

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

Tanzania Mixed Methods Baseline Report

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Executive summary

This report constitutes the mixed methods baseline report of the evaluation of the mNutrition intervention in Tanzania. The report summarises the key findings from the quantitative baseline, the initial exploratory qualitative study and the first cost-effectiveness/business model analysis.

The mNutrition intervention in Tanzania

mNutrition is a five-year global initiative that has been supported by the Department for International Development (DFID) since 2013, organised by Groupe Spéciale Mobile Association (GSMA), and implemented by in-country mobile network operators (MNOs) to use mobile technology to improve the health and nutritional status of children and adults in low-income countries around the world. The nutrition content of the programme aims to promote behaviour change around key dietary and child feeding practices that are likely to result in improved nutritional health within a household.

In Tanzania, mNutrition is implemented through the 'Healthy Pregnancy, Healthy Baby' (HPHB) SMS (text messaging) programme, which is part of the Wazazi Nipendeni mHealth platform (WN). The programme is run by the mHealth Tanzania public-private partnership, which was initiated in 2012 by the Ministry of Health and Social Welfare, with financial support from the US government Centers for Disease Control and Prevention (CDC). WN is targeted at pregnant women and mothers of young children, and their partners (husbands, etc). It is available nationally and on all phone networks.

The HPHB SMS service sends free text messages in Swahili on a range of pregnancy and early childhood issues. Nutrition was a small component of the original HPHB SMS service but was extended substantially with the addition of the mNutrition content (approximately 300 nutrition messages). The resulting product will be referred to as mNutrition in this report.

Evaluation 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, the Institute of Development Studies (IDS) and the International Food Policy Research Institute (IFPRI).

The team uses a mixed methods approach with three interlinked components to gather evidence about the impact of the mNutrition intervention in Tanzania, including:

- A **quantitative impact evaluation**, employing a randomised control design to determine the causal effect of the programme on the impact on dietary diversity, infant and young child feeding (IYCF) practices, and child anthropometry. The quantitative team will conduct large-scale household surveys at the start of the programme implementation and two years later in both the treatment communities, which will receive door-to-door offers to sign up to the service, and the control communities, which will not receive such offers but will still be able to access the mNutrition intervention.
- A **qualitative impact evaluation**, which consists of three qualitative data collection rounds (i.e. an initial qualitative exploratory 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 the 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 evaluation to generate a business model framework and estimate the wider imputed benefits from the value-added service for the range of stakeholders involved.

This report

This report summarises and integrates the key findings from the initial data collection round of each evaluation component carried out between October 2016 and January 2017. This report takes a theory-based approach and makes explicit use of the mNutrition theory of change (ToC) to structure the findings, assess the underlying assumptions about causal links between outcomes, and draw conclusions about whether and how mNutrition may lead to the desired impact in the context of Tanzania.

Key baseline findings

The baseline analysis highlights ample scope to improve the key outcomes which the intervention aims to change: women's dietary diversity, some IYCF practices and children's nutritional status (with regards to stunting).

WN plus mNutrition services may trigger and support those much-needed improvements with carefully tailored and targeted messages. However, the analysis also identified several contextual factors that may hinder the desired improvements; some of these factors may be addressed by careful intervention design, whereas other factors are outside the influence of the intervention. Improvements in dietary practices may be hampered by household poverty and lack of time (e.g. due to work commitments). Carefully tailored messages that address these context-specific limitations are vital.

The analysis of underlying assumptions found that most assumptions that can be assessed based on baseline data fully or largely hold true. However, there are a few assumptions that do not hold true or only partially hold true and which may pose considerable risks to the effectiveness of WN plus mNutrition services. Some of these assumptions can be addressed by the intervention while others clearly lie outside the intervention's influence.

One assumption that does not hold true is the perception that women (households) have sufficient time and available financial resources to act on the behaviour change messages and improve dietary practices during pregnancy, infancy and early childhood. Our baseline findings suggest that both available time and money are likely to be major barriers to change. With regards to time, mothers' work commitments in and around the house as well as outside the home (e.g. in tea plantations) are likely to negatively interfere with good breastfeeding and child feeding practices. Lack of available cash and competing priorities for the money that is available is likely to be a constraint to purchasing healthier and more varied foods (e.g. animal-sourced foods). The WN plus mNutrition service cannot address these underlying limitations and they are likely pose a significant risk to the effectiveness of the intervention. Nevertheless, the limitations should be considered carefully when designing text messages (e.g. text messages specifically targeted at lactating mothers who work full time, recommendations for low-cost alternatives to animal-sourced foods).

An assumption that only partially holds true is the perception that unwanted spam messages will not distract from/interfere with WN plus mNutrition services. The qualitative baseline research suggests that spam messages are a concern for many households and, in particular, messages sent with a 15*** number are often disregarded immediately as they are perceived as spam. WN plus mNutrition messages are sent with such a number and there is a considerable risk that

messages will be deleted. To reduce this risk, we strongly recommend that the intervention uses a different sender ID (e.g. Wazazi Nipendeni or similar).

One of the underlying motivations for mNutrition is the assumption that pregnant women/mothers lack access to credible information on child feeding and nutrition practices and that mobile phone-based services can help to address these existing gaps. While there are certainly knowledge gaps with regards to nutrition among pregnant women and mothers, no acute lack of access to credible information could be identified. In fact, most women had (at least some) access to credible information (e.g. health worker, radio, TV). In this context the value of WN plus mNutrition messages is likely to be as a reminder of existing knowledge; in fact, the service has never been designed to operate in isolation but always meant as a complement to existing sources. Nevertheless, for the service to be perceived as valuable (above and beyond the existing information sources) it needs to extend existing information (e.g. by facilitating operationalisation of information women received during antenatal care (ANC) visits), be more tailored and personalised to specific needs, and/or be more convenient to access.

WN plus mNutrition can be regarded as a multi-sided platform business model. It provides a means of making a product free to one group of customers, while another group pays. Wazazi Nipendeni brings together two groups, providing a link between funders, who pay for the service, and users, who receive the service for free. In the Wazazi Nipendeni model, funders are motivated by improved health outcomes for poor people. Because the customers do not pay, the viability of the service does not depend only on the material (or perceived) benefit to individual users in terms of reduced health expenditures, deaths averted and so on. Rather, it depends on yielding wider benefits that are of value to the funding institutions. The model also benefits from endorsement from the very highest levels of government, and it has a 'cooperative spirit' working with other health providers as one element of integrated multimedia campaigns.

Implications for mNutrition

Child undernutrition is common among measured children in the Iringa region of Tanzania. Despite being less than one year of age – and therefore expected to have a lower prevalence of stunting than children under five years of age who have had longer exposure to detriments to nutritional status – 29.6 percent of children in the mNutrition quantitative sample are stunted. This suggests that dietary inputs, the health and sanitation environment, and caring practices are inadequate, limiting growth for a large proportion of children in the sample. This stunting prevalence will continue to grow as these children age.

Information disseminated through the mNutrition programme aims to modify individual and household information sets and beliefs, which may then change nutrition-related practices and influence nutrition outcomes. The first step in this causal chain is the presence of gaps in nutrition knowledge among beneficiaries. Given these gaps, and contingent on the resources necessary to change behaviours and that messages can be effectively delivered to women through mobile phones, the mNutrition programme will be most effective if it targets knowledge deficits that are especially common and deemed particularly critical for determining nutrition outcomes.

Women in Iringa have clear knowledge gaps and they also struggle to access credible information to address these gaps. Improving nutrition knowledge among pregnant women and mothers of young children is the highest priority for many nutrition information campaigns because mothers usually play a leading role in nutrition-related caring practices.

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Abbreviations and acronyms

ANC	antenatal care
CDC	Centers for Disease Control and Prevention
DFID	Department for International Development
EI	expert interview
FGD	focus group discussion
GAIN	Global Alliance for Improved Nutrition
GDP	gross domestic product
GSMA	GSM Association
HPHB	Healthy Pregnancy, Healthy Baby
IDI	in-depth interview
IDS	Institute of Development Studies
IFPRI	International Food Policy Research Institute
IYCF	Infant and Young Child Feeding
KII	key informant interview
MNO	mobile network operator
NGO	non-governmental organisation
OPMT	Oxford Policy Management Tanzania
PPP	public-private partnership
RCT	randomised controlled trial
SMS	Short Messaging Service
TFNC	Tanzania Food and Nutrition Centre
ToC	theory of change
VAS	Value Added Service
WN	Wazazi Nipendeni

1 Introduction

1.1 Objectives of the report

This report constitutes the mixed methods baseline report of the evaluation of the mNutrition intervention in Tanzania. mNutrition is a five-year global initiative that has been supported by the Department for International Development (DFID) since 2013, organised by the GSM Association (GSMA), and implemented by in-country mobile network operators (MNOs) to use mobile technology to improve the health and nutritional status of children and adults in low-income countries around the world. mNutrition is implemented through existing mAgri and mHealth programmes in a total of 12 countries throughout sub-Saharan Africa and South Asia. The nutrition content of the programme aims to promote behaviour change around key farming practices and dietary and child feeding practices that are likely to result in improved nutritional health within a household.

In Tanzania, mNutrition is implemented through the 'Healthy Pregnancy, Healthy Baby' (HPHB) SMS (text messaging) programme, also known as the Wazazi Nipendeni (WN) SMS programme. The nutrition component aims to improve maternal knowledge and practices around nutrition during pregnancy and in the first year of a child's life, in order to enhance the effectiveness of the WN health platform for improving nutrition.

The main objectives of the evaluation are to measure the impact, cost effectiveness and commercial viability of the mNutrition service in Tanzania. The evaluation includes a quantitative component, a qualitative component and a business model/cost-effectiveness analysis.

The evaluation will address the following research questions as stated in the DFID terms of reference:

1. What are the impacts and cost effectiveness of mobile phone-based nutrition services on nutrition and health 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 and pregnant women and mothers 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?

This report summarises and brings together key findings from the quantitative baseline survey, the initial exploratory qualitative study and the first business model/cost-effectiveness analyses of the evaluation [1-4]. The report describes the baseline situation for impact indicators that are expected to change as a result of the intervention. The report also explores key factors that may affect the

uptake and success of the intervention in changing behaviours, improving the nutritional status of children, Infant and Young Child Feeding Practices (IYCF) and women's dietary diversity, and providing a commercially viable service.

The report is structured as follows:

- **Section 2** describes the programme in more detail, including its theory of change (ToC) and the assumptions that underpin it.
- **Section 3** briefly discusses the overall design of the evaluation and potential limitations.
- **Section 4** describes the economic, health and nutrition contexts of Tanzania.
- **Section 5** uses data from the baselines to analyse the assumptions underlying the programme ToC.
- **Section 6** presents the key baseline findings for the primary outcome indicators (nutritional status of children, IYCF, women's dietary diversity) that are expected to change as a result of the programme.
- **Section 7** presents our conclusions and summarises the implications.

1.2 Intended audience of the report

This report summarises the combined key findings of the quantitative baseline survey, the initial exploratory qualitative study, and the first cost-effectiveness/business model reports. This report deliberately presents results in a way that is accessible to non-technical audiences. This means that in-depth technical and methodological details and discussions have not been included here but are included in our detailed method-specific reports [1-4].

The primary audience for the evaluation results is DFID, along with other key stakeholders including GSMA and its national members (including local MNOs implementing WN), national governments (in particular the Ministry of Health and the Tanzania Food and Nutrition Centre (TFNC)), international agencies and donors, as well as community-level health/nutrition workers.

The findings of this report were presented and discussed with key stakeholders from GSMA, the government of Tanzania, various non-governmental organisations and donors, and academics during a one-day workshop held in Dar es Salaam on 19 April 2018.

2 The mNutrition service in Tanzania: WN plus mNutrition

2.1 Description of the intervention

In Tanzania, mNutrition is implemented through the 'Healthy Pregnancy, Healthy Baby' (HPHB) SMS text messaging service. The mass media programme accompanying the service is called Wazazi Nipendeni (WN).¹

The HPHB SMS service in Tanzania sends free text messages with health care information to pregnant women, mothers with new-borns, and their supporters to drive health-seeking behaviour. The SMS messages are sent in Swahili, originally to women up to 16 weeks post-partum, on a range of pregnancy and early childhood issues timed to the stage of the pregnancy or the age of the child. Anyone interested in receiving healthy pregnancy information can text the word 'MTOTO' (child) to the shortcode 15001. Registrants receive instructional messages, allowing them to indicate the woman's current week or month of pregnancy (or the age of the newborn baby) during the enrolment process. This process allows recipients to receive text messages relevant to the time and stage of pregnancy or early childhood.

Nutrition-related content was a small component of the original HPHB SMS service but was expanded substantially with the addition of content contributed through GSMA under the mNutrition programme. mNutrition adds roughly 120 nutrition messages, which are delivered to pregnant women and mothers or caregivers of children up to five years old. The Wazazi Nipendeni plus mNutrition platform is available to households in all regions of Tanzania and on all mobile phone networks. Participating individuals receive the text messages free of charge. The resulting product will be referred to as mNutrition in the remaining sections of this report.

