Final Report

Applied Research Project (ARP) - 13

Organization: Fundación ADHA

Strategies to reduce chronic child malnutrition in rural areas of the central highlands of Ecuador due to inadequate nutrition

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Context and Organization Partnership

This research was developed in the context of an Applied Research Project (ARP) within the MINT Program at the Geneva Graduate Institute (IHEID). The aim of the ARP is to develop policy-relevant research with a chosen partner organization. The partner organization, Fundación ADHA, is an Ecuadorian-based NGO working to provide solutions for the reduction of childhood malnutrition. Through efforts such as developing and implementing nutrition workshops and low-connectivity digital tools, Fundación ADHA works in areas of Ecuador with high rates of chronic malnutrition, such as the Central Highlands (Chimborazo, Tungurahua, Cotopaxi, and Bolívar).

Aim of Project and Research Questions

The goal of this research is to provide an overview of the current situation of childhood malnutrition as it relates to Ecuador, and more precisely, to the purposes of Fundación ADHA. The research is intended for unrestricted use by Fundación ADHA for whichever purposes as seen fit, including but not limited to raising awareness, implementing new strategies, and providing information for current and prospective donors.

Methodology

This research built upon two main methods: (1) a systematic literature review and (2) semi-structured interviews with key informants. The systematic literature review was conducted at the beginning of the research, and was followed by component two to directly compare with the research of existing literature. The overview of existing literature and comparison are used to further understand the gaps in Ecuador currently contributing to their rate of childhood malnutrition, as well as to provide targeted recommendations for Fundación ADHA in regards to filling critical portions of these gaps.

Systematic Literature Review

Included in this report is a literature review which summarizes existing relevant data on childhood malnutrition. Our research was systematically gathered with the objective of obtaining data on malnutrition globally and in Ecuador, including case studies of success and failure in comparable contexts, as well as the role of artificial intelligence, particularly chatbots, in addressing malnutrition. Information was gathered from credible sources such as research

papers, policy reviews, and government health research databases. With this approach, we aimed to minimize bias and accurately represent available knowledge. Studies and data were selected based on relevance to childhood malnutrition, comparability to the situation in Ecuador (e.g. developing countries), and applicable technology. Irrelevant or outdated literature was excluded, ensuring quality and consistency.

In addition to a thorough data selection process, we categorized the final data into specific areas: Ecuador's situation, comparative case studies, NGO action, and AI interventions. We have explored case studies in comparable countries which have both succeeded and failed in regards to the reduction of childhood malnutrition. Additionally, an overview of the current literature regarding the use of artificial intelligence being used to combat malnutrition was provided, with a particular mention of chatbots, per the goals of Fundación ADHA's organization model. By combining insights from specialists with community-level data, this methodology aims to provide a holistic understanding of childhood malnutrition in the Ecuadorian Highlands and inform targeted, actionable interventions.

Interviews with Specialists and Key Informants

The analysis involved semi-structured interviews with key specialists working in sectors related to childhood malnutrition. Participants included current and former NGO, IO and governmental workers, focusing on areas such as nutrition, potable water access, agroecology, and maternal and child health, as well as digital solutions. These interviews explored the specialists' perspectives on the primary causes of malnutrition, the effectiveness of existing interventions, and recommendations for sustainable solutions. The data also helped to uncover how systemic issues, such as water and sanitation infrastructure or healthcare access, intersect with malnutrition.

Problem Statement

Malnutrition

Despite dramatic improvement in health, nutrition and education worldwide, malnutrition remains a serious issue, especially in low- and middle-income countries (LMICs). Malnutrition refers to the condition resulting from deficiencies, excesses, or imbalances in an individual's intake of energy and nutrients. It includes two main categories of conditions: undernutrition and overnutrition. Undernutrition involves stunting (low height for age), wasting (low weight for

height), underweight (low weight for age), and deficiencies in essential vitamins and minerals, also known as hidden hunger. On the other hand, overnutrition refers to conditions related to excess intake, including overweight, obesity, and diet-related noncommunicable diseases (World Health Organization, 2024). Malnutrition develops through several pathways. Immediate causes include poor diet and illness, while food insecurity serves as an intermediate factor. Underlying these are broader socio-economic conditions that contribute to the risk of malnutrition (Kismul et al., 2015). Malnutrition severely affects children, especially those aged 5 or under, and it represents the most extreme consequence of food insecurity. An estimated 149 million children under five are stunted and 45 million suffer from wasting (UNICEF-WHO-World Bank, 2023; UNICEF, 2023).

