM Application Toolkit required to enable the SIM to operate a VAS.

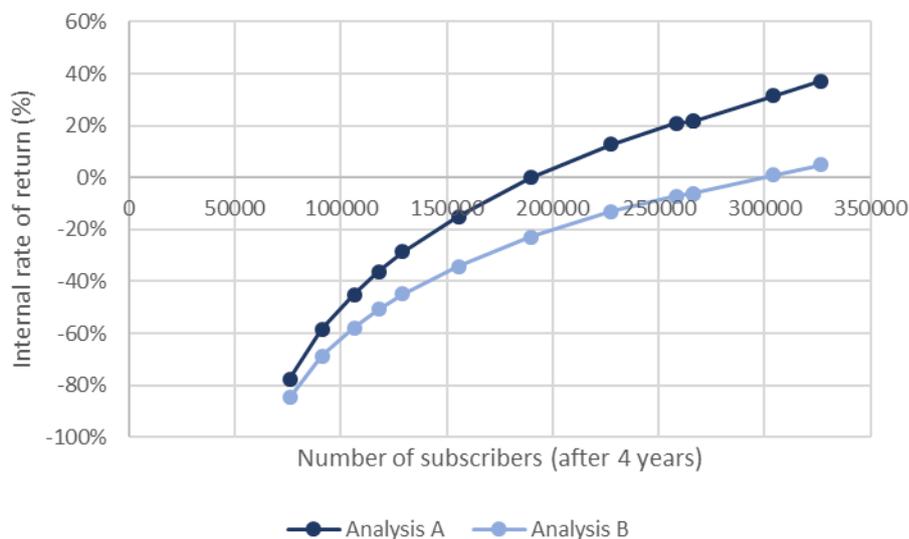
## 5.7 Subscription model

The investment costs outlined above total £387,000 (Analysis A). The total investment costs including the investment in content creation and GSMA business intelligence and programme management (*pro rata* across all mNutrition projects) total £1,187,000 (Analysis B).

Based on the original subscriber price of GHS 2 per subscriber per month and ARPU of GHS 2.5 per month, this gives total revenue over a four-year product lifetime of £7.8 million, with 56% from airtime and 44% from subscription fees. The IRR on Analysis A would be an attractive 80%, but in practice Vodafone was not able to achieve these subscriber numbers at this subscription rate. The IRR on Analysis B would be 35%.

At the reduced subscription rate of GHS 0.5 per subscriber per month, revenue drops to £5.2 million, with only 17% raised from subscriptions. Assuming that the amount passed on to the content provider was also GHS 0.5 per subscriber per month (i.e. 100% revenue share), then the IRR on Analysis A drops to 22%. Analysis B has an IRR of -6% and is not profitable. Given that revenue is dominated by ARPU, the financial performance is not highly sensitive to revenue share with the content provider. If the revenue share was 30% in Analysis A, for example, the IRR would only increase to 44%. However, this is only valid if a subscriber base of 270,000 can be achieved after four years. Since reintroducing the subscription fee, and reducing the amount paid to Esoko, the subscriber base has fallen to nearer 60,000. After the launch period, this level of demand can demonstrate a positive contribution margin but has a negative cash flow over the four-year period, i.e. it is not sustainable. Figure 6 indicates that charging the reduced subscription rate (and paying GHS 0.5 per subscriber per month to Esoko) only starts to become financially viable if subscriber numbers of over 200,000 can be achieved, or over 300,000 if wider investment costs are included (Analysis B).

**Figure 6: Sensitivity of IRR to subscriber numbers (low subscription rate)**



Source: Authors' own.

Note that, at the end of 2018, with a reduced subscriber base of around 60,000, Vodafone reckoned that the contribution margin of VFC was 64%, which is nicely within the target range normally expected for the mass market segment (60%–70%). Entering these assumptions into the model gives a contribution margin lower than that reported by Vodafone, indicating that the model

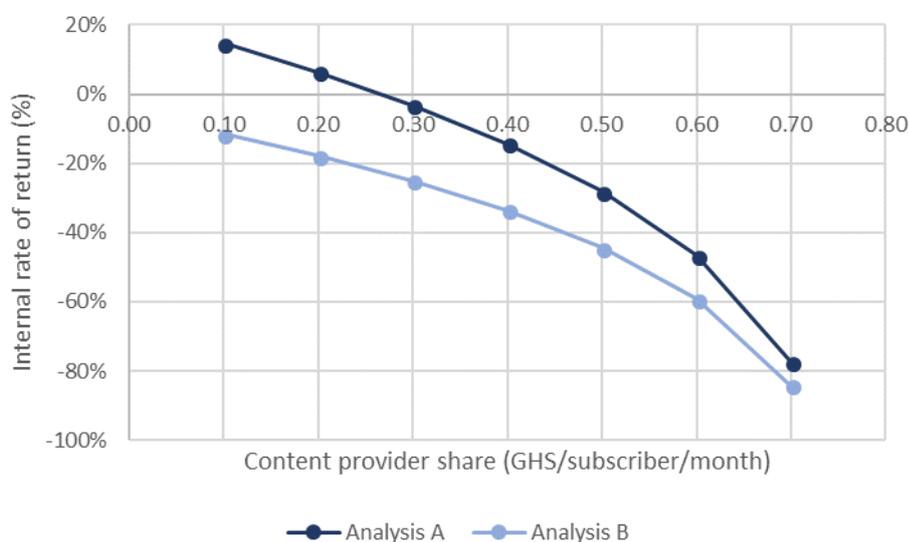
is somewhat conservative. However, that the contribution margin is highly sensitive to the allocated cost per SMS, which may account for the difference.

## 5.8 Freemium model

The total investment remains at £387,000. With no subscription revenue, the airtime revenue drops to £4.3 million, resulting in an operating loss over a four-year lifetime. This appears to confirm that Vodafone was right to say that the content provider costs were not sustainable (based on the original contract price of GHS 0.85 per subscriber per month).

The sensitivity analysis presented in Figure 7 suggests that if the revenue share to the content provider were reduced to around GHS 0.2 per subscriber per month, then the investment might start to look attractive for the MNO, but perhaps less so for the content provider (in this case Esoko).

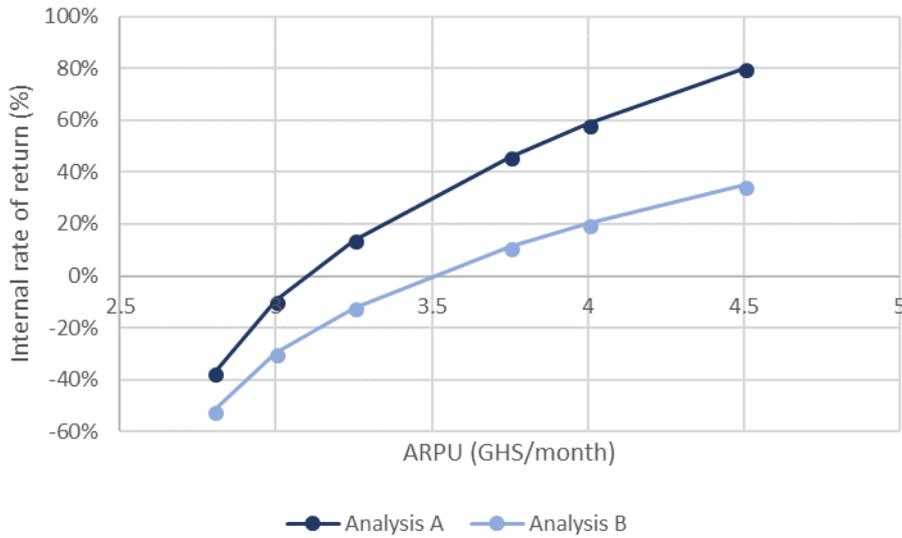
**Figure 7: Sensitivity of IRR to revenue share with content provider**



Source: Authors' own.

A freemium model is driven by revenue generated from additional services, which, in this instance, is expenditure on airtime. The figures above are based on the reported ARPU of GHS 2.5 per month. However, this is for a particularly low-income segment of mass market customers. Figure 8 suggests that financial viability is highly sensitive to ARPU, so if the product could attract a slightly higher status market segment with an ARPU of GHS 3.5 per month, this would be enough to make even a freemium model financially attractive.

**Figure 8: Sensitivity of IRR to ARPU (freemium model)**

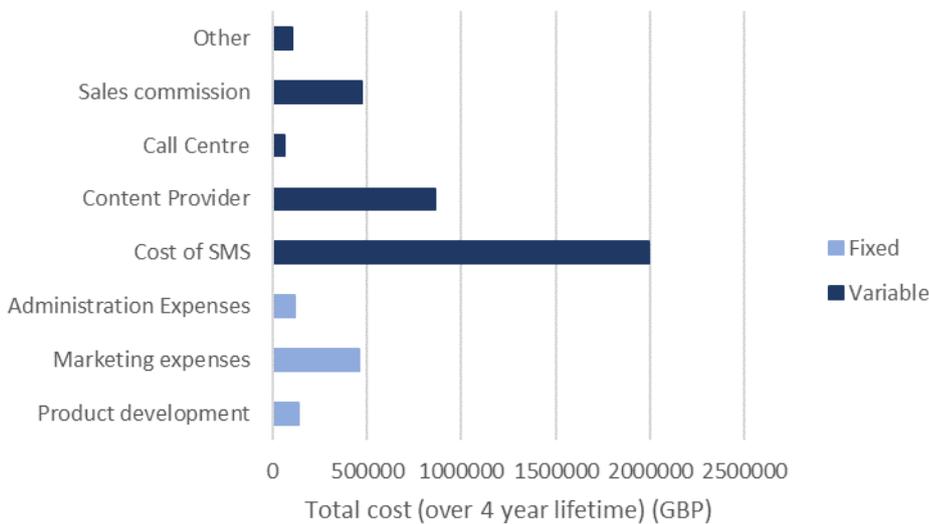


Source: Authors' own.