2.2 Programme theory of change (TOC)

Figure 1 presents the generic theory of change (ToC) developed for mNutrition implemented through existing mHealth platforms [5]. The programme's overarching ToC is that mHealth services offer access to mobile phone-based health and nutrition services while generating direct revenues and indirect commercial value. The mobile phone-based nutrition services will increase pregnant women's, mothers' and other service users' knowledge of nutritional practices that support good nutrition for their young children and for themselves. Acting upon this knowledge will lead to improved nutritional practices, which may result in better nutritional status and health for pregnant women, mothers or caregivers, and their children.

¹ The WN programme is a project funded by the US Centers for Disease Control and Prevention (CDC) and brings together multiple partners contributing towards shared goals. Phase 1 of the programme, launched in 2012, was initially developed in coordination with the Tanzania Capacity Communication Project (TCCP), a programme funded by United States Agency for International Development (USAID) and led by the Johns Hopkins Center for Communication Programs (JHCCP). Wazazi Nipendeni was one of several behaviour-change programmes using methods as diverse as TV drama series, radio distance learning for community health volunteers, and several integrated mass media campaigns. The mass media campaign was developed by JHCCP, while the SMS component of the campaign was led by the mHealth Tanzania Public-Private Partnership (mHealth Tanzania-PPP). The public-private partnership was initiated by the Ministry of Health, Community Development, Gender, Elderly and Children with financial support from CDC.

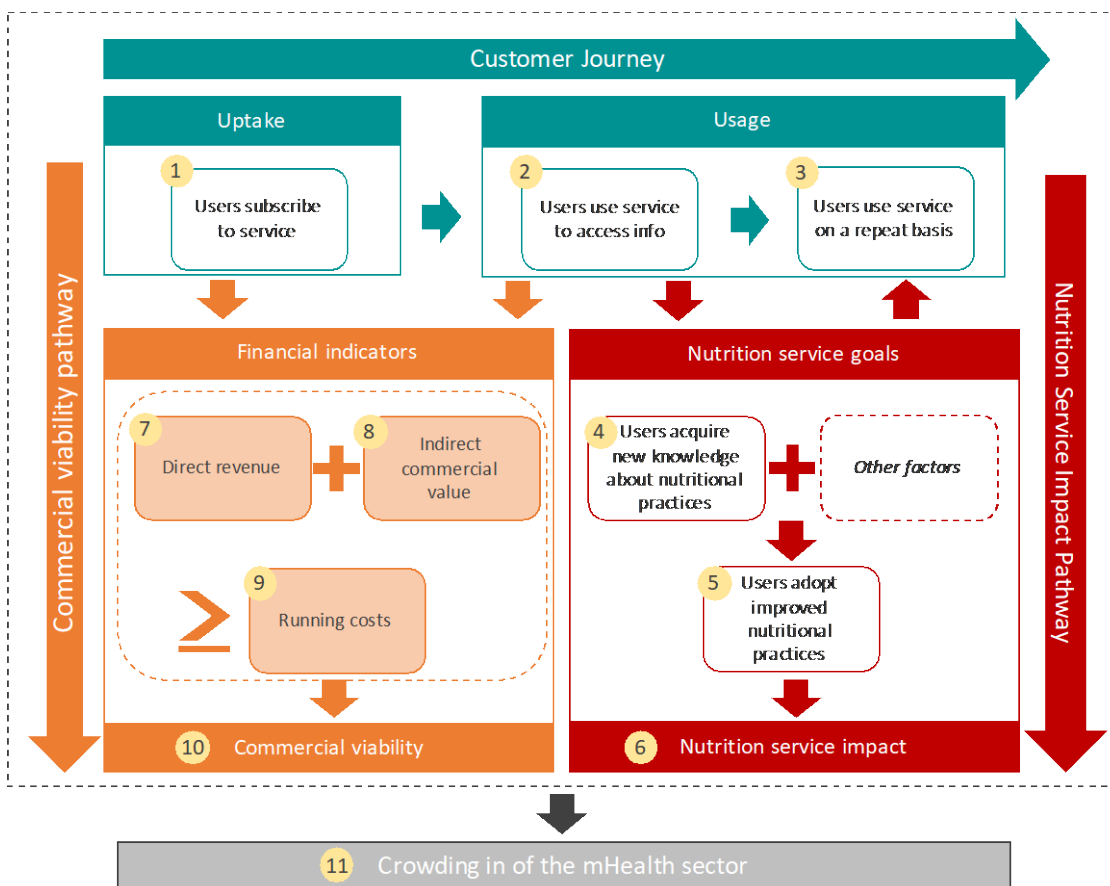


Figure 1: mHealth theory of change

Source: [5]

2.2.1 mNutrition customer journey

The first component of the ToC is the **mNutrition customer journey** (depicted in blue) which consists of the following sequential stages [5]:

- Uptake: awareness and subscription to the mNutrition service
- Usage: use and repeat use that leads to impact.

GSMA hypothesises that repeat users are more commercially valuable to mHealth service providers. They will generate more direct revenue for mHealth services than low-level users – those who try the service only a few times or infrequently – because they access more SMS messages with information. They will be more likely to generate indirect commercial value for operators for the following reasons:

- They stay with the operator providing access to this service
- They like it (known as ‘reduced churn’)
- They spend money on other products and services with that operator, known as incremental upsell – such as making more calls and sending SMS to friends and relatives.

Other indirect benefits include:

- Increased brand awareness and brand affinity leading to improved customer perception

- Increased customer lifetime (length of time spent with an operator and increase in spend as a result). The longer a user stays with a particular MNO the higher is the increase in loyalty and the greater the likelihood to increase spending on other services [5].

GSMA hypothesises that there is a correlation between the extent to which customers use mHealth services, and the likelihood that they will demonstrate improved nutritional information and practices – leading down the pathway to improved nutrition in the ToC [5].

2.2.2 Nutrition service impact pathway

The second component of the ToC is the **pathway to nutrition service impact** (depicted in red). Once mNutrition users have access to the nutrition information they are expected to gain new information about practices that can help them to improve their IYCF practices, women’s dietary diversity and ultimately children’s nutritional status. Contextual factors are expected to support/enable the implementation of the new knowledge and users are expected to change their current nutritional practices and adopt new improved practices. The intended result of the adoption is to improve nutritional practices leading to improved nutrition. The primary outcomes that are the focus of this evaluation are improved IYCF practices, improved women’s dietary diversity and improved nutritional status of children.

2.2.3 Commercial viability pathway

The third component of GSMA’s ToC (depicted in orange) is the **commercial viability pathway**. mNutrition is a commercially viable service when the direct revenues of the service to the MNOs (meaning the revenues generated through the paid elements of the service) and indirect commercial value (meaning revenues generated through new customers who were attracted by the mNutrition service or purchased other services offered by the operator) are greater than the running costs for the service [5].

2.2.4 Assumptions that underpin the ToC

It should be stated that the assumptions that lie behind the ToC have not been explicitly articulated. The evaluation team therefore developed a list of implementation, strategic and purpose-level assumptions about the causal links between outcomes [6]. This list is informed by assumptions developed by Altai Consulting for GSMA (see [5]), the desk review [7] and the landscaping exercise [8] conducted as part of the impact evaluation and the evaluation team’s experiences from previous impact evaluations.

Table 1 presents the assumptions that lie behind the ToC. Assumptions are sub-divided into assumptions related to the customer journey, the nutrition service impact and the commercial viability pathway.

Assumptions that can be explored at baseline stage (before the roll-out of the mNutrition services) are depicted in blue; assumptions that can partly be assessed with data from the baselines are depicted in yellow; and assumptions that can only be assessed based on midline and endline data (after the roll-out of mNutrition) are depicted in green. It should also be noted that the list of assumptions will be further developed throughout the evaluation as new assumptions may emerge. As part of the analysis presented in this report we will test the assumptions behind the ToC to assess the strengths and weaknesses of the programme design and the likely effectiveness of the programme. For each assumption we will draw on baseline findings to determine whether the assumption ‘fully holds true’, ‘largely holds true’, ‘only partially holds true’ or ‘does not hold true’.

Table 1 Assumptions behind the theory of change (ToC) of mNutrition

Customer Journey	Nutrition Service Impact Pathway			Commercial Viability Pathway
Uptake and usage of mNutrition	Uptake of new information	Adoption of new practices	Nutrition service impact	Commercial viability
Pregnant women and mothers can access mobile phones to subscribe & use service	Pregnant women and mothers have information gaps related to nutritional practices	Improved drinking water sources and sanitation are available	Pregnant women and mothers have access to fresh foods	mNutrition targets viable customer segments
Pregnant women and mothers can get sufficient network signal coverage and strengths to subscribe & use service	Pregnant women and mothers lack access to credible information on nutritional practices	Pregnant women and mothers have access to and use antenatal care services	Contextual factors that may interact with nutritional practices and outcomes are not a barrier	The value proposition of the service satisfies the identified customer segments
Pregnant women and mothers are literate and comfortable with receiving SMS messages	Pregnant women and mothers perceive the information as credible and trust the information provided	Pregnant women and mothers have sufficient time and resources to improve child feeding practices		Channels for reaching the customer remain in place and customer relationships are able to reach and maintain the desired customer segments
Pregnant women and mothers have enough money to use the service	Pregnant women and mothers perceive the information as actionable and context relevant	Pregnant women and mothers implement the nutrition advice correctly		Revenue streams, both direct and indirect, fulfil the key performance indicators required by the supply partners
Pregnant women and mothers have access to electricity to charge their mobile phones regularly	The information provided is accurate and correct	Pregnant women and mothers act on the new information and change their nutritional practices		Seeing the performance of the product, the resources are made available from the key supply partners

There are no social norms or attitudes that may hinder pregnant women and mothers from engaging with mobile phone-based information services	Pregnant women and mothers understand the information provided (both language and content)	Other contextual factors support a change in nutritional practices (e.g. community)		Key partnerships in the supply chain are valued by each partner and maintained
Unwanted mobile spam does not interfere with/distract from the mNutrition service		Pregnant women and mothers have the power to make decisions based on the advice received		A balance of cost, expenditure, investment and income, both direct and indirect, make for sustainable commercialisation of the product
Pregnant women and mothers find the service useful and use it repeatedly				Alternative approaches found in-country do not supersede the value proposition of the product
Service is successfully delivered to mothers'/pregnant women's mobile phones				

Key

Blue: assessed at baseline stage
Green: assessed only at endline stage
Yellow: partly assessed at baseline stage

3 Methods and evaluation design

3.1 Overall evaluation design

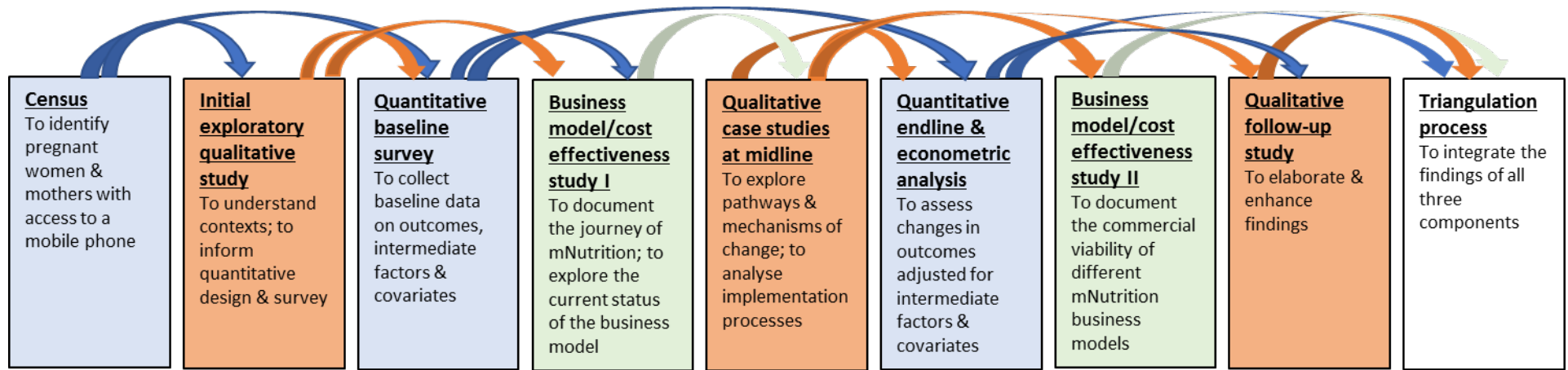
The evaluation employs a mixed methods design with three interlinked evaluation components:

- **A quantitative impact evaluation**, employing a randomised controlled trial (RCT) to determine the causal effect of the programme on increasing the knowledge and changing the behaviour of pregnant women and mothers with children with regards to dietary diversity and Infant and Young Child Feeding (IYCF) practices. The quantitative evaluation will focus on the estimation of the impact on women's dietary diversity, IYCF practices and nutritional status of children. The quantitative team are conducting large-scale household surveys at the start of the programme implementation and two years later (i.e. baseline and endline of the evaluation) in both the treatment communities, which will receive door-to-door offers to sign up to the service, and the control communities, which will not receive such offers but will still be able to access the Wazazi Nipendeni plus mNutrition intervention. The quantitative evaluation is being conducted in Iringa region where WN has no existing relationships with health clinics or other non-governmental organisations (NGOs). Therefore, it can be assumed that the use of the basic WN product is extremely low, thus limiting the potential uptake of the Wazazi Nipendeni plus mNutrition programme in control group areas.
- **A qualitative impact evaluation**, which consists of three qualitative data collection rounds (i.e. an initial qualitative exploratory study, in-depth case studies at midline, and rapid explanatory qualitative work after the quantitative endline). The qualitative evaluation workstream aims to provide understanding of the context within which mNutrition is embedded and which might facilitate or hinder the uptake of the intervention. The qualitative impact evaluation also explores the underlying mechanisms of change in response to the intervention and assesses implementation processes (from the treatment communities' point of view). Qualitative data collection is conducted in a sub-sample of the quantitative communities in Iringa region. Qualitative data collection is limited to treatment communities in order to use the available resources to provide in-depth information on the experience of the intervention among users.
- **A business model and cost-effectiveness evaluation**, employing stakeholder interviews, commercial data and document analysis to estimate the wider imputed benefits from the Value Added Service (VAS) for the range of stakeholders involved. It will relate the model to the GSMA theory of change and consider the effectiveness of the customer journey. This component will rely on ongoing mixed methods data collection, with two intensive phases of in-country data collection with key stakeholders in early 2017 and 2019.