Severe undernutrition in children under 5 can lead to impaired cognitive growth and development, with lasting effects as they age. Malnourished children are at higher risk for stunted physical and intellectual development, potentially reducing their productivity in adulthood (Kalu & Etim, 2018; Clark et al., 2020). Undernutrition can have irreversible effects, if no intervention takes place within the first 1000 days from conception, because the first two years of life represent the period in which the brain and health are vastly developed (Adair et al., 2013; 1,000 Days, 2019).

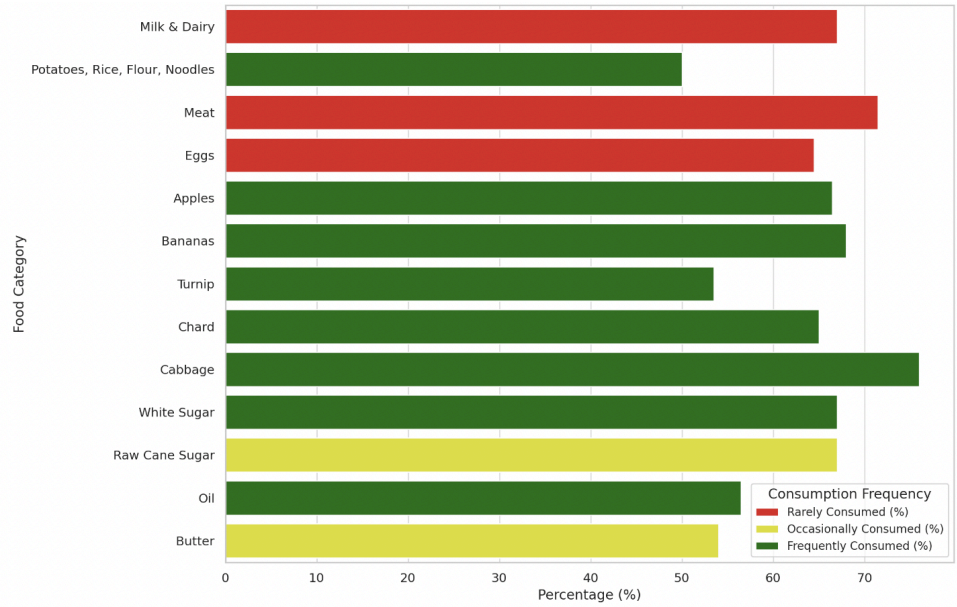
Ecuador

Factors affecting Child Malnutrition in Ecuador

In Ecuador, chronic child malnutrition (CCM) reaches one of the highest rates in Latin America. Indeed, according to the United Nations, Ecuador is the fourth country highest in CCM in Latina America (Secretaría Nacional de Planificación, 2024). In the country, 23,1% of children under 5 are affected by malnutrition, and the percentage increases in the rural communities (United Nations Ecuador, 2023). Indeed, the most affected region of the country is the central highlands, also known as la Sierra, where the number of children affected is 32%, followed by the Amazonia with 22,7%, the Coastal Region 15,7% and the Insular Area 5,8% (Cueva Moncayo et al., 2021; Chaglla & Puga, 2023). Within the Sierra Ecuatoriana, the most affected provinces are Bolívar (35,1%), Chimborazo (35,2%), Cotopaxi (31,8%), and Tungurahua (32,5%). The most affected ethnicity are the Indigenous (40,7%), Mestizo (21,9%), Montubio and others (21,3%), White (18,4%), Afro-Ecuadorian (16,1%) (Secretaría Técnica Ecuador Crece Sin Desnutrición Infantil, 2021; Instituto Nacional de Estadística y Censos, 2023). CCM is a multifactorial issue: it can be caused by an inadequate or insufficient diet, lack of potable water, sanitation and hygiene problems, and/or parents' education (Pazmiño-Tandazo et al., 2019; UNICEF/ EFE, 2023; Chimborazo Bermeo & Aguaiza Pichazaca, 2023).