### 5.9 Sensitivity to cost of sales

The relative weights of different components of operational expenditure are illustrated in Figure 9. These figures are based on assumptions representing the low subscription rate model, and show how operational expenditures are dominated by the cost to the MNO of sending SMS messages to subscribers.

**Figure 9: Operational expenditures (summed over four-year lifetime)**



Source: Authors' own.

Note: this chart refers to operational expenditure only—this does not change with additional investment for Analysis B.

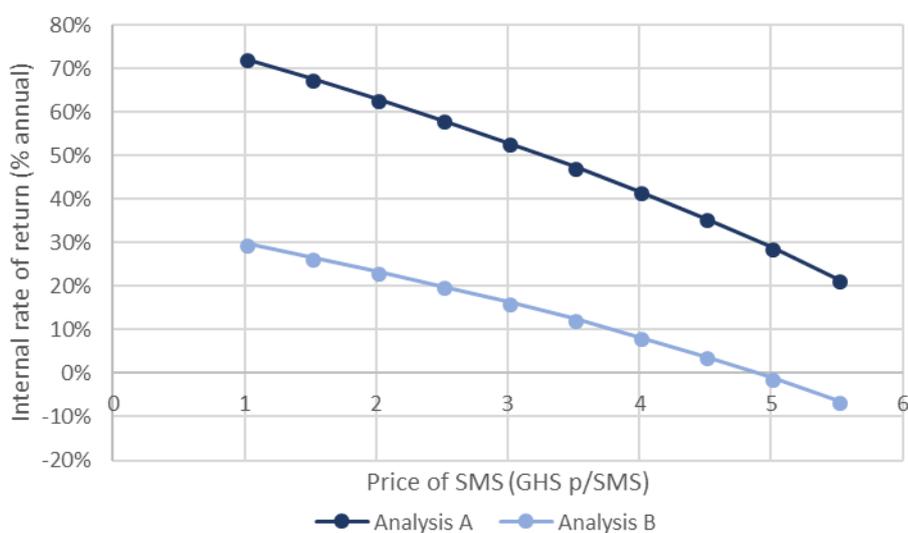
What is the real cost of sending an SMS? In a study on the impact of consumer consumption of network services (voice, SMS, and data) on network profitability, Blackburn *et al.* (2013) highlight a trend toward flat rate pricing (as opposed to pay as you go). They point out one feature that makes

this attractive to operators is that the cost of delivery is a small fraction of the retail price. Keshav (2009) concluded that the cost of sending an SMS message was likely to be less than US\$ 0.003 per SMS, or 2% of the per unit price charged to pay as you go customers. Lack of clarity on the true cost of sending an SMS message continues to plague development cost modelling. For example, in a study of an mHealth intervention in Tanzania, Mangaone *et al.* (2016) modelled scenarios using standard SMS charge rates (US\$ 0.03 per SMS) along with reduced rates (US\$ 0.02 per SMS and US\$ 0.01 per SMS) representing negotiated bulk purchasing agreements.

The analysis up to this point has been based on a figure of GHS 0.055 per SMS, which is the price that an individual customer would pay to send an SMS and is quoted by the MNO; it can be interpreted as representing the opportunity cost to the MNO. However, given that the MNO is sending messages to thousands of subscribers, it could be argued that a bulk SMS price would be more realistic: a figure of GHS 0.03 per SMS was quoted in the baseline report. Figure 10 shows how returns on the investment look much more attractive at this level of SMS price.

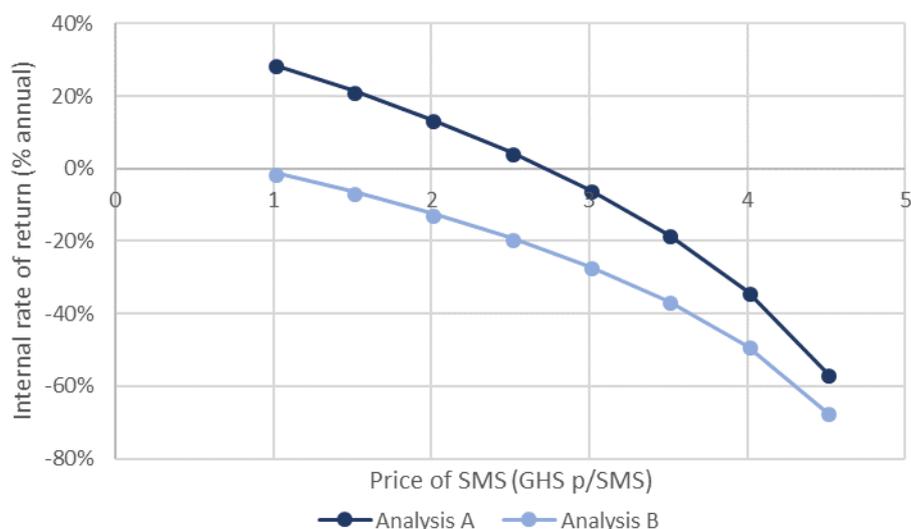
Where an intervention purchases SMS messages, through a negotiated bulk purchase agreement, for example, the cost represents a real cost to the implementing agency. This is not the case with VFC, where the messages are sent by the mobile operator. The fact that Vodafone omitted the cost of sending SMS messages from its financial report to GSMA indicates that this does not incur a real cost, which highlights the difficulty in attributing a meaningful cost to an operator of sending messages. If the real cost of SMS messages is discounted still further, even the freemium model (with GHS 0.85 per subscriber per month paid to the content provider) can show a reasonable rate of return (Figure 11).

**Figure 10: Sensitivity of IRR to SMS price (low subscription model)**



Source: Authors' own.

**Figure 11: Sensitivity of IRR to SMS price (freemium model)**



Source: Authors' own.

## 5.10 Understanding subscribers

When the VFC product was first conceived, it was clearly targeted at low-income small-scale farmers, most of whom are women. The product was intended as a vehicle for attracting the last remaining consumers without phones (the so-called 'laggards') to subscribe to the Vodafone network. The revenue generated by each new customer, therefore, represents additional revenue to Vodafone.

When Vodafone revised the product in order to boost subscriber numbers towards the end of 2016, it not only removed the subscription fee (temporarily) but also relaxed the eligibility criteria. Eligibility was revised to include low-value rural customers from the existing Vodafone customer base. These near dormant SIM cards received an SMS blast inviting these existing customers to change to the VFC product. However, it turned out that many of these new subscribers were urban-based and data suggested they had signed up mainly to take advantage of the closed group free voice calls. From their behaviour, Vodafone concluded they were not farmers signing up to benefit from the content. It then set about improving the subscriber base by changing non-farmers to another more relevant tariff, and by refining the criteria used to send invitations to existing users, which was made on a more geographical basis.

This illustrates a potential threat to revenue by migrating existing customers from one product to another. If the new service offers additional features that are sufficiently attractive to command higher charges, then migrating customers to the new service would generate a positive marginal revenue. However, if the charges associated with the new service are *lower* than those originally charged, then migrating customers will result in a negative marginal revenue. This is likely to have been the case when Vodafone invited existing customers to sign up for VFC because the VFC bundle included free group calls as well as discounted tariffs outside of the group. This appears to be consistent with figures provided by Vodafone: ARPU for the mass market segment as a whole runs at around GHS 3 per month, whereas ARPU for VFC was around GHS 2.5 per month.

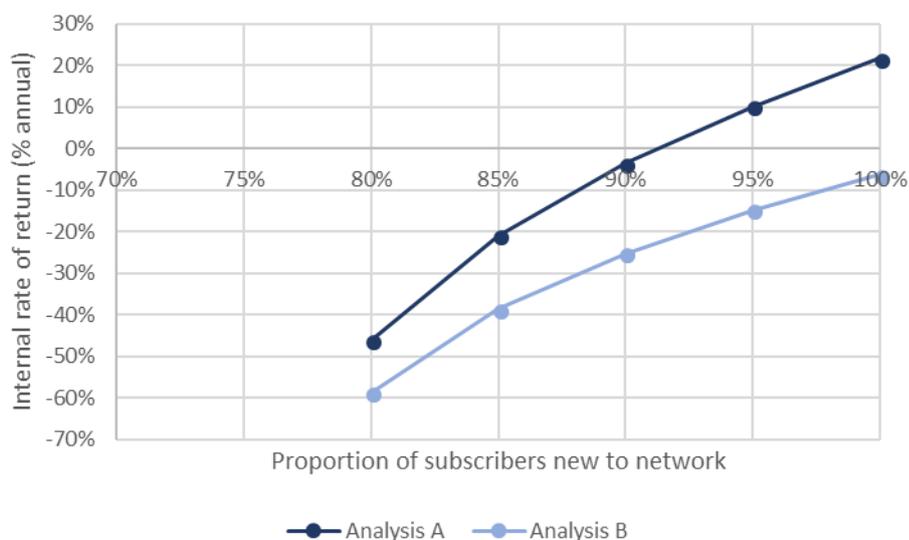
An attractive product can also persuade subscribers on competing networks to migrate to Vodafone. In this instance, the ARPU of these new subscribers represents additional revenue to

Vodafone, in much the same way as people who have signed up for a mobile phone account for the first time.

We have no way of differentiating how many of the subscribers gained during the ‘freemium’ model stage were previous Vodafone customers and how many were attracted from other networks by the free service. Nor can we say what the ARPU of Vodafone customers was before and after they signed up for VFC. The discussion of the freemium model in Section 5.8 suggests that the product would lose money if the content provider fee was fixed at GHS 0.85 per subscriber per month. Any provision for a negative marginal revenue to account for those Vodafone customers who simply changed from a different plan to VFC would make the financial performance worse still.

The IRR calculated for the low subscription model was 22% (based on a fee of GHS 0.5 per month, with 100% revenue share with the content provider). However, Figure 12 suggests that this is highly sensitive to the issue of simply getting existing customers to swap plans. If even 10% of subscribers have swapped from existing plans, then the product appears to lose money, at least from a group perspective.