The three evaluation components are closely linked and integrated with each other at all stages of the evaluation to inform, enhance and explain the design, the development of data collection tools and the analysis of each individual component. The different approaches are thereby used in a sequential manner² (see Figure 2). More details on the evaluation design can be found in the baseline reports [1-4].

² See Creswell, J.W., et al., Advanced mixed methods research designs, in *Handbook of mixed methods in social and behavioral research*. 2003, Sage Publications: London. p. 240

Figure 2 Sequential mixed-method design to assess the impact of mNutrition



Source: Authors' own

3.2 Evaluation activity timeline

Table 2 summarises the impact evaluation activities in Tanzania running from October 2014 to October 2019. Data collection started with the initial exploratory qualitative study in October 2016 followed by the quantitative baseline data collection in October-December 2016. The first business model data collection took place in January 2017. Sign-up for the mNutrition service took place shortly after the quantitative household visit after administration of the household survey. The qualitative midline took place in October-November 2017 (data analysis is currently in progress). The quantitative endline survey is planned for October-December 2018. Finally, a short qualitative endline survey and final business model data collections are planned for March-April 2019.

Table 2 Timeline of evaluation activities during the implementation phase

Date	Activities	Status
September 2016	Desk review	Completed
October-November 2016	Initial exploratory qualitative study data collection	Completed
October-December 2016	Quantitative baseline survey	Completed
January 2017	Business model/cost effectiveness data collection	Completed
October-November 2017	Qualitative midline study data collection	Completed
October-December 2018	Quantitative endline survey	In preparation
March-April 2019	Qualitative endline data collection	Planned
April 2019	Business model/cost effectiveness data collection	Planned

3.3 Limitations of the evaluation

This section outlines the limitations of the evaluation.

1. **Data access challenges:** Accessing business and, in particular, user data has been a persistent challenge for the impact evaluation team. Although stakeholders have expressed a positive intent to share data, this has not been forthcoming. GSMA have emphasised the sensitivities surrounding data and are currently negotiating with stakeholders to access data.
2. **Small qualitative sample;** The aim of the initial exploratory qualitative study was to gain insights into contextual factors that may affect the uptake of the mNutrition intervention. Time and budget allocations for this initial qualitative data collection were relatively small. This made it necessary for the team to restrict the number of communities that could be visited and also influenced the approach chosen to select the participants (e.g. with the help of focal persons in the community). Naturally, this limits the conclusions that can be drawn. However, the qualitative sample is not intended to be representative or allow for generalisable conclusions but instead aims to provide insights into multiple contextual factors.

4 Context: Tanzania

This section discusses the mNutrition operating context and highlights factors that might affect the programme's implementation in a positive or negative way, as well as other factors that might influence the programme's intended outcomes or impact.

This section has been structured into national-level Tanzania and Iringa-region level.

4.1 National level

The East African country of the United Republic of Tanzania has a population of 53.4 million (2015), with 68 percent of the population living in rural areas and 32 percent in urban centres and towns [9]. Tanzania was formed in 1964 shortly after independence from the UK. It consists of Tanganyika (the mainland) and Zanzibar (an archipelago). The Tanzanian mainland is divided into 25 administrative regions, 113 districts and 133 councils [10]. Tanzania is a democratic republic and the constitution guarantees political pluralism. Tanzania is politically stable and in October 2015 held its fifth general election since it transitioned to a multiparty democracy in 1992 [10]. Tanzania is an ethnically diverse country where more than 120 languages are spoken; the national language is Swahili and the official language English.

Tanzania is one of the fastest-growing economies in East Africa, mainly due to its natural resources and tourism. It has a stable economic growth, with an average annual GDP (gross domestic product) growth rate of 7 percent in 2015 and a low inflation rate of 5.6 percent in the same year [11].

The Tanzanian economy depends heavily on agriculture, which accounts for more than one-quarter of GDP, provides 85 percent of exports, and employs about 80 percent of the female labour force and 72.7 percent of the male labour force, based on data from 2005–12 [10]. The main agricultural export commodities include coffee, tobacco, tea, cotton and sisal [11].

Despite promising economic growth and the vision of the government of Tanzania becoming a middle-income country by 2025, poverty levels remain unacceptably high. The Household Budget Survey 2012 estimated that 28.2 percent of the population of Tanzania were poor and 9.7 percent extremely poor. Poverty is estimated to be more prevalent in rural areas (30 percent of all households) than in urban areas (22 percent) [11].

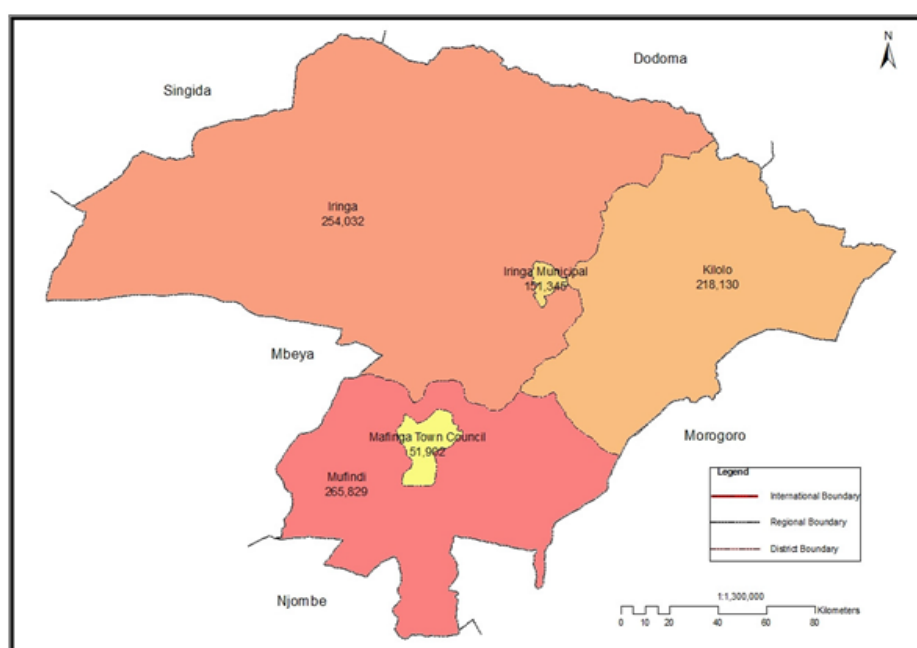
Tanzania's main development priorities (according to the Tanzania Development Vision 2025) include increased agricultural productivity; good governance and political stability; investment in good health systems; raising education quality; increased access to water; and improved availability of electricity [10].

Despite good progress in health, undernutrition remains a public health challenge in Tanzania. Childhood stunting levels are high and so are micronutrient deficiencies (especially vitamin A, iron, iodine). Thinness affects 5.5 percent of all women aged between 15 and 49 years in Tanzania and about one-third are deficient in iron, vitamin A and/or iodine. Overweight is also an increasing health concern, with more than 20 percent of women in rural areas being classified as overweight [12].

4.2 Regional level: Iringa

Iringa region consists of five districts: Iringa Rural, Iringa Urban/Municipal, Kilolo, Mufindi and Mafinga town (see Figure 3). Iringa Municipal and Mafinga Town have no rural component. Iringa district was established in 1964 from the Southern Highland Province. Both Mufindi and Kilolo were created from the Iringa district in 1970 and 2006 respectively.

Figure 3 Map of Iringa region



Source: [13]

Literacy: The adult literacy rate in Iringa is high (81.9 percent of all adults) [13].

Health and nutrition: High levels of malnutrition constitute one of the major health challenges of this region (see Table 3). Stunting, in particular, is very high among children under age five years in Iringa, at 51 percent. Factors that contribute to high levels of malnutrition include: (1) sub-optimal child feeding frequencies because of high work/farm burden; and (2) inadequate number of nutrition staff at local government authorities [13]. Access to health services is reasonably good and a large proportion of women receive antenatal care from a skilled health provider (see Table 4).

Table 3 Key indicators of child nutrition in Iringa

Indicators	%
Stunting (children 0-59 months)	51.3
Overweight	4.1
Prevalence of anaemia	45.6

Early initiation of breastfeeding	75.5
Exclusive breastfeeding (0-5 months)	62.7

Source: [14]

Table 4 Key indicators of women's health in Iringa

Indicators	%
Women receiving ANC from a skilled provider	97.3
Women delivering at a health facility	80.4
Women with anaemia	28.3

Source: [14]

5 Key findings on assumptions behind the ToC of mNutrition

This section analyses the assumptions behind the ToC, drawing on baseline data from all three evaluation streams. For each assumption we assess whether the assumption ‘fully holds true’, ‘largely holds true’, ‘only partially holds true’ or ‘does not hold true’. Assumptions regarding external or contextual factors, the implementation and causal links between the mNutrition services and the expected impact are all explored. As households did not have access to the mNutrition service at the baseline stage, it is too early to discuss assumptions related to service design, content of the messages or actual change of behaviours

5.1 Assumptions that underpin the customer journey

5.1.1 Pregnant women and mothers can access mobile phones to subscribe & use service

This assumption **largely holds true**, although tightly controlled access to and use of mobile phones may prevent some pregnant women and mothers from accessing mNutrition messages.

Mobile phone ownership was high across the evaluation sites, with 59 percent of women and 91 percent of men reporting that they owned a mobile phone. While fewer women owned a mobile phone, most women could get access to a mobile phone if needed (e.g. their spouse’s or the neighbour’s mobile). However, the qualitative data suggests that mobile phone access was often strictly controlled and monitored by the owner (usually their spouse). Young and recently married women in particular were often excluded from regular access and ownership of a mobile phone by their husbands.

Mobile phones were generally perceived as an individual and personal device only to be shared temporarily and in emergencies. The practice of regular mobile phone sharing was uncommon mainly due to trust issues between spouses. Several women who owned a mobile phone explained that their husbands had bought their mobile phones and that therefore their husbands could (and in several cases would) withhold the phone if they had doubts about their wives’ use of the phone.

Several women did not own a mobile phone handset but owned a SIM card that they used in the handset of neighbours or family members. This way they had some control and privacy (e.g. the telephone numbers of their personal contacts saved on the SIM) even without owning a phone. This practice would also allow women who do not own a mobile phone to subscribe to WN plus mNutrition service using their SIM card.

5.1.2 Pregnant women and mothers of young children can get sufficient network signal coverage and strengths to subscribe & use service

This assumption **fully holds true**. mNutrition is provided by all mobile network operators in Tanzania.³ To ensure that households could get access to mNutrition, mobile network coverage was also one of the selection criteria for the quantitative sample selection. Consequently, all villages had network coverage at least in some parts of the village (usually Vodacom, Tigo and/or

³ The qualitative midline and the quantitative endline will explore whether there are any differences in the provision of mNutrition across the different MNOs.

Halotel). The qualitative data suggest that while network coverage was available, there could be occasional coverage holes (in particular on the tea plantations in Mfundi) and indoors.

To access the best network coverage for each location (e.g. across different villages but often also within the same village) and to access the best tariffs, many interviewees owned SIM cards from different service providers and frequently manually exchanged their SIM cards.

Therefore, while network coverage seems to be adequate, multi-SIM card use was common and may lead to mNutrition messages being missed.

5.1.3 Pregnant women and mothers are literate and comfortable with receiving SMS messages

This assumption **fully holds true**. Both the quantitative and qualitative data suggest that the majority of women are comfortable with receiving SMS messages. The quantitative survey found that 62 percent of all women (and 84 percent of men) received an SMS in the last 14 days. High levels of literacy (94 percent of women reported to have some formal education) further increased women's receptiveness to SMS messages.

In the qualitative interviews, several women highlighted that they often preferred to receive information through SMS rather than voice calls as messages were more private and could not be overheard.

5.1.4 Pregnant women and mothers have enough money to use the service

This assumption **fully holds true**. mNutrition is provided free of charge in Tanzania and subscribers will continue to receive mNutrition messages for a limited period of time⁴ even when their phones run out of credit. Women spend on average 2,450 TZ shillings (£0.78) per month on airtime, whereas men spend 7,941 TZ shillings (£2.50). For many women, the purchase of airtime could pose both economic as well as logistical challenges (as they had to travel to the next village to buy credit). As a consequence, respondents frequently went without credit for several days or weeks but seldom for long enough to trigger a deactivation of the SIM card.