Further detailing the issue of an inadequate diet, Pazmiño-Tandazo et al., 2019, analyzed the consumption of food by children and observed that there is a limited intake of nutritious food, especially proteins, which ensure tissue growth and renewal, immune development and provide important amino acids. Less than 30% of children consume protein-rich foods regularly. Fruits and vegetables are frequently consumed, together with carbohydrates-rich and sugar-derived foods (see Figure 1). It must be noted that frequently the problem is not a lack of food, but rather the limited access to a balanced diet. Households in rural areas excessively consume carbohydrates, because they are usually the cheapest products (Cesar, 2018).

Fig. 1 Dietary Habits of Children



Source: Pazmiño-Tandazo et al., 2019

This kind of food consumption may be attributed to various factors: (1) premade foods are usually cheaper; (2) this kind of food is often adopted by working mothers, since it is faster to provide, despite lacking certain nutritional elements; (3) a social bias is present, that is, the consumption of traditional food is often seen in negatively, as it is associated to the poorest sector of the population, thus premade foods are preferred (Leonard et al., 2000; Rivera Vásquez, 2019a). However, to increase the nutritional intake, one of the most straightforward ways would be the reintroduction of Ecuadorian traditional foods like lupine, quinoa and amaranth. Their production and consumption is declining; however, it has been demonstrated that these foods contain high concentrations of nutrients that are of special concern in the Ecuadorian rural population, notably vitamin A, iron, calcium, zinc and vitamin C (Deaconu et al., 2021; April-Lalonde et al., 2023). Furthermore, Iannotti et al, 2017, and Waters et al., 2018, have

demonstrated the potential of eggs in reducing CCM, through their high nutritional value. As a matter of fact, eggs represent a locally accessible food source, they are inexpensive and poultry and egg production are integral components of small-scale farming systems in Ecuador. However, eggs are not consumed daily because most families believe they produce high-levels of cholesterol and allergic reactions and these ideas are reinforced by health professionals and mass media.

Another important factor to be taken into account relates to breastfeeding. The recommended feeding of children is exclusive breastfeeding for the first 6 months of life and continued breastfeeding through the second year of life, which however, must be complemented with an adequate quality and quantity of food after 6 months of age (Black et al., 2008). The importance of breastfeeding is related to its whole nutritional values, which are necessary for a full development. In Ecuador less than 50% of children are exclusively breastfed during the first 6 months of their lives (UNICEF Ecuador, 2019), however, in the central highlands, breastfeeding is considered as extremely important, which has to be attributed to the large presence of indigenous mothers, who attach cultural values to the act, together with the fact that mothers' milk is free and it is known to be good for children (Rivera Vásquez, 2019a). Furthermore, in these rural areas the market has not fully penetrated, thus instant formula is not easily accessible (Rivera Vásquez, 2019a; Tello et al., 2022).

It must be noted that CCM, and especially stunting, increases with age. The most affected children are those between 12 to 23.9 months, compared to children aged 0 to 12 months. The stunting observed in infants aged 1 to 2 years within these communities is likely attributable to insufficient complementary feeding practices during the early stages of transitioning to solid foods, combined with the frequent occurrence of infections during this critical period (Roche et al., 2016; Tello et al., 2022). The education level of mothers is also a critical consideration, as higher education is associated with increased prenatal and postnatal check-ups (Kalu & Etim, 2018; Flores & Congacha, 2021; Rivera Vásquez et al., 2021; Guanga Lara et al., 2022). Maternal employment must also be taken into account. Women often balance dual roles as primary caregivers for their children and contributors to household income. In effect, increased female participation in the labor force can reduce the time allocated to child welfare, which may reduce breastfeeding and ability to provide adequate care (Kalu & Etim, 2018; Andrade & Gil, 2023). Additionally, research indicates a correlation between maternal age and child nutrition; younger mothers are more likely to have children with higher rates of malnutrition, possibly due to the lower education levels and access to resources (Kalu & Etim, 2018; Flores & Congacha, 2021).

Another relevant factor affecting undernutrition is the difficulty in accessing public health facilities and their lack of. Indeed, facilities are often scarce and difficult to reach, especially for the poorest sectors of the population who live hours away from the closest centers. In the most CCM-affected provinces of Ecuador, the population is often dispersed and the medical staff is not able to carry out the necessary visits, because access roads are difficult to travel and there are transport difficulties due to the distances involved and the poor condition of the roads (Cesar, 2018; Karáth, 2022; Josefsen Hermann, 2023; Rodríguez Parrales et al., 2023).