**Figure 12: Sensitivity of IRR to existing customers transferring from other plans (low subscription model)**



Source: Authors’ own.

By September 2016, the planned marketing activities targeting low-income smallholder farmers had attracted approximately 70,000 users. As a result of restructuring the product, relaxing the eligibility criteria, and inviting existing customers, membership peaked at around 240,000 in October 2016. The difference of 140,000 users represents roughly 60% of the peak membership. These additional subscribers will have been made up of:

- first-time mobile phone subscribers;
- customers migrating from other MNOs; and
- existing Vodafone customers transferring from other plans.

Without knowing this breakdown, it is not possible to model the financial viability of the low subscription model. However, if these new customers were spread evenly across the three categories, then the proportion of new subscribers brought on to the network would be 80%. The effect of swapping existing customers would then ruin the financial viability of the product (see Figure 12).

## 5.11 VAS strategy

The previous section started by saying that the original purpose of VFC was to be a vehicle for getting first-time mobile phone users onto the Vodafone network. In this respect, the concept was appropriate at a given time, when a substantial part of the population were not yet mobile phone users. Given that penetration rates have continued to rise over the last five years, the strategy was also only appropriate for a given duration.

Hootsuite (2019) reports that Ghana has 38.8 million mobile phone subscriptions in a population of 29.8 million. Given that 38% of the country's population is under 15 years of age,<sup>10</sup> and assuming that under-15s are not economically active (i.e. it is uncommon for teenagers in Africa to own a mobile phone), this means that penetration rates among the adult population (15 years and over) is 2.1. This suggests a mature market with a relatively small potential market of people without a mobile phone.

In a mature market, in which almost all potential subscribers are signed up with one MNO or another, the VAS strategy is to encourage subscribers on other networks to transfer (churn), and to encourage network subscriber to stay with the VAS provider and increase the loyalty of existing subscribers, rather than switch to competing networks.

## 5.12 Demand scenarios

Up to this point the analysis has been based on the growth of subscriber numbers represented in Figure 5, resulting in 270,000 subscribers at the end of the four-year period. It has already been said that the actual history of VFC subscribers is difficult to use in any analysis because of the changing nature of the product and how it was marketed. Clearly, demand for any product will be sensitive to price but it is not clear from subscriber figures achieved by other mAgri products supported by the mNutrition programme that it is the dominant factor in determining the uptake of agri-VAS services. The highest uptake was achieved by the 7272 service offered by Telenor, Pakistan, as a free service. However, among the subscription services, the highest subscriber numbers were achieved by Bangladesh (430,000) and Sri Lanka (500,000), both of which charged customers around 50% more than the cost of the VFC subscription (using the GHS 0.5 per month fee rate).

This confirms that the success of a product is due to a combination of factors lying behind customer acquisition. Based on the model created to represent the operating finances of the VFC, this section considers the price elasticity of demand and the implications for financial viability.

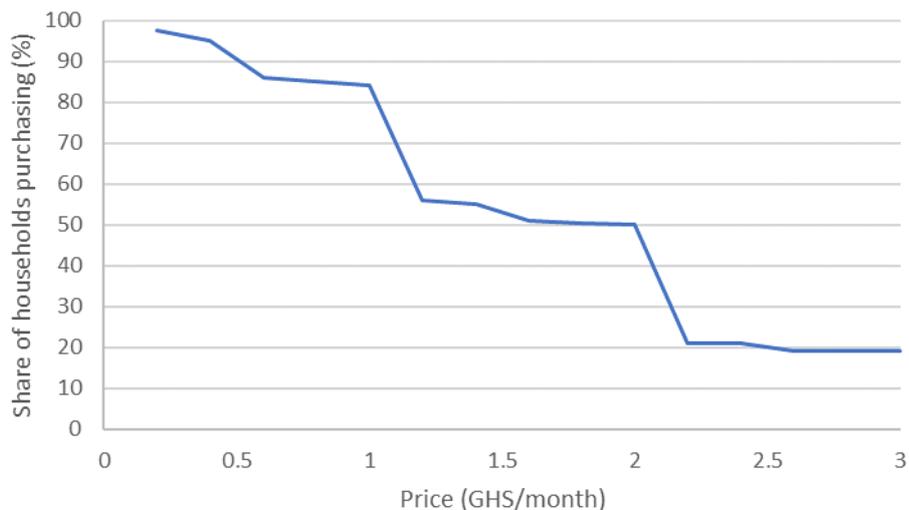
## 5.13 WTP

As part of the baseline survey, the independent study team conducted a WTP game designed to explore potential levels of demand for the VFC product at difference price points. The results in Figure 13 suggest that demand would drop substantially if the product were priced above GHS 2 per month, and that demand would be high below a price point of GHS 1 per month.

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<sup>10</sup> [www.indexmundi.com/ghana/demographics\\_profile.html](http://www.indexmundi.com/ghana/demographics_profile.html).

**Figure 13: WTP**



Source: Authors' own.

### 5.14 Size of the potential market

VFC achieved 70,000 subscribers at the GHS 2 per month price point. The WTP chart suggests that at a price point of GHS 2 per month, uptake would be 50%—although this can only be 50% of those farmers effectively ‘reached’ by the product, i.e. farmers who have never heard of the product cannot elect to pay for it. Combining these two figures implies that the ‘pool’ of reached farmers is 140,000. This seems unrealistically low, given that the product went on to gain nearly 250,000 subscribers when the combination of marketing initiatives was introduced to boost numbers.

Comparing VFC with other agri-VAS projects in the mNutrition portfolio in the business modelling report (Scott *et al.*, 2019) showed that VFC appeared to have the worst performance in terms of percentage of target market achieved (4.8% compared to around 30% for subscription products in Sri Lanka and Bangladesh). However, it is also pointed out that target market identified by VFC seems more ambitious than those for other countries. Expressed as a proportion of the total rural population in the country, the target markets for other countries ranged from 1.7% to 4.4%, yet the figure set for Ghana was 11.4%.

Interestingly enough, if 2% of the rural population were to be used as a guideline for the target market, this would be equivalent to 257,600—almost exactly what was achieved at the peak demand. This is the figure that has been used in the following analysis.

### 5.15 WTP and revenue

Figure 14 shows how the number of subscribers would be expected to vary with the subscription fee rate, according to the WTP findings presented in Figure 13. The figure also illustrates how revenue would be maximised at a high fee rate of GHS 2 per month. However, this only considers the revenue generated from subscriptions; even given an ARPU as low as GHS 2.5 per month, the revenue from airtime will be the dominant share of total revenue.

**Figure 14: Variation of subscriber numbers and revenue with subscription fee**

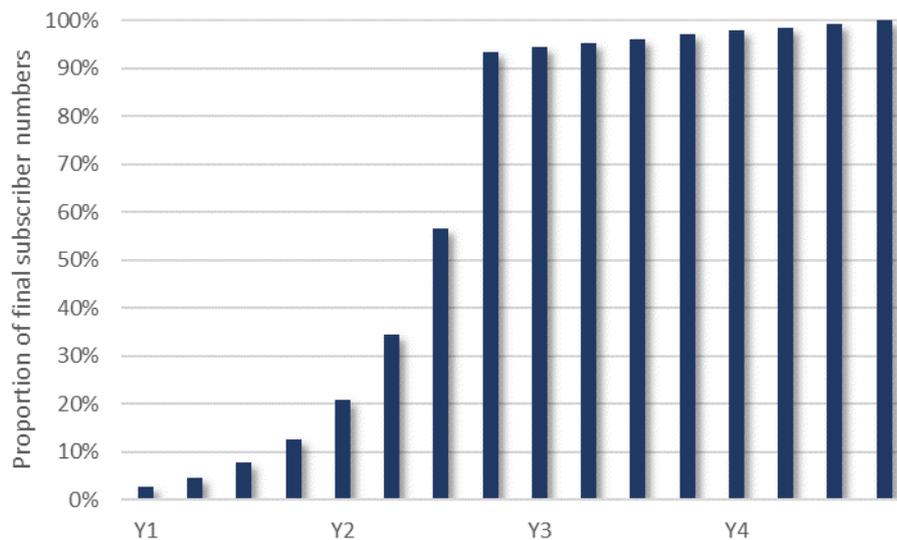


Source: Authors' own.

### 5.16 Variation of financial viability with subscription fee rates

The financial model has been used to estimate the IRR of a product at different subscription fee rates and corresponding levels of demand, as presented in Figure 14. A limited number of price points have been taken, and similar subscriber growth profiles created for each. These profiles were created using a two-year (eight-quarter) rapid growth stage and an example is presented in Figure 15. The financial performance figures were calculated for a four-year lifetime.

**Figure 15: Subscriber numbers growth profile used in model**



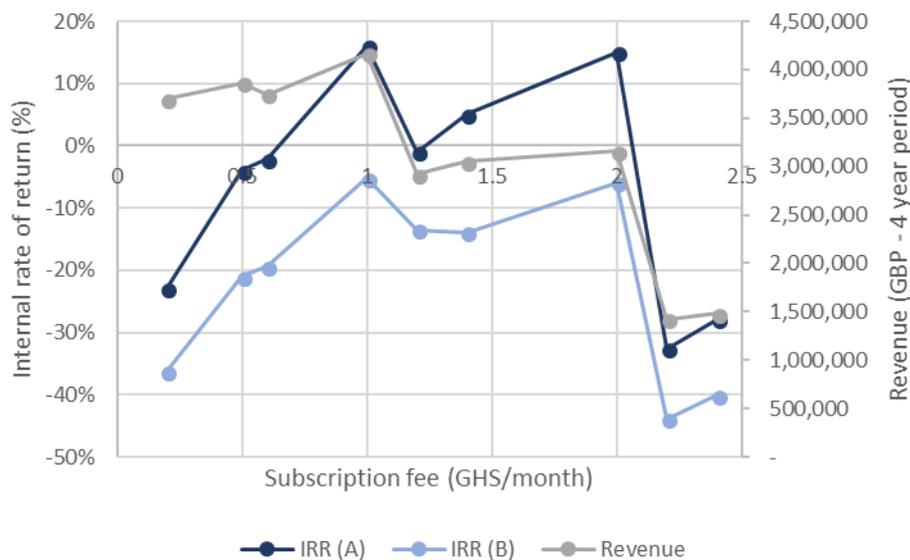
Source: Authors' own.