5.1.5 Pregnant women and mothers have access to electricity to charge their mobile phones regularly

This assumption **only partially holds true** as the majority of households did not have access to electricity and had to charge the mobile at a mobile phone kiosk or another place.

Access to electricity to charge mobile phones posed a challenge and only 46 percent of women were able to charge their phones at home. Households without access to electricity usually charged their mobile phones for a fee at the nearest mobile phone kiosk (97 percent of those households reported to have charging facilities less than 30 minutes away from their house). In households where both men and women owned a mobile phone, charging the man's phone was a priority. This is corroborated by the quantitative data, which suggest that men spent almost double the charging fee that women spend per month (1,813 versus 988 TZ Shillings).

⁴ If new credit is not bought within a period of 90-180 days (depending on MNO) the SIM card will be automatically deactivated.

The qualitative data also found that charging the mobile phone at a kiosk (especially a kiosk outside the village) was a logistical challenge for many women. Women often had limited mobility due to farming and household chore commitments and also because of social norms that restricted them from travelling outside their village. As a result, mobile phones that ran out of power often remained switched off for several days. This means that mNutrition messages could be missed.

5.1.6 There are no social norms or attitudes that may hinder pregnant women and mothers from engaging with mobile phone-based information services

This assumption **largely holds true with** both qualitative and quantitative data suggesting that the majority of households (82 percent) would be receptive to and would trust a mobile phone-based information service on nutrition.

In the qualitative interviews, mothers and pregnant women expressed the opinion that mobile phone-based information could offer an inexpensive and convenient channel for new information. They also liked the fact that SMS messages could be read repeatedly, were private (in contrast to information they received during village meetings or public child growth monitoring sessions) and had the potential to be very timely (i.e. women receive the information they need at the time they need it).

Household attitude towards MNOs was predominantly neutral and is therefore unlikely to pose a barrier to the uptake of mobile phone-based messages.

However, the controlled access to mobile phones (and thus mobile phone-based messages) that many women described, may pose a barrier to engagement (see also 5.1.1).

5.1.7 Unwanted mobile spam does not interfere with/distract from mNutrition services

This assumption **only partially holds true** as mobile spam was perceived a challenge and major distraction by many women. In the qualitative interviews, households frequently complained about mobile spam – meaning unsolicited text messages, especially advertising. While a few unsolicited messages were perceived as informative (e.g. details on birth registration, news) most were seen as a disturbance. Most spam messages were read before being deleted. However, some interviewees said that they had started to delete all spam messages without reading them.

Households frequently pointed out that the number or name of the sender of an SMS message helped them to determine whether it is spam or worth reading. At the time of the baseline data collections mNutrition messages were sent from a 15001 number. Several interviewees said they were generally suspicious of 15*** numbers, as many promotional messages are sent using this number.

If women miss or disregard messages or message notifications, believing the message to be spam, this could negatively impact on the uptake of mNutrition messages. Mobile spam might also fill up women's in boxes, making it impossible to receive new messages.

5.2 Assumptions that underpin the nutrition impact pathway

5.2.1 Pregnant women and mothers have information gaps related to nutritional practices

This assumption fully **holds true**. The quantitative baseline survey used 11 questions to assess pregnant women's and mothers' current IYCF knowledge levels and practices. The questions covered breastfeeding, complementary feeding, and other health and nutrition topics. The assessment suggests medium knowledge levels, with pregnant women and mothers having, on average, 56 percent correct answers.

The assessment suggests that women are more knowledgeable about breastfeeding practices than they are about the potential benefits of different micronutrients for children. Roughly a quarter of women answered each of the five questions about breastfeeding practices incorrectly. In comparison, more than a third of women answered each of the questions related to micronutrient incorrectly.

More specifically, fewer women were able to identify foods rich in vitamin A (58 percent of females; 61 percent of males) or iron (26 percent of females; 32 percent of males), list the potential consequences of diets deficient in iron (21 percent of females; 25 percent of males), or correctly name a strategy for protecting children from intestinal worms (9 percent of females; 10 percent of males).

The qualitative data support these findings and also highlight that most women had good general knowledge on IYCF practices but lacked specific (often practical) information (e.g. regarding the management of breastmilk supply, nutrient rich foods).

The specific information needs of pregnant women included advice on how to prepare healthy low-cost meals to promote good child development, how to eat healthily in spite of food cravings and morning sickness, and where and how to get low-cost iron supplements. Breastfeeding mothers had questions around milk supply management, breastfeeding during mother's sickness, and combining breastfeeding with work commitments. Finally, mothers of young children were concerned about how to prepare low-cost complementary foods that are easy and quick to prepare. Lishe porridge, recommended by health workers as the best complementary food, was time consuming to prepare and also required many ingredients that women could not afford on a regular basis.

These findings suggest that mNutrition could help to address existing information gaps among pregnant women and mothers, especially if the information provided is specific (given that general knowledge was already relatively good).

5.2.2 Pregnant women and mothers lack access to credible information on nutritional practices

This assumption **only partially holds** as most women had at least some exposure to information on IYCF practices. However, there is a lack of credible in-depth information that might be addressed by WN plus mNutrition. Both the qualitative and the quantitative data suggest that pregnant women and mothers perceived government health workers as the most trusted formal information source on health and nutrition (98 percent of households agreed they would trust a government health worker). In line with this, 80 percent of households said that their most

important source of health and nutrition information were government health workers and 17 percent of households mentioned other health workers (e.g. NGO).

Most pregnant women and mothers with children had received at least some information on IYCF from health workers during their antenatal visits (99.8 percent of women attend at least one visit and the average number of visits was four). However, both the qualitative and quantitative data indicate that the number of services women received during antenatal visits was high (including pelvic examination, different clinical tests, supplement administration, checks for obstetric complications). Consequently, the time for nutrition advice during antenatal visits was very limited and the advice provided was seldom in depth. While a few mothers also said they had received nutrition advice during the child growth monitoring sessions, most had not.

In the qualitative interviews, many women said they could ask a health worker if they had specific questions on IYCF, although lack of time often prevented them from doing so.

5.2.3 Improved drinking water sources and sanitation are available

This assumption **only partially holds true** as only three-quarters of all households had access to improved sanitation and 82 percent had access to improved drinking water sources. The remaining households had to rely on unsafe, not improved sanitation and/or water sources, which increase the risk of diarrhoea and worm infestations (both of which have been linked to undernutrition[15]).

The qualitative data also suggest that households that have access to improved drinking water may not always use these sources. For example, in Iringa Rural a shortage of drinking water and lack of money to purchase water from water vendors regularly forced households to resort to unsafe drinking water sources (e.g. river water). Similar constraints also apply with regards to improved sanitation; while households might have access to sanitation facilities, open defecation was still common and practised in the evaluation areas (thus increasing the risk of intestinal infections of children).

Access to improved sanitation and drinking water may be a limiting factor for the improvement of child nutrition.

5.2.4 Pregnant women and mothers have sufficient time and resources to improve child feeding practices

This assumption **does not hold true** as most women lacked both time and resources to improve feeding practices. Based on the quantitative baseline survey, 77 percent of women work in agriculture (on the household's farm or tea plantations). The qualitative data suggest that petty trading and small business were other common economic activities of women (especially in Mufundi). Work often placed a considerable physical strain and time burden on women and forced them to condense time and energy spent on household chores and child care.

Many women (in particular women who worked on tea plantations) also were away from the home for long periods of time. Various child care arrangements were in place when mothers were absent and could not take young children with them (older siblings, grandmothers, neighbours).

Maternal work and the associated time and energy demands of work may pose a barrier to improving child feeding practices.

Household poverty emerged as the main barrier to improving dietary intake during pregnancy and IYCF in all six villages. In the qualitative interviews women frequently said that they are unable to purchase nutritious varied foodstuffs from local markets.

5.2.5 Pregnant women and mothers have access to and use antenatal care services

This assumption **fully holds true**. The quantitative data suggests that most women received antenatal care (99.8 percent) and most also met the government recommendations of four visits during pregnancy. Coverage of the different antenatal care services (recommended in the government guidelines) was good to very good. In particular, iron supplementation during pregnancy (94 percent of all women received iron supplements) was very high.

Government guidelines recommend that the first antenatal care visit should take place prior to week 16 of pregnancy. Based on the quantitative data, women in our sample attended their first visit on average in week 16 and were thus just meeting the guidelines. Women are asked to bring their partners to the first antenatal appointment but the qualitative data showed that many women delayed this appointment because their husbands refused to go with them. This was because the men were concerned about being tested for HIV/AIDS during this appointment. Earlier antenatal visits are more beneficial as there is more time to prevent nutritional deficiencies in both mother and the growing embryo.

5.3 Assumptions underpinning the commercial viability pathway

5.3.1 mNutrition services target viable customer segments

This assumption **largely holds true** as mobile phone ownership and literacy levels are relatively good among the targeted users. The Wazazi Nipendeni service explicitly accommodates four categories of users:

- Pregnant women
- New mothers
- Supporters (of pregnant women or young mothers)
- General interest.

A limiting factor was revealed by the qualitative research, which found that many husbands control their wives' access to mobile phones. Husbands are, therefore, a key customer segment, and indeed are accommodated in the Wazazi Nipendeni service as supporters of pregnant women. Moreover, men are clearly targeted in the Wazazi Nipendeni campaign materials, which focus on the role of couples in bringing up children.

This is in contrast with findings from the qualitative research that men are generally supportive of receiving messages on nutrition and child health, and women can see the advantage in their husbands receiving messages. Women felt that sending messages to men would help engender a sense of responsibility for health and nutrition in the family, which is key to improved nutrition, given that it is men who are the main decision makers regarding food to buy and crops to grow [16]. Men recognised that the efficacy of messaging could be improved by sending messages to both husbands and wives, as they would then be more likely to discuss issues, although there was no suggestion that messages should be sent to men in preference over women.

The fact that the service is text-based will mean that it is likely to be of limited value to illiterate sections of the population. Although adult literacy rates for the population as a whole are around 80 percent,⁵ rates are much higher among the young – literacy among young women (aged 15-24) was 85 percent (2012).⁶ This still leaves a substantial proportion of the potential target group who may be unable to access the Wazazi Nipendeni service.

5.3.2 The value proposition of mNutrition satisfies the identified customer segments

Based on baseline findings this assumption **largely holds true** as pregnant women and mothers have information gaps and needs related to nutrition and health during pregnancy and early childhood, and while access to credible information is possible it is often difficult and not a priority due to limited time. To ensure that messages are perceived as valuable and useful it is important that they are carefully tailored towards specific stages of pregnancy, mothers' previous experiences (e.g. whether this is the first or subsequent pregnancies), and different stages of early childhood.

The original Wazazi Nipendeni multimedia campaign directed women to health services, and to the text messaging service. The aim of the original SMS content was to encourage women to avail themselves of health services targeted at improved neonatal health outcomes, and this is still the case. This original content covered a range of pregnancy and motherhood topics and included a number of nutrition-related messages. The mNutrition project provided an opportunity to strengthen that content and to supplement it with a substantial additional body of nutrition content. Nutrition content has been added in two stages. First, 31 messages were added that coincided with the scope of the Wazazi Nipendeni existing messages (covering pregnancy and up to 16 weeks post-partum). Later, a further 128 messages were added, covering life stages up to five years of age. Subscribers to the text messaging service receive an average of 3-4 messages a week across several safe motherhood topic areas. The text messages provide women with information that is consistent with advice given by health workers in the field.

A key feature of the value proposition of WN plus mNutrition services is the timeliness of the information. This is one area where the partnership with the Tanzania Food and Nutrition Centre (TFNC) adds value to the service, as TFNC is responsible for ensuring that the content is accessible and consistent with national nutrition strategies. A total of 62 factsheets, 990 SMS and 312 voice transcripts were created. TFNC was the government agency responsible for signing off content at the end of the content generation process. TFNC adopted a much more proactive role than just approving content. TFNC did not work alone in approving final content, but shared responsibility with other members of the National Nutrition Social and Behaviour Change Communication Technical Working group. The National Nutrition Strategy calls for a Social and Behaviour Change Communication strategy to guide behaviour relating to nutrition activities. The Technical Working Group reports to the High Level Steering Committee on Nutrition, which is chaired by the Prime Minister's Office [17]. This illustrates the importance for the content-generation process of forging alliances with existing structures within the country.

To facilitate the design of the WN plus mNutrition messages and address customers' needs as best as possible, different pieces of end user research were conducted in the design phase (including research by GeoPoll, Think Place and frog). The end user research developed different

⁵ <http://data.worldbank.org/indicator/SE.ADT.LITR.ZS?locations=AF>

⁶ <https://www.indexmundi.com/facts/tanzania/literacy-rate>

personas of WN plus mNutrition users and the messages were tailored to address users' specific needs.