Finally, an important factor is also the access to potable water. Public water supply in many cases serves only 50% of the population. This is due to the logistic and economic difficulties related to the altitude of several villages (Cesar, 2018), but also to the lack of technical skills within the municipalities that manage this competence (Rivera Vásquez, 2019b). Those lacking public supply networks resolve the issue through pipelines, rivers, springs, tankers, among other means, which do not guarantee water's quality. Several sources affirmed that the most pressing issue is the quality of water more than the quantity. Water often has excessive fluoride and bacteria including coliforms from faeces. These are predisposing factors for the incidence of gastrointestinal diseases, because hygiene practices are not adapted to this type of situation and there is widespread ignorance about the quality of the water supply and the dangers of consuming untreated water (Cesar, 2018; Rivera Vásquez, 2019a; Guanga Lara et al., 2022). The last relevant factor to consider is the size of the household, because children's nutritional status can be adversely impacted by an increase in household size, as this often reduces per capita income. Larger family sizes may lead to less food being available for each child, which can negatively affect their overall health (Ortiz et al., 2013; Kalu & Etim, 2018; Flores & Congacha, 2021).

Public Policies in Ecuador against Child Malnutrition

Since 1980, Ecuador has brought forward many public policies tackling nutrition (see Table 1), however, despite a decrease in the first decade from implementation, since 2012, the reduction in chronic child malnutrition has been minimal for children under 5, while between 2014 and 2018, it has increased for children under 2 (Bermeo, 2022; United Nations Ecuador, 2023; Mejía Cocha & Galarraga Pérez, 2023).

Table 1. Public Policies implemented in Ecuador since 1980

Public Policy	**Coordination actors**	**Period**	**Description**	**Implementation effectiveness**	**Impact on Access to Water, and Maternal Feeding Practices**
Programa de Alimentación Escolar PAE	Ministerio de Educación	1980-2023	It is one of the largest public investment programs, which aims to improve access to and use of the education system. It has been reformulated several times for technical and political reasons, which has inconsistent results. It lacks evaluation studies to demonstrate its effectiveness.	Partially Effective: The program has undergone multiple reformulations, with inconsistent results due to challenges in resource management and limited evaluations.	It moderately improved school attendance and nutrition awareness but had limited direct impact on water access and feeding practices due to lack of coordination.
Programa de Bono de Desarrollo Humano	Ministerio de Inclusión Económica y Social	1998 - present	It positioned itself from a social and developmental approach. The program focuses on conditional cash transfers, mainly aimed at mothers	Highly Effective: It is widely recognized for improving maternal practices and access to healthcare.	It strengthened maternal feeding practices by incentivizing clinic visits but it had limited direct impact on water or facility access.

Programa PANN	Ministerio de Salud Pública	2000	Focused on the promotion of breastfeeding and complementary feeding. It included the "Mi Papilla" and "Mi Drink" programs, with the delivery of 2 kg per month of these products at checkups for children and pregnant women; these preparations contained rice and quinoa flour, soybean, powdered milk, soybean oil, and added vitamins and minerals.	Moderately Effective: It promoted breastfeeding and it improved nutritional status of target group	It influenced maternal feeding practices positively but did not address systemic water and sanitation issues.
Aliméntate, Ecuador – AE	Ministerio de Bienestar Social	2004	Its objective was to improve health and nutritional status, reduce the prevalence of anemia and improve children's cognitive and psychomotor development of children. It had the technical support of international cooperation.	Moderately Effective: It had positive health outcomes but was limited in scope due to funding.	It reduced anemia prevalence but did not significantly affect water or maternal feeding practices.
Política para la Reducción Acelerada de la Malnutrición Infantil en el Ecuador – PRAMIE	Ministerio Coordinador de Desarrollo Social	2009 - 2014	Policy focused on reversing the state of child malnutrition, through multisectoral public action, the strengthening of local governments and the active participation of civil society.	Moderately Effective: It created awareness and mobilized resources but faced political and logistical barriers.	It improved urban interventions but limited reach in rural areas for water and sanitation.