The results presented in Figure 16 show total revenue would be stronger below the GHS 2 per month price point, peaking at a fee rate of GHS 1 per month. The financial performance (i.e. IRR), on the other hand, drops off at fee rates below GHS 1 per month. This is because, although the revenue remains relatively constant (airtime revenue increases with increasing subscriber numbers at lower fee rates), the cost of sales increases with increased subscriber numbers. Bear in mind

that these figures are based on a constant content provider fee rate of GHS 0.5 per subscriber per month, and an SMS cost to the MNO of GHS 0.055 per SMS.

This figure suggests that the product would be most attractive if offered at a fee rate between GHS 1 and GHS 2 per month.

**Figure 16: Financial performance with varying price and demand**



Source: Authors' own.

Figure 16 highlights an interesting dilemma for operators considering a social VAS. Based on the assumptions used, the analysis suggests that, from an operator's point of view, the service becomes most commercially attractive at a fee rate of GHS 2 per month (given a revenue share with the content provider of 25%). However, at this rate, it is likely to be adopted by fewer customers than if it were marketed at a lower fee rate. For example, at GHS 2 per month, the analysis indicates that the number of subscribers would be only 55% of the numbers of subscribers that might adopt a service priced at GHS 0.5 per month. This illustrates a potential conflict between development benefit (maximising impact on smallholder farmers) and commercial benefit (maximising return on investment).

### 5.17 Dedicated users

The original marketing activities acquired 70,000 VFC members. After the change in product and marketing to reach the 200,000 target, the number of subscribers returned to around 60,000 following the reintroduction of a subscription fee (at GHS 0.5 per month). This would seem to indicate that VFC commands some kind of loyal following of around 70,000 farmers, even though there is a known monthly attrition. The financial model indicates that with this number of subscribers it is not possible to make money at any tariff fee rate below GHS 3 per month. Furthermore, it indicates that, given a content provider fee of GHS 0.5 per subscriber per month, the product will not make money even if the cost of SMS messages is reduced to zero.

## 5.18 Limitations

Many of the stated costs in Analysis B are integral to a number of other services in other countries. The mNutrition programme as a whole has transaction costs that may or may not be imputed in part to the VFC service. Vodafone Ghana as a whole has infrastructure that is being used for the delivery of the service, and one could argue that a proportion of 'overhead' costs needs to be assigned to the service. If the objective of the cost-effectiveness assessment is to add such a service to existing MNOs, then provider costs may be enough. However, were FCDO to consider the VfM of its intervention and seek to repeat it in a new country with new partnerships, then Analysis B may be more applicable.

## 6 Discussion

The lack of measurable effects could, on the face of it, suggest the proposition has limited merit; however, the cost data and the commercial viability suggest an alternative view.

In Analysis A, the IRR is dependent on the combinations of the revenue, which in itself depends on the subscriber numbers and the revenue model, and the cost of sales, within which the two major costs are the cost assigned to SMS and the share given to the content provider (Esoko). The financial model shows that if GHS 2 a month is charged, in theory the revenue is high, but in practice the subscriber numbers are low (at least less than hoped for). A freemium model raises the number of subscribers but reduces the revenue to the increases in ARPU.

Whatever the combination of these various factors, it is possible to come to a point where there is positive IRR, and, indeed, in some scenarios quite a healthy IRR. Note that at the end of 2018, with a reduced subscriber base of around 60,000, Vodafone stakeholders indicated that the contribution margin of VFC was 64%, which is within the target range normally expected for the mass market segment (60%–70%). Entering these assumptions into the model gives a contribution margin lower than that reported by Vodafone, indicating that the model is somewhat conservative.

If the experience of the MNO is that it gets its investment back, and indeed there is no loss of opportunity cost in applying the product, then for Analysis A costs could be considered to sum to zero. This is the essence of the question: how commercially viable are the different business models being employed at country level?

However, the quantitative component has suggested that the effectiveness in terms of measurable DALYs is also zero. There is no net measurable beneficial impact on the users. While this remains the basis for our proposed analysis, the quantitative component does identify a few subsets of the subscribers that do make changes, which could have benefits: those in the Central region consume more dairy; those below the 150% poverty line grow more maize; targeting the primary male leads to a significantly higher maize price received by the primary female, and although impacts across targeting the female or male are not significantly different, there is a suggestion that market price information is being shared from male to female. These results are not strong enough to identify the DALYs saved, but they can be taken as a positive contribution to the lives of the poor.

If the cost of the service is effectively zero, i.e. the MNO gets its investment back over time (depending on the various parameters mentioned), then it could be argued that even if one person is helped, the service is ‘cost-effective’—albeit the result of a lot of effort to help one person.

Cost-effectiveness analysis is generally used to compare publicly funded strategies to support the population. The cost-effectiveness analysis in this case was intended to be a tool for policymakers and decision makers spending public funds. For instance, it was the intention to compare the service with agricultural extension systems that have limited cost recovery models. However, without a measurable change of the primary outcomes, this has not been possible.

Analysis A is intended to help an MNO decide whether to add value to its service offering by undertaking something like the VFC, and is presented with the assumption that the content is available.

Analysis B takes into account the investment of public funds in the upfront requirement to develop content and stimulate MNOs’ participation in an agri-VAS offering that includes nutrition-sensitive content. In Analysis B, the IRR is also dependent on the combinations of the revenue (which in

itself depends on the subscriber numbers and the revenue model) and the cost of sales, within which the two major costs are the cost assigned to SMS and the share given to the content provider (Esoko). With the added upfront Capex, the crossover into positive IRR is more challenging, but not impossible. The increase in ARPU does suggest that the costs could be zeroed. And for this to be truly zero as far as investment decision making is concerned, there would need to be a mechanism for financial flows whereby the income from the service was used to 'reimburse' the public investment. This was not the case for VFC; the public funds were used to develop content that was then made open source.

## 6.1 Commercial viability

The idea that the product was commercially viable and could be replicated commercially suggests that traditional notions of cost-effectiveness should not be applied to this case. MNOs could be convinced to apply the service, not by definition of the number of beneficiaries, but by it being a sound VAS. Whether it then benefits 100 or 1,000 people need not be part of the decision. GSMA and Vodafone studies show that the product is appreciated; the perception among stakeholders is that the product or service is valuable. For an MNO, it is a viable service to consider offering.

The allocation of public funds to the initial set-up creates a different question—is it the best use of public funds? Since Analysis B shows that cost recovery could be undertaken and the whole would still be commercially viable, we suggest that the question be changed to the following: what mechanisms could be used to recover the public investment? It is conceivable that, instead of this being a grant to GSMA, there could have been the provision of debt equity for the development of the content. This could either be through social investment funds with patient capital or some other mechanism of risk mitigation. Stakeholder commentary on this suggestion was that it neglects the function of demand creation (an MNO willing to launch the service with social purpose) and funding for product development that would not be put in place without soft capital.

It is not within our remit to suggest structures for future work, but we raise the question of whether cost recovery of the initial public funds could be built into future work. Even with the added capital costs, Analysis B shows that the system can be commercially viable if certain thresholds of subscribers are met, the assigned costs of SMS are low, and the revenue share is balanced. Under these conditions, even if there are no measurable average impacts on primary outcomes, the subsample that do benefit from the service could be justification enough.

Having said this, we are aware that the allocation of Capex in Analysis B and its cost recovery would make the product less attractive to MNOs, and this would require further discussion.

## 7 Conclusions and learnings

### 7.1 Conclusions

The aim of the impact evaluation is to assess the impact, cost-effectiveness, and commercial viability of mNutrition. The evaluation is being conducted by a consortium of researchers from Gamos, IDS, and IFPRI. The team draws on a number of methods and interlinked components to gather evidence about the impact of the mNutrition intervention in Ghana, including a qualitative component, a quantitative component, and a business model and cost-effectiveness component.

The design of the cost-effectiveness component relied on there being measurable change in household and women's dietary diversity, and changes in agricultural production and income. Given that such measures were not found within the quantitative component, the cost-effectiveness analysis could not be carried out as planned.

The analysis of costs has also not been straightforward. There have been three distinct phases in the VFC journey, each with a different revenue model. The journey resulted in an unusual profile of subscriber numbers. Financial data provided by Vodafone and GSMA has been used to create a financial model, which has been used to model the financial viability of each of the three iterations. The model calculates two key metrics: net present value of investment in the product and the IRR. Key to the model is an estimated profile of subscriber numbers. The modelling considers the viability of the agricultural information product to the mobile operator. Therefore, it considers investment costs incurred in developing the product for roll-out in a specific country (Analysis A).

The sensitivity analyses show that the model is sensitive to the subscriber numbers, the revenue model, and the cost of sales, within which the two major costs are the cost assigned to SMS and the share given to the content provider (Esoko). Financial viability is highly sensitive to ARPU, and currently attracts a reported ARPU of GHS 2.5 per month. At that level, the model suggests that if the revenue share to the content provider were reduced to around GHS 0.2 per subscriber per month, then the investment might start to look attractive to the MNO. The other major cost centre is the assigned cost of SMS. There are arguments for assigning between zero and GHS 5.5 per SMS, and even at the highest figure there is still a positive IRR with a low subscription model, although for the freemium model the IRR becomes negative at an SMS cost above GHS 2.5.

The above analyses assume that Vodafone is gaining new customers. The sensitivity analysis shows that if the proportion of new customers is less than 90% for the low subscription model, the IRR becomes negative as existing customers are already providing revenue on another tariff.

Analysis B added in the extra upfront investment to create the content and considered the financial model from a public contribution point of view. Given these extra investments, the model still gives a positive IRR under some scenarios, but these are less convincing in terms of matching subscriber numbers with assigned SMS costs and shared costs of content provision.