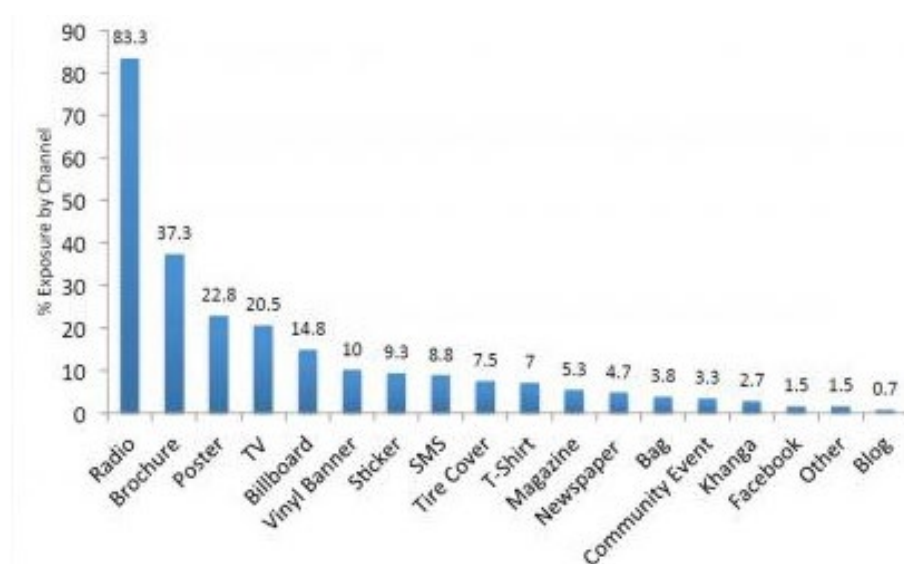
5.3.3 Channels for reaching the customer remain in place and customer relationships are able to reach and maintain the desired customer segments

This assumption **fully holds true**. As a multi-media campaign, WN plus mNutrition targeted women through a comprehensive range of channels:

- Mass media: TV, radio, newspapers and magazines
- Print media: brochures, billboards, vinyl banners
- Other promotional items: stickers, tyre cover, t-shirt, bag
- Electronic media: SMS service, blog
- Social media: community events, Facebook

Radio was the single channel that achieved greatest reach during phase 1 of the campaign. Figure 4 presents results from a survey carried out in October 2013.

Figure 4 Women's exposure to campaign material



Source: [18]

Missing from the list above are field-based partners. There are three ways of registering for the Wazazi Nipendeni text messaging service:

- Self-registration – instructions were given in the multimedia campaign. People dial the shortcode and then are guided through a small number of profiling questions (category of user, and stage of pregnancy/age of child).
- Assisted by health facility worker – women can be signed up when they come for ANC visits, etc.
- Assisted by community health workers – community workers can sign up women when they visit them in their homes or other local venue.

Assisted registration, either in communities or in facilities, is facilitated by representatives of on-the-ground partners who have been trained. Partners will typically have invested time and effort in developing programme materials in collaboration with the public-private partnership (PPP), for

which PPP will usually have provided some training, so training on text service registration processes can be included at marginal additional effort. In this scenario, the mHealth Tanzania PPP only has to pay travel expenses for trainers – partners are sufficiently keen for clients to be registered with Wazazi Nipendeni that they are willing to pay for the additional training. Frog research, based on in-depth interviews, found that users prefer assisted registration.

TFNC believes that there is a qualitative difference in the user experience between users who were assisted with registration and those who used the self-registration process. They believe that people who engage with a health professional in order to register on the system are more committed to the service and will have a positive bias to comply with messaging. They also suspect that contact with a health professional will give them a better understanding of how the service works, so they are less likely to become frustrated with the service and are more likely to appreciate how they can benefit from the service.

The qualitative baseline research found that the government was widely regarded as a trustworthy source of information.

In addition to literacy constraints associated with text messaging, SMS only facilitates one-way communication, yet the qualitative research clearly shows that channels that encourage active interaction and communication are preferred. For example, mothers like educational group seminars and counselling by health workers, as they provide an opportunity to ask questions.

Wazazi Nipendeni has a strong brand, which is quite distinct from the MNOs that support the service, and it is asserted that users view it as a Ministry service. People view Wazazi Nipendeni messages as coming from the government, as it is the government that has pushed it through the media. Therefore, people do not necessarily realise that messages are coming through the MNO, nor do they appreciate that the MNOs are paying for the messages. The mHealth Tanzania PPP is not concerned that MNOs might assert greater ownership of the service, because the government has recently increased its commitment to the service and is interested in increasing its ownership of the service. Originally Wazazi Nipendeni was branded as a Centers for Disease Control and Prevention (CDC) programme, but gradually the CDC logo is being reduced and the Ministry logo enlarged. The change in branding reflects an aspiration within the mHealth Tanzania PPP that the Ministry will adopt the service fully as part of its core activities.

Another aspect of branding is the image that the service fosters among customers. In their early customer research, frog made an interesting observation that ‘soft’ branding was more likely to foster a positive image (and greater compliance) than direct marketing. Soft branding was described as building an emotional connection with customers, whereas direct marketing is an approach designed to sell specific products. They embellished this further by suggesting that messages should be tailored to emphasise health, and they should be family focused. This approach was then reinforced still further in the new creative design used for branding phase two of the campaign, launched in July 2015.

5.3.4 Revenue streams, both direct and indirect, fulfil the key performance indicators required by the supply partners

This assumption **only partially holds true** and applies mainly to indirect revenue. Wazazi Nipendeni is free of charge to users, so there is no direct revenue stream. It was originally envisaged that information would be made available using a freemium model, which would enable the service to cover costs of the nutrition content delivery. However, late in 2016 the mHealth Tanzania PPP and the TFNC held intense negotiations over whether or not Wazazi Nipendeni

would be permitted to charge for these information services. In the end, the government insisted that health information should be made available to citizens free of charge.

The mHealth Tanzania PPP is funded primarily through CDC, although in-kind contributions are made by MNOs through the zero-rating of SMS messages sent out (and USSD (Unstructured Supplementary Service Data) sessions for assisted registration). The Ministry of Health is also providing financial support for the new platform. The result is that the service is vulnerable to any withdrawal of funding from CDC, and to a termination of the zero rating of text messages by the MNOs. Both Wazazi Nipendeni and GSMA remain keen to find a commercially sustainable model and have taken steps to address this vulnerability. GSMA convened a workshop of mNutrition partners in February 2017 specifically to explore business models and sources of revenue. In the assessment of the business model it is noted that this is a not-for-profit model. A high reliance on CDC for funding is noted for diversified revenue streams, and the inability to charge users means a vulnerability regarding charging what users are willing to pay.

However, indirect revenues may be included even though the mHealth Tanzania PPP deals mostly with Corporate social responsibility (CSR) departments within MNOs (but also marketing), it is seen as a commercial offering in that it increases average revenue per user (ARPU) and reduces churn. Over and above the effect that VAS has on loyalty, some of the messages distributed by the platform encourage women to communicate with their friends and family, which encourages them to make more calls. The original Wazazi Nipendeni content offered the potential of holding customers on the network for up to 12 months (eight months of pregnancy and four months post-partum) but incorporating nutrition content covering children up to the age of five years now potentially extends the period of relevance to over five years. The Wazazi Nipendeni VAS is regarded by MNOs as good value when compared with the cost of getting a customer back on to a network after they have left – mostly marketing costs, but also the costs of agents and registration. Now that the service has migrated to the new mHealth platform, the user's phone number is their unique identification. This eliminates the possibility of accessing the service using multiple SIMs, and effectively ties the users into their current operator. This may not be the case for long, though, because number portability (the ability to change operator but keep the same phone number) was introduced in Tanzania in March 2017.

Despite their considerable support for Wazazi Nipendeni in the form of zero-rated SMS messages, it is not clear that any of the MNOs have actively promoted the Wazazi Nipendeni service. Within Airtel, for example, responsibility for Wazazi Nipendeni rests with the CSR department, but even they are not focused on the service. When the CSR department presents their projects at public events, no mention is made of Wazazi Nipendeni. This may be because it has no budget line in CSR, and neither does it take up any time – it's just there. Other Airtel CSR projects include the Opportunity for Youth programme (Airtel Fursa), which takes a lot of time to select beneficiaries and then provides them with financial assistance, for example to buy new tools. A zero-rating SMS message is an opportunity cost rather than a direct cost, so it seems to be a hidden cost, in much the same way as the government mandates MNOs to zero-rate emergency calls to the police.

Why do MNOs supporting Wazazi Nipendeni not promote it? Most MNOs publicise within their advertising and promotional materials any VAS offered as part of any bundle for the very reason discussed above, that these services can increase loyalty. In principle, there is potential for tension between promoting Wazazi Nipendeni and the cost to MNOs of sending messages. Getting more people registered would increase the opportunity cost that the MNO would need to bear in terms of zero-rated messages. There appears to be scope for MNOs to capitalise further on their existing support for Wazazi Nipendeni, and again it appears that GSMA is addressing this opportunity.

From the government's point of view, the Wazazi Nipendeni text messaging service offers a means of increasing the effectiveness of their work on improving nutrition throughout the country.

5.3.5 Key suppliers make resources available after seeing the performance of mNutrition

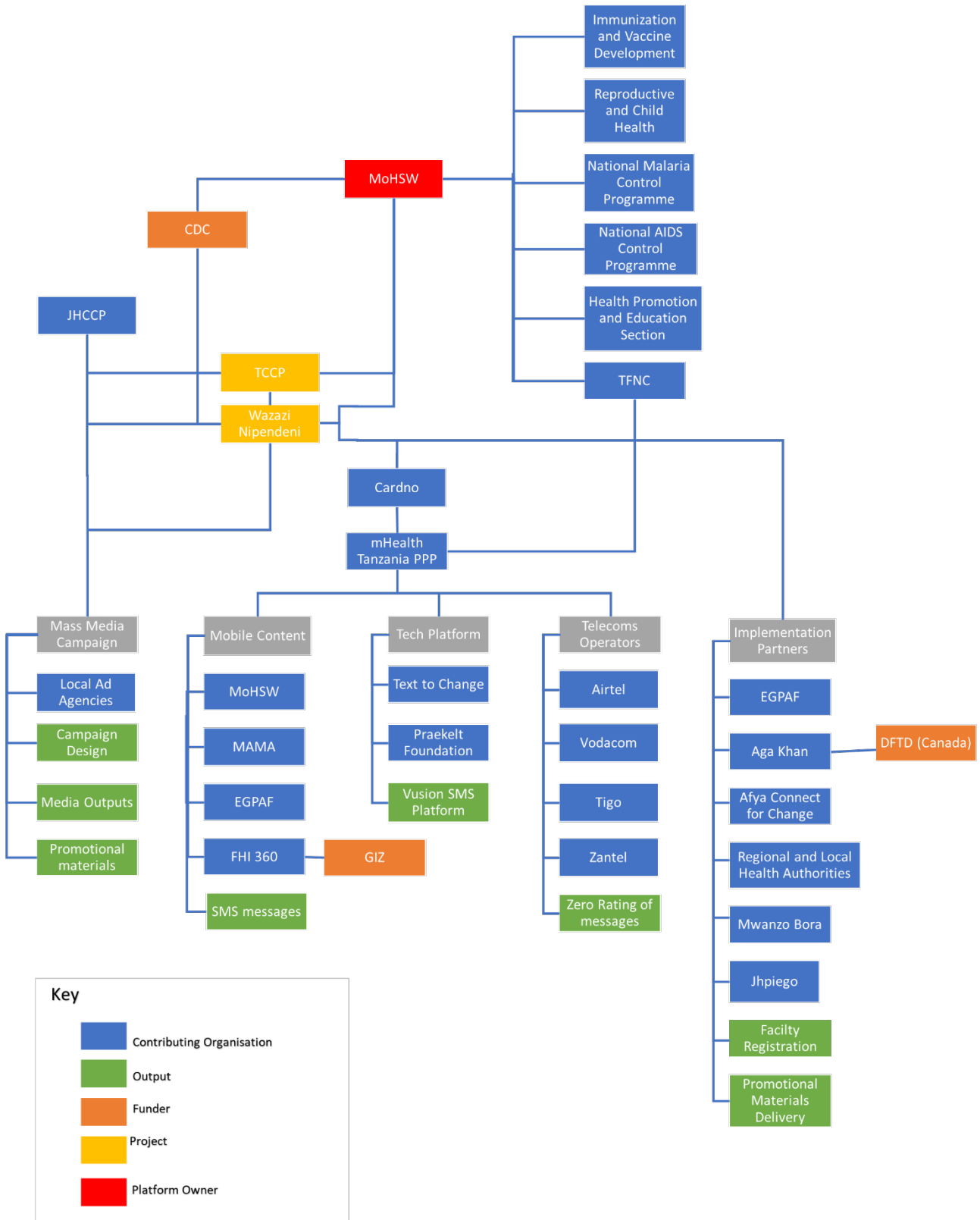
This assumption **only partially holds**. The primary assets employed by the mHealth Tanzania PPP in delivering the text messaging service are the content database and the applications platform that sends scheduled messages. The text messaging service originally ran on a platform developed by Text to Change Mobile (TTCM) in partnership with the Praekelt Foundation. The 'Vusion' platform was designed to deliver high volumes of messages at scale through direct connections to MNO SMS gateways, or aggregators. In Tanzania, they partner with a local aggregator who has connections to the associated MNOs. It is interesting to note that TTCM has also made Vusion an open source project, so it is freely available for others to use and modify. Wazazi Nipendeni has since migrated to a new platform, created for the Ministry of Health by a local software developer (Rasello). The service was migrated to the new platform in October 2016, and benefits from improved reliability as well as monitoring and reporting facilities.