Proyecto Emblemático Acción Nutrición	Ministerio Coordinador de Desarrollo Social	2015 - 2017	Improving the health and nutrition of children under five years of age, through inter-institutional coordination mechanisms at the national and local levels.	Partially Effective: It strengthened coordination but faced funding and execution issues.	It improved access to facilities in urban areas but had limited effect on water or feeding practices.
Plan Intersectorial de Alimentación y Nutrición Ecuador – PIANE	Secretaría Técnica Plan Todo una Vida	2018 - 2025	Policy that addresses the life course through comprehensive care and the generation of mechanisms of co-responsibility between all levels of government and civil society.	In Progress: It is showing early success in promoting shared responsibilities.	It is likely to improve maternal feeding practices; water and sanitation impact are yet unclear.
Estrategia Nacional Ecuador Crece sin Desnutrición Infantil - ENECSDI	Secretaría Técnica Ecuador Crece sin Desnutrición Infantil	2020 - présent	The focus is specifically on the prevention and reduction of child malnutrition through effective intersectoral coordination. The policy addresses structural determinants of social and economic determinants.	Effective in Progress: The early results show improved intersectoral cooperation.	It is ikely to make significant contributions to maternal practices and overall facility and water access.

Sources: Rivera Vásquez, 2019b; Rivera Vásquez, 2022; Secretaría Técnica Ecuador Crece Sin Desnutrición Infantil, 2023; Fundación Ecuador Crece Contigo, 2024

Most of the programs implemented had issues. The first issue was inconsistent implementation, largely attributed to government instability. There was poor coordination among the various national ministries in realizing the projects, and the programs lacked a multi-sectoral approach. A subsequent problem has been the scaling up of nutritional programs, which did not have community participation in their design and implementation, thus lacking a bottom-up approach. In addition, the reduction of child malnutrition has been limited by the relationship

between the central and decentralized government, and the private sector. Indeed, the implementation and monitoring by local municipalities has been unequal, depending on political interests, and resources (Rivera Vásquez, 2019b). The implementation of concrete projects and regulations creates opportunities and constraints, shaping an environment where dominant interests prevail. Construction companies and local public officials, who stand to gain the most, exerted significant influence over the process (Manosalvas, 2019). Moreover, corporations, especially from the food industry, have become increasingly entrenched in Ecuador's nutrition policies. This influence has been institutionalized through various policy instruments (Torres et al., 2024). The course of action of these policies often follows an incremental-minimalist logic, which aims at increasing results, with the least possible budget. The aim is to achieve visible results in a limited period of time, however, these policies do not target the root causes of undernutrition, but usually just one of its numerous aspects (Manosalvas, 2018). Finally, the monitoring and evaluation of policies and programs for the prevention of CCM in Ecuador has been inadequate, making it difficult to measure the success or failure of the programs, to carry out accountability exercises or to localize the care provided (Secretaría Técnica Ecuador Crece Sin Desnutrición Infantil, 2023).

To date, the most effective policy against malnutrition has been the *Programa de Bono de Desarrollo Humano (BDH)*, which began in 2003. Since 2013, the BDH program has provided conditional cash transfers of $50 per month to families with members under 18 years of age, with an additional transfer based on the number of children. The program requires specific behaviors, including regular attendance at preventive health check-ups and a minimum school attendance rate for school-age children. Its primary goals are to ensure a minimum level of consumption for families, reduce chronic malnutrition, and prevent avoidable diseases among children under five. The program largely managed to reduce malnutrition of children under 5 through a reduction of poverty. The program has been effective in increasing preventive check-ups, consumption of healthy foods, and encouraging healthy behavior. However, due to macroeconomic volatility, since 2014, stricter eligibility criteria have been implemented. This adjustment led to a decrease in coverage rates, but targeting improved, as a higher proportion of beneficiaries came from the poorest quintile (Moncayo et al., 2019).

The most recent policy has been the national strategy *Ecuador Crece sin Desnutrición Infantil*. The goal is to reduce CCM, through improved health and nutrition, especially for children under 2 and pregnant women. This policy envisions full cooperation among various sectors of society. It is achieved through the creation of an advisory council, made up of several national ministries, national civil service, decentralized autonomous governments, the private sector, international organizations and academia. These alliances are essential to ensure an

effective implementation of nutrition policies, as they guarantee a broad representation and foster collaboration and synergy among them (Fundacíon Ecuador Crece Contigo, 2024).