It has been argued in Section 6 that, given a positive IRR, the cost of the VAS has been effectively zeroed, and that even minimal effectiveness among a limited proportion of subscribers could be presented as worthwhile. However, the sensitivity analyses have had to be based on theoretical subscriber rates informed by other agri-VAS services in other countries and not by the VFC *per se*. Despite a difference in take-up of 67% between encouragement and comparison group households, the low active-usage rates of the VFC service among households in the encouraged group makes it unsurprising that being offered the VFC service, or having used it at least once, has minimal impacts on household and women's dietary diversity, agriculture production, or nutrition or

farming knowledge. This finding of the quantitative component perhaps explains the low subscriber numbers.

It should be noted that the quantitative study also documented challenges in service take-up and use. Of the 1,901 households in the encouragement group, 68% (or 1,297 households) registered for the service, following the extensive door-to-door campaign to promote the service and facilitate sign-ups, compared to 1% in the comparison group. Despite this substantial encouragement effort to promote the service, only 49.8% of those registered for the service (or 646 households) reported someone in the household using the service in the last 18 months. This means that only 34% percent of encouragement households had used the service in the last 18 months. The main reasons for encouragement households not using the service was losing or not using the SIM, followed by not having access to a mobile phone (the latter reason being significantly larger in the Upper West region than in the Central region, and among primary females compared to primary males). To a lesser extent, phone malfunction and bad network connectivity were other frequently reported reasons.

The evaluation as a whole therefore found substantial challenges in maintaining active service usage. For instance, the quantitative component showed that, of the 646 households that had used the VFC service at least once in the last 18 months, approximately 8%–11% reported never receiving any weather, market price, or agriculture/nutrition information, while 74% had never called the call centre to speak with an agriculture expert. Among households that did receive market price, weather, or agriculture/nutrition messages, approximately 45% did not always or often read the weather or market price information and 27% did not always, or often, listen to the voice messages. The reasons for not actively interacting with the platform varied by component, region, and gender. For weather and market price information, which was delivered via SMS in English, the main reasons for not reading all the messages were not being able to read or not understanding English. For agriculture and nutrition tips, which were delivered via voicemail in the local language, the main reasons were weak service and not having access to a phone. For speaking with an agriculture agent, the main reasons for not using the service were not knowing that it was available, followed by believing they would be charged for the service. Households in the Upper West region were more likely than those in the Central region, and females were more likely than males, to report not actively reading the weather and market price information because they could not read, and to report not listening to the agriculture and nutrition voice messages because they did not have access to a mobile phone.

Although active participation (and 'effectiveness' as defined by the nutritional outcomes) among households is low, respondents' perceptions of the service are quite favourable for several service components. The majority indicated that they found the content of the VFC service useful, that it has changed their behaviour, and that they trust and feel confident in the information. Overall, the most useful and trusted component was the agriculture expert advice, but this was the least used and known component, followed by the agriculture/nutrition tips. Respondents in the Central region were more likely to find the weather and agriculture/nutrition messages useful compared to respondents in the Upper West region. Overall, quality ratings of the service were around 7 out of 10. The highest quality ratings were given to agricultural and nutrition tips (7.1 out of 10 for males and 7.36 out of 10 for females). Ratings were higher in the Central region than in the Upper West in every category, and among females compared to males in seven of the eight categories, with the exception of 'ease of use'.

What, then, can we say about cost 'effectiveness'?

*If* the subscriber numbers could be raised with the majority coming to Vodafone from other providers or being new customers, and *if* that were done with a low subscription model (and to some degree freemium), *if* the revenue share with the content provider was kept low, and *if* we

assign a low cost to the SMS, then the VAS gives revenue to the MNO and could be considered cost neutral. If that is the case, then measurable impact in terms of DALYs is not the be-all and end-all of effectiveness, and the marginal effects on certain subgroups of subscribers could be considered beneficial.

If all the above can be achieved, and the revenue income is high enough and the costs low enough to include a positive IRR inclusive of the capital expenditure involved in content creation, then the marginal effects on certain subgroups of subscribers could again be considered beneficial, and this may speak to the FCDO agenda of 'leave no one behind'. However, for this to be truly cost neutral, there would have to be a mechanism for recovering the public investment back into a public agency.

## 7.2 Learning

The evaluation as a whole has been able to document and learn from studying the VFC. However, the lack of measurable primary outcomes of VFC means that this report cannot present a useful cost-effectiveness analysis. As such, there is no cost-effectiveness analysis that could contribute to policy recommendations.

However, the possibility of commercial sustainability does suggest that, even with marginal beneficial effects, the VAS could be encouraged by policy and financial instruments. The system is intended to be a service that the farmer pays for. The original proposition of the mNutrition programme was that such services would be 'commercially sustainable'. In theory, if the service is commercially sustainable, then Vodafone as its implementer would expect the service to yield an attractive IRR on their investment. While the original mNutrition programme documents spoke extensively about commercial sustainability based on direct revenue generation, the logical framework evolved to talk about imputed benefits to the MNO. The business modelling report (Scott and Batchelor, 2020) discusses how changes in ARPU and reductions in churn (users moving to other networks) can benefit the overall MNO bottom line without actually showing as a direct revenue from a service. Increased ARPU and reduced churn can indeed make the provision of even a freemium service 'commercially justifiable'.

There remains a need to identify a mechanism whereby content created by public funds can be paid for from the revenues of services inclusive of that content.

## 7.3 Challenges and limitations

The core challenge for the cost-effectiveness analysis has been the lack of measurable impact. Others include the following:

**Staff turnover:** there have been many changes in staff at the partner organisations over the duration of the project. There are two effects at play here. First, there tends to be high turnover rates in high-tech industries, particularly MNOs. Personnel who were involved in VFC have moved on and some have even moved back again, while personnel covering for maternity leave have varying levels of engagement with the service. The second effect relates to the ending of the GSMA mNutrition grant period. After the end of the grant period top-level personnel moved on and additional support personnel were reallocated away from the service.

*Lesson learned:* to catch the narrative of an evolving service such as this, the study team has needed to make contact throughout the study; an end-of-service or initiative study alone would not have captured the wider narrative.

**Commercial changes:** telecommunications is a dynamic and rapidly evolving industry. During the five-year duration of the initiative, there have been changes in leadership and structure within the commercial organisations involved in the VFC partnership. This has inevitably led to changes in priorities. For example, once the champion of a product moves on, the next responsible person is unlikely to exhibit the same degree of commitment and vision, preferring instead to pursue their own priorities.

The timescales of the evaluation have extended beyond the period of support offered by the GSMA mNutrition initiative in order to allow the intervention to take hold and make an impact. However, stakeholders' commitment (and interest) in the service tends to wane after it is no longer being actively supported and they no longer have any obligations to the grantor. This has been particularly true in the case of Vodafone Ghana. There is no incentive to provide data to external parties after the grant period, which can manifest itself in a reluctance to invest further time in the form of interviews and discussion, for example, but it can also have structural implications. For example, cost data were no longer collected and disaggregated in the same detail as they were for the purposes of reporting under the GSMA mNutrition project.

Furthermore, MNOs tend to have poor institutional memory. This is not only a result of high staff turnover but also because customer call data (call detail records) are only stored for a finite period of time, so if they are not analysed on a regular basis, then that understanding is lost.

*Lessons learned:* the short timescales involved in developing mobile VAS products mean that formative evaluations need tight feedback loops to inform product design. The implementing partner would ideally collect and retain key data for longer. Perhaps this could be a more explicit part of any grant agreement, although it is recognised that commercial parties will typically build trust in each other over the implementation of the intervention.

**Data availability and commercial confidentiality:** although Vodafone and Esoko both expressed positive intent to share various data, there have been challenges in regard to access. GSMA has been fully supportive in securing permission from Vodafone to share the final mNutrition Financial Report. Esoko has shared subscriber numbers. However, commercially sensitive cost information within the subcontract agreement has not been shared in detail. Information on costs and performance became even more sensitive when the MNO was considering different options and talking to potential competitors to provide subcontract services.

*Lesson learned:* despite expressions of positive intent to share data, the reality of commercial sensitivities makes it difficult for businesses to share financial data, especially after the grant period.

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## Annex A Terms of reference

### Call-down Contract

## Terms of Reference

### PO 6420: External evaluation of mobile phone technology based nutrition and agriculture advisory services in Africa and South Asia

#### Introduction

DFID (Research and Evidence Division) wishes to commission an external impact evaluation of mNutrition, a mobile phone technology based nutrition and agricultural advisory service for Africa and South Asia. mNutrition is a programme supported by DFID that, through business and science partnerships, aims to build sustainable business models for the delivery of mobile phone technology based advisory services that are effective in improving nutrition and agricultural outcomes.

mNutrition is primarily designed to use mobile phone based technologies to increase the access of rural communities to nutrition and agriculture related information. The initiative aims to improve knowledge among rural farming communities especially women and support beneficial behaviour change as well as increasing demand for nutrition and agriculture extension services. The mNutrition initiative launched in September 2013 will work in 10 countries in Africa (Cote d'Ivoire, Ghana, Malawi, Mozambique, Nigeria, Tanzania, Kenya, Rwanda, Uganda, Zambia) and four countries in South Asia (Bangladesh, India, Pakistan and Sri Lanka). The desired impact of mNutrition will be improved nutrition, food security and livelihoods of the poor.

Mobile phone based services have been endorsed by WHO as an effective strategy for behaviour change and for driving adherence to anti-retroviral treatment protocols (Horvath, Azman, Kennedy and Rutherford 2012). There is currently scant evidence on the impact and cost-effectiveness of mobile phone technology based services for nutrition and agriculture and on the sustainability of different business models for their provision. A rigorous evaluation of mobile phone technology based nutrition services would add significantly to the current evidence base. An external evaluation team managed by the Evaluator, independent of the programme-delivery mechanism, will conduct an assessment of the impact, cost-effectiveness and sustainability of mobile phone technology based information and behaviour change messages for nutrition and agriculture.