The text messaging service is not intended to operate in isolation, rather it is expected to serve as part of a multi-media campaign, so these interventions are a key resource required to deliver the full potential of the value proposition. Various campaigns and partners have been involved in the development of the text messaging service and the content database. Although existing Wazazi Nipendeni users are currently receiving the updated content, including the nutrition messages, the TFNC has yet to officially launch the nutrition content. It is expected that this will include a concerted effort to network with organisations involved in nutrition interventions, with a view to promoting the text messaging facility available through Wazazi Nipendeni, and to enter into the next phase of partnerships with field-level agencies.

5.3.6 Key partnership in the supply chain are valued by each partner and maintained

This assumption **fully holds true** (assuming one allows an ebb and flow of partnerships). The complex set of partnerships brokered by the mHealth Tanzania PPP and TFNC is a defining feature of the Wazazi Nipendeni service. Organisations that have contributed to the development of the Wazazi Nipendeni text messaging service (prior to the mNutrition project) are illustrated in Figure 5.

Figure 5 Organisations involved in Wazazi Nipendi



Source: [2]

5.3.7 The partnerships are ever evolving, and in general look strong

Strong support from government, and the successful engagement of implementing partners, suggests that support for the service (including financial support) is likely to continue to be forthcoming, so there is positive sustainability of revenue streams, and little danger of losing partners. Also, nutrition is a high priority so there is little threat from competing health care priorities. A balance of cost, expenditure, investment and income, both direct and indirect, make for sustainable commercialisation

This assumption **only partially holds**. Where possible, the team has collected and collated the costs for the Wazazi Nipendeni service. These costs, particularly ongoing ones, have changed and are likely to change further as the service offering is adjusted. Some cost data is incomplete, and with the introduction of a new platform, the ongoing costs are likely to change. As a baseline then, we have 'sketched' the costs in order to identify the gaps to be filled during the coming months. It has been difficult to draw out the relevant costs due to the complexity of the Wazazi Nipendeni partnerships, the nature of the nutritional component, building on what has gone before, and the lack of a single budget for the intervention.

Only the cost of message scheduling and the cost of sending the SMS messages themselves have been assumed to be variable costs. These costs have been based on estimated average numbers of users of 200,000 in Year 1, and 220,000 in Year 2. If we assume an attrition rate of 20 percent at the end of Year 1, then out of the 220,000 users in Year 2, 160,000 continued using the service from the previous year, and 60,000 would be newly registered in Year 2. The total number of people using the system over the two-year period would then be 260,000 (200,000 in Year 1 plus 60,000 new registrants in Year 2). This would give a figure of £3.70/user. If it can be assumed that there is no material cost to the MNOs of sending the SMS messages, then this ratio drops to £1.90/user. Although interesting, these figures have little meaning in isolation as they take no account of any impact achieved.

With the caveat that the figures are based largely on assumptions and estimates, a number of points arise from the relative magnitudes of categories of costs:

- The value of SMS messages delivered accounts for almost one half of operational costs.⁷ Even if bulk purchasing meant that these costs could be halved, they would still represent the largest single cost component, which emphasises the importance of private sector partnerships to the continued operation of the service. Total costs are, therefore, highly dependent on the in-kind contribution made by MNOs.
- Technical costs represent another large cost component (e.g. aggregator fees, systems administration). As a largely fixed cost, this can be spread across hosted services. If the government introduces additional mHealth services, these costs can be diluted. As fixed costs, these are largely predictable.
- Another large component is personnel costs. Given the specific set of networking skills present in the mHealth Tanzania PPP, it is unlikely that a government department (or any other party for that matter) could simply appropriate the service using their existing staff; the costs of dedicated, specialised team would need to remain.

Although a large number of organisations have invested in Wazazi Nipendeni and the text messaging service over the years, they have done so on a grant or expenditure basis, i.e. there is no expectation of receiving any financial return on this investment.

⁷ These are based on a 'market' value of 65 TZS/SMS, which is the weighted cost calculated from MNO contributions reported by Cardno.

Most of the funding sunk into development of Wazazi Nipendeni has come from donors, which justify project costs incurred over the duration of the project in terms of the outcomes achieved, rather than in any kind of financial return.

5.3.8 Alternative approaches found in-country do not supersede the value proposition of the product

This assumption **largely holds true**.

There are currently 11 mHealth projects in Tanzania that are classified as having major reach: four deal with finance and insurance; six address various aspects of administration; and the one behaviour change communication programme is Wazazi Nipendeni [21]. This suggests that although there is a lot of interest in mobile health applications in Tanzania, few have reached scale, so it is difficult to find similar products to compare with Wazazi Nipendeni. However, with regards to information services there are several well-established and highly trusted alternative information sources in place including health workers, television and radio. In this context it should be noted that WN plus mNutrition service was never meant as a stand-alone intervention but aims to complement and reinforce other information services.

5.4 Implications of the assessment

Table 5 presents the findings of the baseline assessment of the assumptions that underpin the ToC of mNutrition. In the last columns we reflect on the potential risks of the findings of the assessment for the successful uptake and use of mNutrition (as described in the three components of the ToC) and suggest potential mitigation strategies.

Table 5 Summary table of the assessment of the assumptions underlying the ToC

Assumptions					Risks for the success of mNutrition	Suggested mitigation strategy
	Fully holds	Largely holds	Only partially holds	Does not hold		
	Customer Journey					
Pregnant women and mothers can access mobile phones to subscribe & use service		X			Reaching mothers and pregnant women could be challenging, due to exclusion from mobile phone ownership	To reach as many women as possible, promotion campaigns should not only target women but also men, who often control women's' access to mobile phones
Pregnant women and mothers can get sufficient network signal coverage and strengths to subscribe & use service	X				No specific risk could be detected	No mitigation strategy needed
Pregnant women and mothers are literate and comfortable with receiving SMS messages	X				No specific risk could be detected	No mitigation strategy needed
Pregnant women and mothers have enough money to use the service	X				No specific risk could be detected	No mitigation strategy needed
Pregnant women and mothers have access to electricity to charge their mobile phones regularly			X		mNutrition messages may be missed if the mobile phone runs out of battery and cannot be recharged	Promotion strategies could potentially highlight the importance of ensuring that the mobile phone is charged
There are no social norms or attitudes that may hinder pregnant women and mothers from engaging		X			Reaching mothers and pregnant women could be challenging, due to strict control of mobile phone access by spouse	To reach as many women as possible, promotion campaigns should not only target women but also

Assumptions					Risks for the success of mNutrition	Suggested mitigation strategy
	Fully holds	Largely holds	Only partially holds	Does not hold		
with mobile phone-based information services						men, who often control women's access to mobile phones
Unwanted mobile spam does not interfere with/distract from mNutrition services			X		mNutrition messages or notification of messages may be treated as spam and deleted without being read, especially if the message is sent from a 15*** number	Ensure that mNutrition messages are not sent through a 15*** number but a clearly identifiable sender
Nutrition Impact Pathway						
Pregnant women and mothers have information needs related to nutritional practices	X				No specific risk could be detected	No mitigation strategy needed
Pregnant women and mothers lack access to credible information on nutritional practices			x		All pregnant women and mothers have at least some access to information on IYCF and there is a risk that the content of the mNutrition messages does not add new information	Ensure that the mNutrition messages are based on context-specific analysis of information needs to address the specific information needs highlighted and information gaps identified
Improved drinking water sources and sanitation are available			X		If access to water and sanitation is not improved the effectiveness of nutrition-related behaviour change may be limited	mNutrition messages should promote the use of improved washing and sanitation facilities as well as hygiene behaviours
Pregnant women and mothers have sufficient time and resources to improve child feeding practices				X	Lack of time and resources is likely to be a major barrier to the adoption of new practices	mNutrition messages need to consider lack of time and resources to be successful in changing behaviours

Assumptions					Risks for the success of mNutrition	Suggested mitigation strategy
	Fully holds	Largely holds	Only partially holds	Does not hold		
Pregnant women and mothers have access to and use antenatal care services	X				No specific risk could be detected	No mitigation strategy needed
Sustainable Commercialisation Pathway						
mNutrition services target viable customer segments		X			While mNutrition is generally well targeted, there is a risk that some important customer segments are excluded (e.g. illiterate young women)	Explore different targeting mechanisms to ensure that all customer segments are covered (e.g. voice messages)
The value proposition of mNutrition satisfies the identified customer segments		X			No specific risk could be detected	No mitigation strategy needed
Channels for reaching the customer remain in place & customer relationships are able to reach and maintain the desired customer segment	X				No specific risk could be detected	No mitigation strategy needed
Revenue streams, both direct and indirect, fulfil the key performance indicators required by the supply partners			X		As mNutrition is free of charge there are no direct revenue streams for MNOs. This may limit MNOs' interest in actively promoting and delivering mNutrition	Explore other incentives for MNOs to encourage high levels of engagement and performance
Key suppliers make resources available after seeing the performance of mNutrition			X		As mNutrition messages are meant to be delivered as part of a wider Wazazi Nipendeni campaign, co-dependencies	Ensure that all suppliers are incentivised to perform

Assumptions					Risks for the success of mNutrition	Suggested mitigation strategy
	Fully holds	Largely holds	Only partially holds	Does not hold		
					exist and may pose a risk to sustainable delivery	
Key partnerships in the supply chain are valued by each partner and maintained	X				No specific risk could be detected	No mitigation strategy needed
A balance of cost, expenditure, investment and income, both direct and indirect, make for sustainable commercialisation			X		Most of the initial development of mNutrition was funded by grants. The sustainability of the intervention without grants may be a risk factor	No mitigation strategy identified
Alternative approaches found in-country do not supersede the value proposition of the product		X			No specific risk could be detected	No mitigation strategy needed

Drawing on the baseline data from the three evaluation streams, most assumptions behind the ToC of mNutrition fully, largely or partially hold. The only assumption that may not hold is related to women's time and resource availability to improve feeding practices. Consequently, mNutrition risks **being less effective** if it fails to:

- Consider women's existing work burden in agriculture and other areas and how these might conflict with improved child feeding practices (e.g. time demands for responsive child feeding techniques or the preparation of specific complementary foods)
- Consider women's financial resource limitations and how these might hamper improvements in child feeding practices (e.g. lack of money to purchase more varied food).

Other contextual factors that may **limit the effectiveness** of mNutrition if not addressed or considered in the programme design/marketing include:

- Limited or controlled access to mobile phones for women
- Illiteracy of some members of the potential target group who may be unable to access the Wazazi Nipendeni service, as it is text based
- Limited access to electricity and the associated risk of being offline for some time
- The risk that mNutrition messages are perceived as spam (especially important here is the number under which messages are sent)
- The role of government health workers as highly trusted information sources and how mNutrition messages can support/complement the work of health workers
- Poor access to improved sanitation and drinking water sources
- Ensure MNOs capitalise further on their existing support for Wazazi Nipendeni
- Operate as part of a broader multi-media campaign, as the text messaging service is not intended to operate in isolation
- Ensure that key suppliers including the local aggregator make resources available after seeing the performance of mNutrition
- That TFNC will make a concerted effort to promote the Wazazi Nipendeni facility to other organisations involved in nutrition interventions
- The costs of the dedicated, specialised team continue to be met and that in-kind contributions continue to be made by MNOs.

Among the most relevant programme components that could **contribute to the success** of mNutrition are those that focus on:

- Addressing pregnant women's and mothers' information needs (especially if the provided information responds to specific information needs identified by pregnant women/mothers themselves).

6 Key findings on the baseline characteristics of the impact indicators

This section will present the findings from the three evaluation streams on the baseline characteristics of the indicators that are intended to be changed because of the programme.

6.1 Women's dietary diversity

When asked about their perceptions of a 'good and healthy' diet, most women described varied diets with plenty of meat, eggs, dairy and vegetables. However, women reported that they seldom could afford such a diverse range of foods themselves but rather had to rely on starchy, relatively monotonous and simple diets. The quantitative survey corroborated these findings⁸ and found that women on average had low diversity in their diets (on average only 3.5 out of nine food groups were consumed in the 24 hours prior to the survey).

The qualitative data and the desk review [7] both highlighted that food insecurity was no longer a problem in Iringa. However, several barriers to a diverse diet were identified and need to be considered by mNutrition when aiming to improve the dietary diversity of women:

- a) Poverty was highlighted as the main barrier to women being able to afford more diverse diets.
- b) Availability of fresh foods (e.g. meat, fresh vegetables and fruits) in local markets was often very limited, seasonal and difficult to access (due to distance, cost related to travel).
- c) High workloads and time burdens of farm work/paid employment often prevented women from spending time on food preparation and on the purchase of fresh foods.
- d) Low diversity in households' agricultural production limited the range of foods available for household consumption.

6.2 IYCF practices

The quantitative survey assessed current IYCF practices based on mothers' reports on past practices for up to two children.⁹ Practices were examined for six core IYCF practices including:

1. Early initiation¹⁰ of breastfeeding
2. Exclusive breastfeeding for infants aged 0-5 months
3. Continued breastfeeding at 1 year
4. Introduction of solid, semi-solid and soft foods between 6 and 8 months
5. Minimum dietary diversity (children aged 6-23 months)
6. Minimum meal frequency (children aged 6-23 months).