Literature Review

Case Studies: Countries Which Have Successfully Combated Malnutrition

Childhood malnutrition is a global challenge, but several countries have made significant progress in reducing its prevalence through targeted, multisectoral approaches. These countries serve as valuable case studies from which we can learn much about proven techniques to combat malnutrition. More specifically, these success stories show the importance of a multisectoral approach, combining nutrition education, economic incentives, improved health services, community engagement, and policy reforms to address malnutrition's underlying causes.

1. Peru: Multisectoral Approaches and Conditional Cash Transfers

Peru provides a compelling case study of how strategic interventions can reduce childhood malnutrition. According to the World Bank, "in just 8 years between 2008 and 2016 Peru cut its stunting rate from 28 percent to 13 percent" (Kathuria et al., 2019). Through the creation and expansion of a Conditional Cash Transfer (CCT) program called *JUNTOS* in 2005, Peru incentivized mothers to participate in health and nutrition programs. In essence, the program stipulated requirements such as regular visits to health clinics for vaccinations, education sessions, assessments of a child's growth, and prenatal checkups for pregnant mothers (Pérez-Lu et al., 2017). In return for meeting these requirements, families are compensated approximately 30 USD per month (Department for International Development, 2017). Studies show that exposure to *JUNTOS* positively impacts children by reducing severe stunting. It should be noted, however, that this impact is only observed if a child is exposed early, during the first three years of life (Department for International Development, 2017).

In addition to *JUNTOS*, Peru initiated an expansion of their existing health insurance program (the Integral Health Insurance Program (SIS). Targeted towards the most economically disadvantaged populations, this expansion further increased access to preventative health and nutrition services (Marini et al., 2017). In the following years, Peru generated a number of additional strategies and budgets in order to better organize their efforts to reduce malnutrition. In 2007, a national nutrition strategy, *Crecer* ("To Grow"), was established, which aimed at reducing stunting by focusing government spending on implementing poverty reduction and social welfare initiatives (Marini et al., 2017). The spending primarily targeted the poorest districts of Peru, and specifically focused on children under the age of two. In particular, *Crecer*

invested in programs prioritizing "maternal-child health, birth registration and access to social services" (Marini et al., 2017). In 2008, Peru established a Results Based Budgeting (RBB) which provided monetary incentives aimed at regional governments. These incentives improved the quality of health and nutrition services by incentivizing politicians to follow through on the results they promised to achieve. Through RBB and financing, funds were strategically allocated to support the CRED packages (Control de Crecimiento y Desarrollo), which focused on growth monitoring and related treatments and education. The percentage of health clinics equipped to provide the full CRED package plus vaccinations increased from 0% in 2011 to 91% in 2016 in areas targeted by the intervention. By 2016, nearly 70% of children under 36 months had received full CRED packages and vaccinations in these areas (World Bank Group, 2021).

2. Brazil

Over the span of 30 years, Brazil successfully reduced the prevalence of stunting by 80% among children under five years old. By 2007, Brazil's stunting rates among this age group reduced from 37.1% to 7.1% (Monteiro et al., 2010; Paes-Sousa et al., 2011). Success was most widely seen in the poorest populations of Brazil, where stunting rates decreased from 59% to 11%. Brazil's success is attributed to a combination of factors, which the World Bank describes is due to "increased maternal schooling, improved purchasing power of families with equity oriented public policies, expansion in provision and quality of health care, and better sanitation" (Kathuria et al., 2019). This multidimensional approach resulted in changes in both government policy and resource allocation, as well as directly in the homes of affected families through the addition of schooling, potable water, and changes in practices such as breastfeeding. For instance, by 2008, the rates of exclusive breastfeeding in children under six months increased by 54% compared to the decade prior.

Like Peru, Brazil also implemented a Conditional Cash Transfer program, known as the *Bolsa Familia* program. The program was found to have improved height and weight for age markers by 26% in children when exposed to the program, compared to children who did not participate (Paes-Sousa et al., 2011). In addition, the program was found to lower by more than 50% the infant mortality rate caused by undernourishment and diarrhea (Hellman, 2015). Once a family qualifies for and is enrolled in the program, it must meet certain conditions in order to receive the cash transfer. These include: (i) required attendance of children in school for a minimum of 85% of school hours, and (ii) a health and nutrition agenda, such as pre-natal care, health and nutrition monitoring, and vaccinations, for families with pregnant or nursing mothers or children aged 7 and under. If these requirements have been met, the payments are made to a female head of household, with the payment amount based on the family's income level as well

as age and number of children. The budget for Bolsa Familia amounts to less than 0.5% of Brazil's GDP and has helped over 36 million individuals escape poverty (Hellman, 2015).