#### Background to mNutrition

##### Introduction

Undernutrition is a major challenge to human and economic development globally. It is estimated that almost one billion people face hunger and are unable to get enough food to meet their dietary needs. Agriculture is a major source of livelihood in many poor countries and the sector has a potentially critical role in enhancing health, specifically maternal and child health and nutritional status. A well-developed agriculture sector will deliver increased and diversified farm outputs (crops, livestock, non-food products) and this may enhance food and nutrition security directly through increased access to and consumption of diverse food, or indirectly through greater profits to farmers and national wealth. Better nutrition and health of farmers fosters their agricultural and economic productivity. Current agricultural and health systems and policies are not meeting current and projected future global food, nutrition and health needs.

Despite major investment in agricultural and nutrition research and its uptake and application, there is significant social and geographic inequality in who benefits from these investments.

Furthermore, in many developing countries, public extension systems for agriculture, health and nutrition are inefficient, have limited capacity and have a poor track record of delivery, especially in terms of supporting women and girls and the most marginalised populations (Alston, Wyatt, Pardey, Marra and Chan-Kang 2000; Anderson 2007; IFPRI 2010; Van den Berg and Jiggins 2007).

Several research and mobile network operators (MNOs) are testing a range of information and communication technology (ICT) solutions for improving access to a wide range of information and advisory services. Mobile phone based technologies are among the most promising ICT strategies, although current initiatives in nutrition are relatively small and fragmented.

### **What is mNutrition?**

Enhancing access to the results of nutrition and agricultural research and development is potentially critical for improving the nutrition, health and livelihoods of smallholders and rural communities. mNutrition will harness the power of mobile phone based technologies and the private sector to improve access to information on nutrition, health and agricultural practices especially for women and farmers (both male and female). Specifically, mNutrition will initiate new partnerships with business and science to deliver a range of services including:

- An open-access database of nutrition and agriculture messages for use in mobile phone based communication (for example, information and behaviour change messages on practices and interventions that are known to have a direct impact on nutrition or an indirect impact via for example agriculture);
- A suite of mobile phone based nutrition and agriculture information, extension and registration services designed to: improve knowledge and generate beneficial behaviour change in nutrition and agriculture; increase demand for nutrition, health and agriculture goods and services; register and identify target populations for support; and, using real-time monitoring, support the conduct of nutrition risk assessments by community health workers.

The impacts of mNutrition are expected to include improved nutrition, food security and livelihoods of the poor, especially women in 10 countries in Africa (Cote d'Ivoire, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda, Tanzania, Uganda and Zambia) and 4 countries in South Asia (Bangladesh, India, Pakistan and Sri Lanka). This impact will result from the increased scale and sustainability of mobile phone based nutrition and agriculture-based information services, delivered through robust public private partnerships in each country.

mNutrition has two major outcomes. One outcome will be cost-effective, sustainable business models for mobile phone enabled nutrition and agriculture services to 3 million households in 10 countries in Africa and 4 countries in South Asia that can be replicated in other countries. Linked to this outcome, the second outcome will expect these services to result in new knowledge, behaviour change and adoption of new practices in the area of agriculture and nutrition practices among the users of these mobile phone based services.

These outcomes will be achieved through four outputs:

- Improved access to relevant mobile based health, nutrition and agricultural advisory services for 3 million poor people and community health workers across 10 SSA and 4 Asian countries;
- Launch and scaling of mobile phone based health, nutrition and agricultural advisory services targeted to poor people and community health workers;

- Generation and dissemination of high quality research and evidence on the impact, cost-effectiveness and sustainability of mobile phone based advisory services in nutrition and agriculture in South Asia and SSA; and
- Development of locally relevant content for mobile phone technology based agriculture and nutrition services meeting demands from users and community health workers.

In terms of promoting behaviour change and/or adoption of new practices, mNutrition will seek to achieve changes in one or more of the following areas:

- Adoption of new agricultural practices that are nutrition sensitive, improve agricultural productivity and utilise post-harvest technologies
- Changes in nutrition practices in either one or several knowledge domains including improved maternal nutrition practices during pregnancies; infant and young child feeding practice; and micro-nutrient supplementation to children at risk (i.e. Vitamin A, Zinc and Oral Rehydration Solution (ORS)).

mNutrition has started implementation from September 2013. For the 2 countries selected for the impact evaluation (Tanzania and Ghana), mobile network operators and content providers have been identified through a competitive process during the first half of 2014. The MNOs and content providers started developing and launching their services during the 4th quarter of 2014 and early 2015. The mobile phone based advisory services are expected to run at least till 3rd quarter of 2018.

### **mNutrition Project Coordination**

DFID support to mNutrition will be channelled to GSMA, as well as directly to this associated independent external impact evaluation. GSMA is a global body that represents the interests of over 800 mobile operators. GSMA already works with the major mobile operators across Africa, (including Airtel, MTN, SafariCom/VodaCom) with a collective mobile footprint of more than 67 percent of total African connections. GSMA has a number of existing development initiatives, including mHealth and mFarmer, that are part of GSMA's Mobile for Development which brings together mobile operator members, the wider mobile industry and the development community to drive commercial mobile services for underserved people in emerging markets. GSMA will provide technical assistance to mobile phone operators, and support new partnerships with content providers to develop and scale up new nutrition and agriculture message services. GSMA will ensure sharing of best practices and promote wider replication and uptake of effective business models.

### **Objective and Main Questions**

The objective of this work is to conduct an external evaluation of the impacts and cost-effectiveness of the nutrition and agriculture advisory services provided by mNutrition compared to alternative advisory services available in the two selected countries (Ghana and Tanzania), with particular attention paid to gender and poverty issues. The impact assessment is required to answer the following questions that relate to impact, cost-effectiveness and commercial viability:

- What are the impacts and cost-effectiveness of mobile phone based nutrition and agriculture services on nutrition, health and livelihood outcomes, especially among women, children and the extreme poor?
- How effective are mobile phone based services in reaching, increasing the knowledge, and changing the behaviour, of the specific target groups?
- Has the process of adapting globally agreed messages to local contexts led to content which is relevant to the needs of children, women and poor farmers in their specific context?

- What factors make mobile phone based services effective in promoting and achieving behaviour change (if observed) leading to improved nutrition and livelihood outcomes?
- How commercially viable are the different business models being employed at country level?
- What lessons can be learned about best practices in the design and implementation of mobile phone based nutrition services to ensure a) behaviour change and b) continued private sector engagement in different countries?

Further evaluation questions related to other aims of mNutrition will be addressed in at least 1 country (either Ghana and/or Tanzania):

- Are mobile phone-based services a cost-effective way to register and identify at risk populations to target with nutrition support?
- Are mobile phone-based services a cost-effective way for community health workers to improve the quality and timeliness of data surveillance (a core set of nutrition-related indicators)?

The content for the mobile phone based advisory services will be based on international best practices and widely endorsed protocols (i.e. by the World Health Organisation) and evidence-based nutrition-sensitive agricultural practices identified by international experts. Through an iterative multi-stakeholder process, international and country experts will localise and adapt the content to make it relevant to the specific target audience in the 14 countries. The adapted content and nature of messages is expected to vary across specific target audiences within and across countries. The main purpose of assessing the relevance of the content is not to evaluate the overall health and nutrition content but on how this content has been localised and adapted and to what extent the needs of the specific target groups within their particular context have been met.

In assessing the commercial viability, it is recognised that evaluating the sustainability/long-term financial viability of the mobile phone based advisory services will be difficult as mobile network operators may not be willing to provide this potentially commercially sensitive information. Therefore, GSMA will provide support through its access to aggregated confidential financial results of the mobile network operators providing the service. GSMA will provide a financial summary report on the commercial viability of the business models without compromising the commercial sensitivity of the data for the mobile network operators. The evaluator will assess and validate commercial sustainability through an analysis of the aggregated information provided by GSMA and additional qualitative business analysis approaches.

The Evaluator has the option of proposing refinements of the existing evaluation questions during the inception phase as part of developing the research protocol. These suggestions will be considered by the Steering Committee and an independent peer review during the review of the research protocol as part of the inception phase.

### **Output**

The output of this work will be new and robust evidence on the impact, cost-effectiveness and commercial viability of mobile phone based advisory services focusing on nutrition and agriculture delivered by public and private partners, and including the development of robust methodological approaches to impact assessment of phone based advisory services.

### **Recipient**

The primary recipient of this work will be DFID, with the beneficiaries being GSMA, governments, international agencies, foundations, MNOs and other private companies and civil society involved in policies and programmes in nutrition and agriculture that are aimed at improving nutritional, health and agricultural outcomes. The findings of this impact evaluation are intended as global public goods.

## Scope and timeline

The scope of this work is to:

- Develop a research protocol for the external evaluation of mNutrition;
- Design and undertake an external evaluation of mNutrition in two countries: Ghana and Tanzania;
- Contribute to the communication of the learning agenda, evaluation strategy and evaluation results.

The evaluation will be in two of the 14 mNutrition target countries; Ghana and Tanzania. These countries have been selected based on the phased start-up of mNutrition programme activities. The focus and approach in the two respective countries will be different allowing for a comparison of the effectiveness of approaches applied. In Tanzania, mNutrition will focus on mobile phone technology based nutrition and health services and registration and identification of target population. In Ghana, the mobile phone technology will focus on nutrition and agriculture sensitive services.

In terms of coverage in number of people being targeted for these services, in total 3 million people will be reached through mNutrition; including 2 million for nutrition sensitive agriculture advisory messages in 4 Asian and at least 2 African countries and about 1 million beneficiaries for mobile phone based nutrition services in 10 countries in SSA.

The evaluation contract period will be September 2014 to 31<sup>st</sup> December 2019. The development of the research protocol must be completed by month 4 for review and approval by DFID. Full details on tasks and deliverables are provided in sections below.