The findings of the quantitative assessment suggest that the prevalence of these practices varied tremendously. Some practices were adequate for the majority of children (e.g. early initiation of

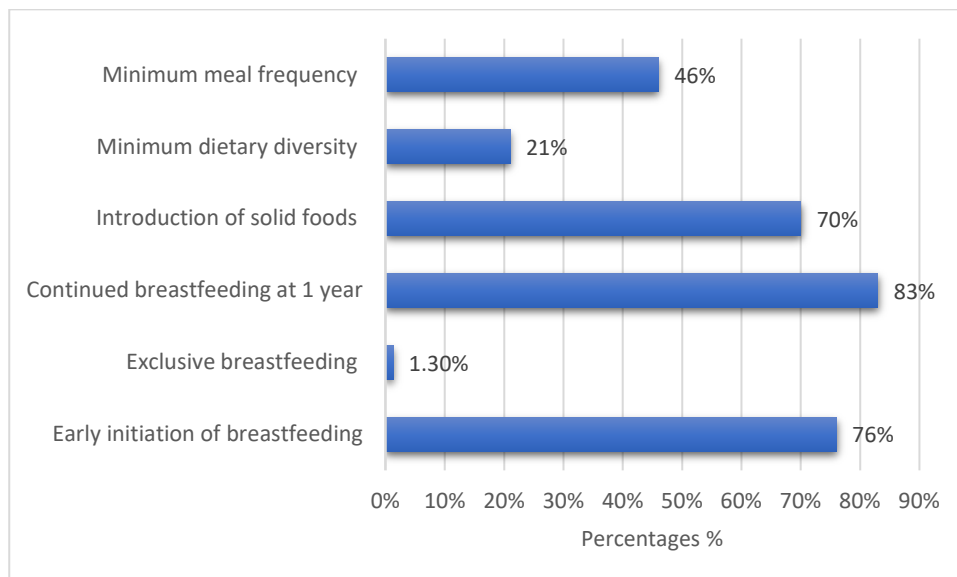
⁸ Women's dietary diversity is assessed using the Women's Dietary Diversity Score that is calculated based on a count of the number of food groups, out of a maximum of nine, from which the woman consumed during the 24-hour period preceding the survey. Kennedy, G., T. Ballard and M.C. Dop, *Guidelines for measuring household and individual dietary diversity*. 2011: Food and Agriculture Organization of the United Nations.

⁹ Mothers were only asked about practices relevant to the age of their children. For example, a mother of a 3-month-old infant was not asked about the diversity of her child's diet.

¹⁰ Children are put to the breast within one hour of birth.

breastfeeding, continued breastfeeding, introduction of solids) but other practices were sub-optimal for most children (e.g. exclusive breastfeeding, minimum dietary diversity, minimum meal frequency) (Figure 6). This suggests, that to successfully change IYCF practices mNutrition messages should focus on changing sub-optimal practices.

Figure 6 Infant and Young Child Feeding practices indicators (%)



Source: [4]

The qualitative data identified several barriers that need to be considered by mNutrition when aiming to improve the identified sub-optimal IYCF practices.

Barriers to exclusively feeding an infant aged 0-5 months breastmilk included:

1. Maternal employment (e.g. on tea plantations in Mfundi) and/or on the households' farm was often incompatible with exclusive breastfeeding as mothers were outside the home for long stretches of time and could not take their infants.
2. Limited support from husbands for exclusive breastfeeding (e.g. encouragement, help with chores and/or care for other children).
3. Belief that infant may not get enough breastmilk and needs additional foods/drinks to develop well.
4. Maternal alcohol consumption was common in three of the six qualitative evaluation villages and could interfere with mothers' desire to exclusively breastfeed.¹¹

Barriers to diverse diets and frequent enough meals for children aged 6 -23 months included:

1. Lack of money to purchase varied foods
2. Limited availability of fresh foods on local markets

¹¹ A previous study suggests that alcohol consumption is associated with stopping of exclusive breastfeeding earlier. Binns, C.W. and M.R. Giglia, *Influence of alcohol consumption on breastfeeding initiation and duration in Australia*. 2005, Alcohol Research Foundation: Perth, Australia.

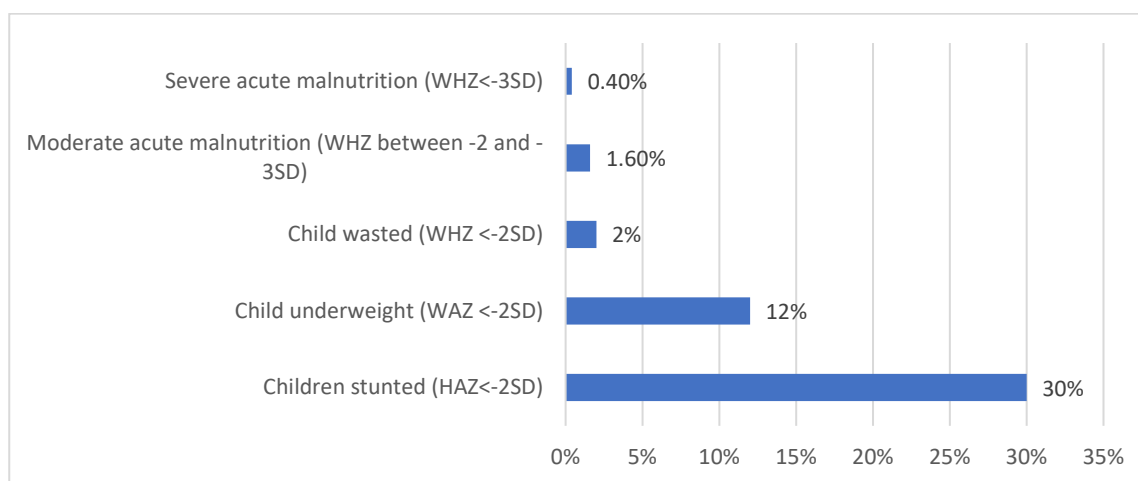
3. Difficult access to local markets
4. Maternal time allocation conflicts, and especially lack of time for food preparation and purchases
5. Frequent maternal alcohol consumption that may interfere with her ability to care for her children.

In the qualitative interviews women identified several specific information needs related to the core IYCF practices (see section 5.2.1) that mNutrition messages could address to effectively improve existing practices.

6.3 Nutritional status of children

The quantitative survey assessed children's nutritional status based on anthropometric measurements (i.e. weight and length/height) and used these measurements to calculate nutritional status indicators (Weight-for-Age; Height-for-Age; Weight-for-Height) and z-scores using World Health Organization (WHO) reference populations.¹² Findings are presented in Figure 7 and show that child stunting and underweight are both at a medium prevalence level in the evaluation sites (based on the WHO classification for assessing the severity of malnutrition among children under 5 years of age [21]). Child wasting is at a low level.

Figure 7 Undernutrition among children in the sample



Despite almost one-third of all children being stunted and 12 percent underweight, child undernutrition was not perceived as a problem by most qualitative interviewees (except by health workers). There was the common perception that undernutrition would be clearly visible and identifiable (e.g. thin body, swollen belly). As no child in their community had these signs, undernutrition was not seen as an issue. Many people also believed undernutrition to be a challenge from the past that was mainly associated with food insecurity and poor education about child care.

¹² Height-for-Age z-score (HAZ) is a measure of chronic malnutrition, with stunting (HAZ < -2) reflecting cumulative retarded growth. Weight-for-Height z-score (WHZ) is a measure of acute malnutrition, with wasting (WHZ < -2) reflecting a deficit in tissue and fat mass. Weight-for-Age z-score (WAZ) is a composite indicator of HAZ and WHZ, and thus captures both transitory and chronic aspects of malnutrition.

In contrast, most of the interviewed health workers and national experts pointed out that undernutrition (and in particular stunting) remained a challenge and was mainly linked to poor diets and lack of adequate water and sanitation.

These findings suggest that to successfully address child undernutrition, mNutrition should raise people's awareness of the different types of undernutrition.

6.4 Implications of the key findings

The findings from the baselines on women's dietary diversity, IYCF practices and children's nutritional status suggest there is some scope for improvement.

On average women had monotonous diets dominated by starchy staple foods with low nutrient density. While awareness of the components and benefits of a diverse diet was already reasonably high among most women, several contextual factors prevented them from consuming more diverse diets, with poverty being the main limiting factor. With women already aware of the health benefits of a diverse diet, the mNutrition messages could serve as reminder or refresher intended to prompt women to diversify their diets. This could be done either by accessing more nutrient-dense foods in markets or diversifying food production at home. The market-based approach is likely to be utilised less often by poorer households and those with more limited market access. The own-production approach depends on the household's comparative advantage at producing more nutritious crops and animal-sourced foods on their own farm.

While some IYCF practices were already in line with international recommendations (e.g. early initiation of breastfeeding, breastfeeding beyond the age of 1 year, and timely introduction of solids at 6-8 months) other practices were sub-optimal (e.g. only very few children were exclusively breastfed until 6 months, minimum dietary diversity and meal frequency were not achieved). mNutrition may be most successful in improving IYCF practices when messages focus on currently sub-optimal practices and take contextual barriers to these practices into consideration (e.g. maternal employment, time allocation conflicts, poverty).

In particular, child stunting was identified as a persistent challenge for many children in the evaluation sites. However, stunting often went unrecognised by community members, as it does not present with the 'typical' and expected physical signs of undernutrition (e.g. thinness). mNutrition may help to raise awareness of different types of undernutrition within communities.

7 Discussion and conclusion

This section summarises the key findings of our analysis of the assumptions underpinning the ToC as well as the baseline situation of key outcomes expected from the programme. The implications of the findings are also discussed. The outcomes are presented in the order in which they appear in the ToC.

Child undernutrition is common among measured children in the Iringa region of Tanzania. Despite being under the age of one year – and therefore expected to have a lower prevalence of stunting than children under five years of age who have had longer exposure to detriments to nutritional status – 29.6 percent of children in the mNutrition quantitative sample are stunted. This suggests that dietary inputs, the health and sanitation environment, and caring practices are inadequate, limiting growth for a large number of children in the sample. This stunting prevalence will continue to grow as these children age.

Information disseminated through the mNutrition programme aims to modify individual and household information sets and beliefs, which may then change nutrition-related practices and influence nutrition outcomes. The first step in this causal chain is the presence of gaps in nutrition knowledge among beneficiaries. Given these gaps, and contingent on the resources necessary to change behaviours and that messages can be effectively delivered to women through mobile phones, the mNutrition programme will be most effective if it targets knowledge deficits that are especially common and deemed particularly critical for determining nutrition outcomes.

As presented above, women in Iringa have clear knowledge gaps and they also struggle to access credible information to address these gaps. Improving nutrition knowledge of pregnant women and mothers of young children is the highest priority for many nutrition information campaigns because mothers usually play a leading role in nutrition-related caring practices.

The analysis of underlying assumptions found that most assumptions that can be assessed based on baseline data fully or largely hold true. However, there are a few assumptions that do not hold true or only partially hold true and that may pose considerable risks to the effectiveness of WN plus mNutrition services. Some of these assumptions can be addressed by the intervention while others clearly lie outside the intervention's influence.

One assumption that does not hold true is the perception that women (households) have sufficient time and available financial resources to act on the behaviour change messages and improve dietary practices during pregnancy, infancy and early childhood. Our baseline findings suggest that both access to time and money are likely to be major barriers to change. With regards to time mothers' work commitments in and around the house as well as outside the home (e.g. in tea plantations) are likely to negatively interfere with good breastfeeding and child feeding practices. Lack of available cash and competing priorities for the money that is available are likely to be constraints to purchasing healthier and more varied foods (e.g. animal-sourced foods). The WN plus mNutrition service cannot address these underlying limitations and they are likely to pose a significant risk to the effectiveness of the intervention. Nevertheless, the limitations should be considered carefully when designing text messages (e.g. text messages specifically targeted at lactating mothers who work full-time; recommendations for low-cost alternatives to animal-sourced foods).

An assumption that only partially holds true is the perception that unwanted spam messages will not distract from/interfere with WN plus mNutrition services. The qualitative baseline research suggests that spam messages are a concern for many households and that in particular messages sent with a 15*** number are often disregarded immediately as they are perceived as spam. WN

plus mNutrition messages are sent with such a number and there is therefore a considerable risk that messages might be deleted (especially if messages are received on a mobile phone that is owned by a different household member on behalf of the pregnant woman/mother). To reduce this risk, we strongly recommend that the intervention uses a different sender ID (e.g. Wazazi Nipendeni or similar).

One of the underlying motivations for mNutrition is the assumption that pregnant women/mothers lack access to credible information on child feeding and nutrition practices and that mobile phone-based services can help to address these existing gaps. While there are certainly knowledge gaps with regards to nutrition among pregnant women and mothers, no acute lack of access to credible information could be identified. In fact, most women had (at least some) access to credible information (e.g. health worker, radio, TV). In this context the value of WN plus mNutrition messages is likely to be a reminder of existing knowledge; in fact, the service has never been designed to operate in isolation but always meant as a complement to existing sources. Nevertheless, for the service to be perceived as valuable (above and beyond existing information sources) it needs to extend existing information (e.g. by facilitating operationalisation of information women receive during ANC visits), be more tailored and personalised to specific needs, and/or be more convenient to access.