### Statement on the design of the mNutrition evaluation

The evaluation design is expected to measure the impact, cost-effectiveness and commercial viability of mNutrition, using a mixed methods evaluation design and drawing on evidence from two case study countries and the M&E system of the programme. Overall, the proposed design should ensure that the evidence from the two case study countries has high internal validity and addresses the priority evidence gaps identified in the Business Case. Being able to judge the generalisability/replicability of lessons learned from the programme is of equal importance and so a credible approach to generalization and external validity will be an important component of the overall evaluation design. The final evaluation design and methodology to generate robust evidence will be discussed in detail with DFID and GSMA before implementation.

For assessing cost-effectiveness, the Evaluator will further fine-tune their proposed evaluation approach and outline their expectations in terms of data they will require from implementers. A theory based evaluation design, using mixed methods for evaluating the impact has been proposed. During the inception phase, the Evaluator will put forward a robust evaluation design for the quantitative work, either an experimental or a quasi-experimental method, with a clear outline of the strengths and limitations of the proposed method relative to alternatives. During the inception phase, the Evaluator is also expected to identify clearly what will be the implications of the design for implementers in terms of how the overall programme would be designed and implemented and for evidence to be collected in the programme's monitoring system. The Evaluator will also assess the degree to which it is realistic to assess impacts by early 2019 for a programme where implementation started mid 2015 and, if there are challenges, how these would be managed.

The Evaluator, in its 6 monthly reports, will be required to provide information to feed into the DFID Annual Review and Project Completion Report of mNutrition.

## Gender and inclusiveness

The impact evaluation will pay particular attention to gender and other forms of social differentiation and poverty issues. From current experiences, it is clear that access to and use of mobile services is differentiated along a range of factors, including gender, poverty, geographic marginalisation, education and illiteracy levels. Therefore, the impact evaluation will look at and analyse differentiated access to and potential utilisation of mobile phone based services for improved nutrition and agricultural production. Based on the findings, it will identify opportunities and challenges in having an impact on women in general and more specifically the poor and the marginalised.

## Tasks

The Evaluator will perform the following tasks:

### A. Finalise a coherent and robust evaluation approach and methodology based on their proposal (inception phase)

- Conduct landscape analysis of existing experiences in mobile phone based services for nutrition and agriculture based on available publications and grey project documents to identify additional critical lessons and priorities for evidence gathering and programme design and implementation;
- Ensure that gender issues and poverty issues are well integrated into the impact evaluation design;
- Develop robust sampling frameworks, core set of indicators and research protocols that allow the consistent measurement and comparison of impacts across study countries, taking into account differences in business models and programmes as needed;
- Work closely with mNutrition programme team in GSMA to familiarise them with impact assessment methodology, discuss evaluation approaches, identify and agree on data provided by programme monitoring system and possible modifications to design;
- Identify risks to the evaluation meeting its objectives and how these risks will be effectively managed;
- Review existing evaluation questions and if deemed relevant propose refinement of existing questions and/or add other questions;
- Prepare a research protocol, including an updated workplan, project milestones and budget. The research protocol will be subject to an independent peer review organised by DFID; and
- Develop a communication plan.

### B. Implement and analyse evaluations of impact, cost-effectiveness and commercial viability in accordance with established best practices

- Based upon the agreed evaluation framework, develop and test appropriate evaluation instruments which are likely to include data collection forms for households, community health workers, service providers including health and agricultural services, content providers and private sector stakeholders including mobile network operators. Instruments will involve both quantitative and qualitative methods;
- Register studies on appropriate open access study registries and publish protocols of studies where appropriate;
- Conduct baselines and end-lines, qualitative assessments and business model assessments in both of the two impact evaluation countries;
- Conduct and analyse the evaluations and present findings in two well-structured reports addressing the evaluation questions. The reports should follow standard reporting guidelines

as defined by, for example, the Equator Network. Primary findings should be clearly presented along with a detailed analysis of the underlying reasons why the desired outcomes were/were not achieved;

- The Evaluating Organisation or Consortium may subcontract the administration of surveys and data entry, but not the supervision of those tasks, study design, or data analysis; and
- The country-specific mixed methods evaluation reports, cost effectiveness and business models studies and final evaluation report will be subject to an independent peer review organised by DFID.

### **C. Contribute to the communication of the learning agenda, impact evaluation strategy, and evaluation results.**

- Develop a communication plan outlining the main outputs and key audiences;
- Conduct lessons learnt workshops in each of the 2 impact evaluation countries and key dissemination events; and
- Assist in communicating the results of the evaluation and contribute to the development and communication of lessons learnt about mobile phone based extension approaches in nutrition and agriculture.

## **Deliverables**

The Evaluator will deliver the following outputs<sup>11</sup>:

During the design and study inception phase of maximum 4 months:

- A publishable landscape analysis report highlighting lessons learnt from existing initiatives on mobile phone based advisory services related to nutrition and agriculture by month 4;
- A updated work plan with project milestones and budget by end of month 1 (possibly adjusted based on the approved research protocol by month 4);
- A communication plan outlining the key outputs, audience and timeline for review and approval by month 4; and
- A full research protocol by month 4 for review and approval. The research protocol should be registered with appropriate open access study registries;

Interim reports:

- 4 biannual progress reports for the External Evaluation as a whole, and for each country evaluation, against milestones set out in the workplan;
  - Two desk reviews submitted by June 2016
  - Two Baseline quantitative reports submitted by April 2017
  - Two Baseline qualitative reports submitted by February 2017
  - Two Cost-effectiveness reports 1 submitted by March 2017
  - Two Business Model reports 1 submitted by March 2017
  - Two Mixed Methods Baseline reports completed by September 2017
  - Two Midline qualitative reports submitted by March 2018
- All survey data collected during the evaluation provided in a suitable format to DFID for public release.

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<sup>11</sup> Exact timeframe of deliverables will be agreed on during the design phase as appropriate.

At project's end:

- Two Endline quantitative reports submitted by June 2019
- Two Endline qualitative reports submitted by August 2019
- Two Cost-effectiveness report 2 submitted by July 2019
- Two Business Model report 2 submitted by July 2019
- Two Evaluation reports submitted by October 2019
- At least 1 article, based on the findings from the country evaluation reports, published in a research journal;
- A shared lesson learnt paper published and at least one presentation highlighting key lessons for similar initiatives of promoting mobile based technologies for providing extension services and the promotion of uptake of technologies by December 2019.

Research protocol and all final reports will be independently peer reviewed. This will be organised by DFID. Outputs are expected to be of sufficiently quality so that a synthesis of findings can be published in a leading peer-reviewed journal.

## Coordination and reporting requirements

A mNutrition Advisory Group (AG) will be established for the programme which will a) provide technical oversight and b) maximise the effectiveness of the programme. The Advisory Group will meet on a bi-annual basis and comprises of representatives of DFID, NORAD and GSMA representatives and independent technical experts. The Evaluator will be managed by DFID on behalf of the mNutrition Advisory Group. The Evaluator will work closely with the mNutrition programme team in GSMA and its specific country implementing partners. The Evaluator will:

- Ensure coherence and lesson learning across all pilot impact assessments on the key evaluation questions and indicators identified.
- Incorporate a clear code of ethics; incorporate plans for open access publications and public access to data sets.

The Evaluator will work closely with the mNutrition project management team, in particular in the design of the overall evaluation framework and the evaluation plan for the specific project components and the countries selected for the evaluation. Collaboration and regular communication between Evaluator and mNutrition project management team and implementing partners in selected case study countries is crucial as the evaluation design may have implications for project implementation and vice versa. The mNutrition project management team will lend support in communication as requested by the Evaluator or the Advisory Group. The Evaluator will report directly to DFID who will manage the evaluation on behalf of the mNutrition Advisory Group. The main point of contact for technical matters is Louise Horner, Livelihoods Adviser and Hugh McGhie, Deputy Programme Manager for all other project related issues. The mNutrition Advisory Group will be the arbiter of any disputes between the evaluation function and the overall programme implementation.

At the end of each 6 months, the Evaluator will submit a brief report outlining key achievements against the agreed deliverables. Pre-agreed funding will then be released provided that deliverables have been achieved.

In addition to the 6 monthly reports outlined above, the Evaluator will provide information to feed into the DFID Annual Review of mNutrition. The 6 monthly reports will be a key source of information used to undertake the Annual Review and Project Completion Report for the programme. These reviews will be led by the Livelihoods Adviser and Deputy Programme

Manager, in consultation with the mNutrition AG. All reviews will be made available publicly in line with HMG Transparency and Accountability Requirements.

Mandatory financial reports include an annual forecast of expenditure (the budget) disaggregated monthly in accordance with DFID's financial year April to March. This should be updated at least every quarter and any significant deviations from the forecast notified to DFID immediately. In addition the Evaluator will be required to provide annual audited statements for the duration of the contract.

## **Contractual Arrangements**

The contract starts in September 2014 and will run till end of December 2019 subject to satisfactory performance as determined through DFID's Annual Review process. Progression is subject to the outcome of this review, strong performance and agreement to any revised work plans or budgets (if revisions are deemed appropriate).

A formal break clause in the contract is included at the end of the inception period. Progression to the implementation phase will be dependent on strong performance by the Evaluator during the inception period and delivery of all inception outputs, including a revised proposal for implementation period. Costs for implementation are expected to remain in line with what has been agreed upon for this contract, with costs such as fee rates fixed for contract duration. DFID reserves the right to terminate the contract after the inception phase if it cannot reach agreement on the activities, staffing, budget and timelines for the implementation phase.

DFID reserves the right to scale back or discontinue this assignment at any point (in line with our Terms and Conditions) if it is not achieving the results anticipated. The Evaluator will be remunerated on a milestone payment basis. DFID has agreed an output based payment plan for this contract, where payment will be explicitly linked to the Evaluator's performance and effective delivery of programme outputs as set out in the ToR and approved workplan. The payment plan for the implementation phase will be finalised during the inception period.

## **Open Access**

The Evaluator will comply with DFID's Enhanced and [Open Access Policy](#). Where appropriate the costs of complying with open access policy should be clearly identified within your commercial proposal.

## **Branding**

The public has an expectation and right to know what is funded with public money. It is expected that all research outputs will acknowledge DFID support in a way that is clear, explicit and which fully complies with DFID Branding Guidance. This will include ensuring that all publications acknowledge DFID's support. If press releases on work which arises wholly or mainly from the project are planned this should be in collaboration with DFID's Communications Department.

## **Duty of Care**

The Evaluator is responsible for the safety and well-being of their Personnel (as defined in Section 2 of the Contract) and Third Parties affected by their activities under this contract, including appropriate security arrangements. The Evaluator is responsible for the provision of suitable security arrangements for their domestic and business property. DFID will share available information with the Evaluator on security status and developments in-country where appropriate.

The Evaluator is responsible for ensuring appropriate safety and security briefings for all of their Personnel working under this contract and ensuring that their Personnel register and receive briefing as outlined above. Travel advice is also available on the FCO website and the Evaluator must ensure they (and their Personnel) are up to date with the latest position.

The Evaluator has confirmed that:

- The Evaluator fully accepts responsibility for Security and Duty of Care.
- The Evaluator understands the potential risks and have the knowledge and experience to develop an effective risk plan.
- The Evaluator has the capability to manage their Duty of Care responsibilities throughout the life of the contract.

## Annex B Stakeholder contact list

Organisation	Contact
<b>Key stakeholders</b>	
GSMA	Natalia Pshenichnaya (Head of mNutrition)
GSMA	Tegan Palmer (Business Intelligence mAgri)
GSMA	Matthew Strickland (MAgri Project Manager)
CABI	Charlotte Jordan (Nutrition Project Manager)
GAIN	Kyla Stockdale (Senior Programme Manager)
Esoko	Daniel Asare-Kyei (Managing Director)
Esoko	Eugenia Ankomah Malan (Senior Business Advisor)
Esoko	Godwin Cudjoen
Esoko	Francis Adjei
Tulaa	Mohammed Issifu (Agriculture Content Specialist)
Tulaa	Alfred Yeboa
Vodafone	Luois Manu
Vodafone	Nanama Boa-Essilfie (VFC Manager)
Vodafone	Victor Bannerman Chedid
Vodafone	Cephas Pobi (Manager, VFC)
Vodafone	Carlos Asare Okoh
Acumen	Rebecca Mincy
<b>Alternative service providers</b>	
Syecom	Solomon Elorm Allavi (Founder, GIS Mapping Specialist)
Farmerline	Worlali Senyo (Director of Business Development)
Viamo	Sandra Abrokwa
Viamo	Hannah Metcalfe
Agro Sourcing	Richmond Nutsuglo
Onyeka Akumah	FarmCrowdy (CEO)
Emmanuel Bakirdjian	Precision Agriculture for Development (Country Director)
Safaricom	Benjamin Makai (Tech for Development, Kenya)
MobileContent.com	Rudolph Kotoka
Agrocenta	Michael Ocansey
Hamwe	Allan Asimwe
Spiderbit	Alex Rukundo

## Annex C mAgri comparable cost-effectiveness

The baseline cost-effectiveness report included a literature review to identify recent learning on the cost-effectiveness of mAgri projects. In anticipation of some effectiveness on the primary outcomes, the team updated this literature to ensure the final report would be based on the latest learnings on cost-effectiveness.

Green *et al.* (2018) provide a possible comparable study to mAgri, as the aims of the study are similar (to improve household food security and nutrition outcomes, livelihoods, and women's empowerment), although the means and context are different. The intervention, 'Family Farms for the Future (FF4F)', ran in Cambodia and supported households to enhance their homestead food production through several means, including fishponds and crops. They ran a randomised control trial type study with control groups to assess the impact and found significant positive differences in agricultural production and micronutrient deficiencies.

Green *et al.* (2018) carried out both a cost-benefit analysis and a cost-effectiveness analysis. The former took a societal perspective (equivalent to Analysis C), converting agricultural production to monetary gains, and came out as cost neutral over two years. The authors then forecast the analysis over 10 years and found it is cost saving—more benefits are derived from increased production than costs. Obviously, this analysis does not contain any nutritional outcomes. Also, it should be noted that the value of increased agricultural production is for the whole yield, not just the proportion sold. This neglects the nutrition outcome of what might be consumed by the family and potentially overestimates the monetary value of the increased agricultural production. This issue comes up again in the cost-effectiveness analyses described in the following paragraphs.

Green *et al.* (2018) performed a cost-effectiveness analysis that took some account of nutritional outcomes but, interestingly, only focused on one of these. The authors stated that the challenge was to relate diet to DALYs averted, and to do this they picked out zinc deficiency/intake only as the health outcome. They then constructed a model that ran for 10 years to map zinc deficiency rates to DALYs averted, tracking 1,000 households over the same period (this method is attributed to Stein *et al.*, 2005). They connected zinc deficiency with four health outcomes (stunting, mortality, diarrhoea, and pneumonia), modelling the number of incidences in children, adding up 'Years Lived with Disability' and 'Years of Life Lost' to get DALYs for each year, taking cumulative totals. For the intervention arm, an efficacy factor reduced the incidence of zinc deficiency and associated mortality. They ran the model for the scenario without the intervention, and the scenario with the intervention, to calculate DALYs averted.

A couple of other methodological decisions are of interest. The authors stated that to avoid double counting the benefit of increased agricultural production of zinc-rich food, they decreased the monetary value of the increased production by 10%. There is no discussion about this number, but presumably it suggests that 10% of the produce is consumed by the household and not sold (or is wasted). To combine the health outcome from zinc deficiency and the increase in agricultural production, the value of agricultural production was subtracted from the cost side of the cost-effectiveness analysis (as is proposed by mAgri).

The result of Green *et al.*'s analysis was that the FF4F intervention was very cost saving—a negative cost per DALYs averted was found. This was due in part to low costs, but also to the large increase in agricultural produce, and monetisation of 90% of it. A defence, or discussion, of the selection of the proportion sold would have been helpful to guide others using this methodology. Presumably the analysis is sensitive to the assumption of the percentage consumed.

The study method could not be utilised in the VFC study as in the latter there were no significant increases in agricultural production.

The search for comparable projects to mAgri resulted in numerous biofortification results, most of which were *ex ante* studies (modelling of the potential benefits and costs of a particular intervention). Where these were carried out on a large scale (for example on the scale of a whole country), or where little information on assumptions was given, the cost efficiency metrics were not extracted.

The search also found multiple World Bank studies, which are *ex ante* scaling up studies. They model the scale up of interventions at a country or global level and consider cost, impact, cost-effectiveness, and economic benefits. As they are relatively abstract analyses, they are intended to influence policy on a high level.

Hasan's (2018) doctoral thesis examined the agriculture–water–sanitation–hygiene nexus, and through this considered the link of these aspects to nutrition. An educational campaign focused on good hygiene was implemented for households that had benefited from a clean piped water intervention. Without the education, Hasan (2018) concluded that hygiene practices did not change and so there was no effect on the health of the beneficiaries. With education, it was found that hygiene practices improved among other things, including a small drop in child wasting (no impact on stunting). The experiment was somewhat limited as it seems the effects of the intervention were only measured over one month, which does not appear to be enough time to fully assess benefits. In addition, Hasan uses a cost–benefit analysis for the evaluation, converting health outcomes (wasting) to a monetary value using the 'value of a statistical' life method.

None of the search results came up with actual cost-effectiveness metrics in DALYs, suggesting that, when it comes to agricultural interventions, **there is still no prior experience in assessing their outcomes in ways that allow comparison to more standard health evaluations**, which use DALYs.

However, two ongoing trials in the agri-nutrition field might yield interesting comparisons or results for mNutrition. One trial (currently ongoing, and which will unfortunately not finish until 2020) is the Upscaling Participatory Action and Videos for Agriculture and Nutrition trial. This is testing the use of videos shown at women's groups, which demonstrate nutrition-sensitive practices (Kadiyala *et al.*, 2018). (Nutrition-sensitive interventions refers to those addressing the underlying causes of poor nutrition, rather than 'nutrition-specific' interventions, which refer to programmes targeting the immediate cause. An example of the former is WASH initiatives; of the latter, food supplements.) Their cost-effectiveness evaluation will be a cost consequence analysis (Haghparast-Bidgoli *et al.*, 2019). See the methods report for detail on this. They will use a societal perspective.

A second trial, found through the mHealth search (also ongoing), and which has some relevance to mNutrition, is Ohly *et al.* (2019). This is an actual measured intervention of biofortification, testing whether biofortified flour with zinc affects zinc deficiency in Pakistan. This may well be an example of an agricultural-nutrition intervention that will be quantified in DALYs averted. Results are expected in March 2019, so evaluative output might be available 2020.

Several papers came up about agri interventions that used mobile phones, but these had no relation to nutrition outcomes (and no cost-effectiveness analyses) (Khan *et al.*, 2018; Thakur *et al.*, 2018; Anunobi *et al.*, 2018). In Mushtaq *et al.* (2017), educational videos were sent to sugarcane farmers in Australia, and although they conduct a cost-effectiveness analysis they quantified the impact on a per farmer basis. Several studies considered use of mobile phones for dissemination of agri information (e.g. weather or aphids), but no economic analysis was attempted (Etwire *et al.*, 2017; Ashraf *et al.*, 2018). Anunobi *et al.* (2018) conducted surveys to elicit feedback

about ICT extension services, and the services were described by extension agents as cost-effective during qualitative data collection, but no numerical evaluation backs this up.

Ruel *et al.* (2018) called for research on how cost-effectiveness analysis can be conducted for complex, multisectoral programmes, citing the difficulty of carrying this out as the reason it is done so rarely. That said, Masset *et al.* (2018) did review how cost-effectiveness analysis is applied for complex multisectoral projects.

The updated literature review concludes that there have been no significant advances in cost-effective analysis methods that might have improved the outcome of the VFC cost-effectiveness analysis.

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