The baseline analysis of the indicators that are expected to change as a result of the intervention indicate that there is significant scope in for improving women's dietary diversity, some IYCF practices and children's nutritional status (with regards to stunting).

WN plus mNutrition services may trigger and support improvements with carefully tailored and targeted messages. However, the analysis also identified several contextual factors that may hinder the desired improvements; some of these factors may be addressed by careful intervention design, whereas other factors are outside the influence of the intervention. Improvements in dietary practices may be hampered by household poverty and lack of time (e.g. due to work commitments). Carefully tailored messages that address these context-specific limitations are vital.

In terms of the business model, it can be regarded as a multi-sided platform business model, something that is commonly associated with information technology businesses. It provides a means of making a product free to one group of customers, while another group pays. Wazazi Nipendeni brings together two groups, providing a link between funders, who pay for the service, and users, who receive the service for free. In the Wazazi Nipendeni model, funders are motivated simply by improved health outcomes. Because the customers do not pay, the viability of the service does not depend only on the material (or perceived) benefit to individual users in terms of reduced health expenditures, deaths averted and so on. Rather, it depends on yielding wider benefits that are of value to the funding institutions, and where institutions have a mandate to improve health outcomes the sum of benefits to the individual will be of value. The model also benefits from endorsement from the very highest levels of government, and it has a 'cooperative spirit' working with other health providers as one element of integrated multimedia campaigns.

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Annex: Further details on the methodologies used

1. Quantitative evaluation design

This section provides a brief outline of the design and methodology of the quantitative part of the evaluation. For a more detailed description of the quantitative methodology please refer to the quantitative baseline report [4].

The primary aims of the quantitative work stream are to study the impact of the mNutrition on: (1) IYCF practices; (2) women's dietary diversity; and (3) children's nutritional status. There are also several secondary aims including the assessment of the impact of mNutrition on nutrition knowledge and practices and the impact of sending the content to both the mobile of the primary female and the mobile of the primary male, relative to just the mobile of the primary female.

1.1 Randomised controlled trials

A randomised controlled trial (RCT) is used to estimate the causal impact of mNutrition. Randomised controlled trials (RCTs) are widely viewed as the most reliable method of quantitative programme evaluation. By allowing researchers to randomly select who is affected by or offered access to a programme, RCTs eliminate selection bias¹³ and thus provide a clean way to estimate the causal effect of the programme.

The RCT includes two stages of randomisation:

- (1) A village level randomisation where villages¹⁴ are assigned to a mNutrition treatment group or to a control group. In villages that were assigned to the treatment group, sampled households are offered access to the mNutrition content on their mobile phone, free of charge, through a door-to-door, in person visit. In villages that were assigned to the control group, no offer of access to the programme is made. Though registration for the mNutrition programme is possible for all households - regardless of treatment assignment - knowledge and take-up of the programme was very low in the study region at baseline. We therefore believe that the random assignment of access to the programme is likely to generate a substantial difference in participation between treatment and control households.
- (2) A household level randomisation within treatment villages whereby eligible households are either assigned to receive the mNutrition content only on the mobile phone of the primary female or on the mobile phones of both the primary female and the primary male.¹⁵

1.2 Quantitative sampling strategy

Household sampling

Beneficiary households had to have either a pregnant woman or the mother of a child under twelve months of age to be included in the household sample for the quantitative baseline survey. In practice, this was done by setting two distinct sampling targets in each study cluster: one for households with a pregnant woman (six per cluster) and one for households with a child under the age of 12 months of age and the mother or caregiver of that child (11 per cluster). To be eligible,

¹³ Selection bias: is bias introduced by the selection of individuals for analysis in such a way that proper randomisation is not achieved, thereby ensuring that the sample obtained is not representative of the population intended to be analysed.

¹⁴ All selected villages were rural and had to have network coverage.

¹⁵ Only households in treatment villages whose primary female and primary male each owned a distinct mobile phone were available for this sub-randomisation. In the sample of households in treatment villages, only 19 percent of households met these criteria. In all other treatment households, only the phone of the primary female was included in the programme.

households were also required to have at least one household member that was literate in Swahili and at least one household member had to own a mobile phone.

Cluster size

The quantitative evaluation groups together all households residing within the same village by designating each sampled village as a distinct study cluster and ensuring that the first level of treatment status – any participation in Wazazi Nipendeni plus mNutrition – is the same for all households in the same cluster. The resulting cluster randomised controlled trial provides less statistical power than a randomised controlled trial that assigns treatment status at the individual level, but it greatly reduces the risk that spill overs (when one unit's treatment assignment has a direct effect on the outcomes of another unit) contaminate estimates of the effect of the mNutrition programme.

Ultimately, there were five rounds of village level randomisation with between three and 47 villages allocated to treatment groups in each wave. Across all five rounds 180 villages were allocated to a treatment group: 90 to the control group and 90 to the treatment group.

Please see section 3 of the quantitative baseline report for a detailed discussion of the different steps of the quantitative sampling approach [4].

1.3 Data collection: tool development and fieldwork

Baseline household questionnaires were designed by the IFPRI team based on the initial exploratory qualitative study [1], the landscaping review [8], and past experiences conducting quantitative evaluations of health and nutrition interventions in sub-Saharan Africa.

The household survey is the principal source of information for the primary and secondary outcomes. In addition, the questionnaire collects data on indicators expected to be strongly correlated with the primary and secondary outcomes - which can be used to help improve the statistical precision of the treatment effect estimates - as well as on measures that are important for testing the different causal mechanisms that could generate differences in the final outcomes of interest. When paired with the endline data collection in the context of the randomised evaluation design, the baseline instrument will enable us to carefully test for causal effects of the mNutrition programme at different levels of the causal chain. Data collected during the baseline survey - GPS coordinates and all mobile phone numbers for each household - will also be used to help locate the households surveyed at baseline for endline fieldwork

The baseline household questionnaire collected information on the primary outcomes (i.e. IYCF, dietary diversity and nutritional status measurements¹⁶) secondary outcomes (i.e. knowledge and current practices), basic demographics, indicators that were likely to be predictive of the primary and secondary outcomes, and intermediate outcomes that are relevant for testing different causal mechanisms. The full baseline questionnaire can be found in the baseline report [4].

The presentation of quantitative data is kept brief in this mixed methods report, but substantially more detail is provided in the quantitative baseline report [4].

1.4 Findings of balance test for differences in baseline characteristics

To test for baseline differences between the treatment and control groups, as well as between the two sub-treatment groups defined by the household level randomisation, we compared average values for a large set of characteristics observed at baseline across the different treatment and

¹⁶ Nutritional status was assessed based on anthropometric measurements of the body composition of children. More specifically, lengths/height and weight measurements.

sub-treatment groups. The balance tests found that overall, randomisation was successful and the samples were well-balanced with regards to all key outcomes of interest (for further details see [4]).

2. Qualitative evaluation design

The qualitative component of the evaluation aims (1) to provide an in-depth understanding of the context within which mNutrition is embedded, and which is likely to affect the take-up and outcomes; and (2) to explore processes of change and their underlying mechanisms to explain how and why (and why not) mobile phone-based services lead to change in nutrition behaviours.

The qualitative component consists of three qualitative data collection events:

1. An initial exploratory qualitative study
2. In-depth case studies at midline
3. Qualitative follow-up mini-case studies following the quantitative endline.

This report only draws on findings from the initial exploratory study. For a detailed presentation of the methods used and their strengths and limitations please see the initial exploratory qualitative report [1]. In the following sections we will provide a brief overview of the methods.

2.1 Initial exploratory qualitative study

In the initial exploratory qualitative study, a comprehensive contextual analysis of social, institutional, political and environmental factors was carried out. The analysis specifically focuses on:

- The acceptability, familiarity and use of mobile phone technology.
- Factors that may affect the operation and/or access to a mobile phone and mobile-phone-based behaviour change messages by the target group.
- Current information-seeking behaviours related to nutrition and health.
- Social, economic and environmental factors that may influence the up-take of behaviour change messages provided by mNutrition.

2.2 Qualitative sampling

A purposive sample of six communities in the Iringa region was chosen. The selected sites were a sub-sample of the quantitative sites and aimed to provide insights into different geographic contexts. Within each site participants were purposively selected to illustrate characteristics of different sub-groups.

2.3 Qualitative data collection

Data collection consisted of audio-recorded in-depth interviews (IDI) with pregnant women, mothers who have access to a mobile phone and local key stakeholders including health workers and community leaders (key informant interviews – KIs). This was accompanied by detailed field-note observations and focus group discussions (FGD) with other relevant community members (e.g. elderly, men). Three IDIs with national-level experts for child nutrition were also conducted per country to triangulate the qualitative findings (expert interviews – EIs). All IDIs and FGDs were guided by semi-structured topic guides organised around the main aims of the initial exploratory qualitative study. Please see Table 6 for a summary of data collection tools.

Table 6 Data collection tools for the initial exploratory qualitative study per region and district

Interview category	Iringa Rural			Mufindi			National	TOTAL
	Ariga	Isana	Oloro	Bolira	Esula	Lomola		
In-depth interviews								
Mothers	1	1	1	1	1	1		6
Pregnant women	1	1	1	1	1	1		6
Key informant interviews	2	2	3	3	3	3		16
Expert interviews	0	0	0	0	0	0	3	3
Total IDIs	4	4	5	5	5	5	3	31
Focus group discussions								
FGDs with fathers/elderly women	1 (fathers)	1 (elderly)	1 (fathers)	1 (elderly)	1 (elderly)	1 (father)		6
FGDs with mothers/pregnant women	1 (mothers)	1 (pregnant)	1 (pregnant)	1 (mothers)	1 (mother)	1 (pregnant women)		6
Total FGDs	2	2	2	2	2	2		12

2.4 Qualitative tools

Multiple data collection tools were used to obtain qualitative data from different sources and perspectives. This enabled a nuanced analysis of the context but also helped in the triangulation of the data. The main data collection tools were semi-structured in-depth interviews with pregnant women, mothers (IDIs), key informant interviews (KIIs), expert interviews (EIs), and community member interviews and focus group discussions (FGDs). In total 32 in-depth interviews and 12 FGDs were conducted across six communities.

2.5 Qualitative data analysis

The qualitative data were analysed using a directed content analysis approach. Data analysis started with open coding of several interviews using the qualitative data analysis software (NVivo) and the development of an initial coding scheme that guided the coding of the remaining data. To increase the rigour of the data analysis, coding was done by two researchers independently and coding schemes were then discussed and modified into a joint scheme. While the coding scheme guided the coding, it was flexible enough to allow for unforeseen topics that emerged to be added at any point. After preliminary coding, transcripts were recoded for additional information and emerging themes. Initial analysis results as well as the final report were shared with the field team and lead researcher in Tanzania to ensure the IDS team interpreted the findings correctly and to provide additional details that were necessary.

3. Business model and cost-effectiveness evaluation

The business model component aims to describe the value proposition of mNutrition and how services are provided, and how these change over the duration of the programme. The cost

effectiveness analysis will compare the costs and outcomes associated with mNutrition programmes with more conventional or traditional communication channels such as radio and extension agents.

3.1 Methods

Business models traditionally describe how a business is going to make a profit from a product or service and identify the direct relationship between the two. It considers who its customers are, why they will buy the product or service (the value proposition), as well as how the company is going to provide the product or service. On the financial side, it considers both revenues (and pricing) and costs. The role of Value Added Service (VAS) within MNOs is not always straightforward. There are imputed benefits, and these are recognised as important within the DFID log frame for the whole GSMA programme. The challenge here is to identify the broad business model – including the non-monetary benefits of the service to each stakeholder.

This component consists of ongoing mixed methods data collection drawing on:

- Qualitative interviews with stakeholders and MNOs
- Commercial data provided by stakeholders and MNOs
- Findings from qualitative research by IDS [1] and quantitative research by IFPR [2]
- Monitoring data
- Cost and impact performance data available in published literature
- Government stakeholders and alternative service providers as a source of additional, unpublished information on costs and impact.

For more details on the process and methods used, please see the detailed cost-effectiveness and business model reports [2,3].

3.2 Data management and analyses

Given the complexity of the partnerships involved in the mNutrition projects, Osterwalder and Pigneur's [22] business model canvas was used as a framework for the research. Initial data analysis for the quantitative data was conducted by IFPRI and the qualitative data was conducted by IDS in close collaboration with the in-country partners (OPM Tanzania) who assisted in data collection, transcription and data cleaning.

Data were then used to populate the Osterwalder and Pigneur canvas and complemented and enhanced with other data sources (e.g. user experience testing, case studies, Rapid Feedback surveys, etc), as well as grey literature.

4. Ethical approval

The ethical implications of the study were reviewed by three independent committees. National-level ethics approval for the impact evaluation was obtained by the Institutional Review Board (IRB) for Tanzania. In addition, ethics approval for the quantitative component was obtained from IFPRI's Institutional Review Board and IDS Ethics Board provided approval for all components of the evaluation.