3. Thailand

In 1982, half of all children in Thailand suffered from malnutrition (Marini et al., 2017). However, by the year 2006 this figure had drastically improved, with less than 10% of children being affected by malnutrition (Chavasit et al., 2013). Thailand's achievement is one of the first documented success stories in a country aiming to combat childhood malnutrition, and their results have been attributed to a number of factors. Thailand developed a National Food and Nutrition Program which targeted high risk groups, particularly lower income, pregnant mothers, and children under the age of five. Various iterations of the program were released every 5-10 years to better target populations of need and implement more effective strategies. Among these strategies was a Poverty Alleviation Plan, a national development plan which comprised a multisectoral approach across health, nutrition, education, agriculture, and rural development (Winichagoon, 2014). Most notably, however, Thailand implemented a unique community-based nutrition program, which proved to be highly successful (Tontisirin & Winichagoon, 1999). This community program engaged community mobilizers to deliver minimum services and monitor community programs. The program was largely volunteer-based, and engaged 1 mobilizer per 10-20 households, as well as 1 supervisor per mobilizer (Gillespie et al, 2016). Among the mobilizers, 80% were women (Kathuria et al., 2019). Mobilizers received basic training on nutrition and health care, on a variety of subjects such as pre- and postnatal care, breastfeeding, complementary feeding, deworming, as well as the promotion of sanitation and income-generating activities (Kathuria et al., 2019). In return, volunteers received free medical services for their families, as well as public recognition in the form of awards and certificates. Much can be learned from Thailand's emphasis on community engagement, and experts suggest the program both empowered and better engaged community members while reducing costs in the long-term (Heaver & Kachondam, 2002).

In addition to community programs, Thailand's efforts have also impacted other sectors. Education has also been prioritized, as it shows a positive relationship between reduced stunting, particularly for the mother's education (Semba et al., 2008). Over the span of only 20 years, secondary education increased dramatically from 29% in 1990 to 87% in 2012 (Compact 2025 Team, 2017). Other measures including food fortification and improvements in water, sanitation and hygiene (WASH) were implemented in Thailand. A Ministry of Health committee dedicated to the study of food fortification was established in 1994, and has increased the fortification of foods for nutrients such as iron, vitamin A, iodine and others (Chavasit & Tontisirin, 1998). Regarding sanitation, the percentage of households with a hygienic latrine increased from 47% in

1985 to 96% in 1995. Similarly, households with safe drinking water also saw impressive improvements, increasing from 65% of all households in 1985 to 92% in 1995. These improvements in WASH were funded by government programs, the Poverty Alleviation Program and the Rural Development Plan, which designated funding towards 288 of the poorest districts in Thailand (Heaver et al., 2002). Furthermore, the government provided a creative solution to improving access to clean water by providing jars with a 1-2 thousand-liter capacity (as well as larger tanks occasionally) to rural households in order to store clean drinking water during the monsoon season (Ariyabandu, 2001). Between 1980 and 1991, over 300 million jars had been distributed to rural households. It is estimated that the subsequent increase in clean drinking water is among the main causes for low intestinal parasites in Thailand, thus aiding a reduction in malnutrition (Heaver et al., 2002). Finally, the country has also benefited from economic growth on the whole, and is now classified as an upper-income developing country in 2024 (World Health Organization, 2024). This increase in economic status has allowed the government to improve services such as social programs.

Case Studies: NGO Efforts Which Have Successfully Combated Malnutrition

At this point in time, there is limited data on NGO intervention, their program designs, and quantitative impact on the reduction of childhood malnutrition. We surmise this is in part due to the specific, grassroots nature of NGO interventions, and thus often limitations on funding for the creation of studies. However, a few analyses have been performed on NGOs, analyzing shortcomings and proposing recommendations to better impact target populations. The analyses came to similar conclusions, and were noted as critical in transforming projects which have proved to be successful only in the short-term, into projects whose effects are seen in the long-term as well.

In summary, these recommendations were:

1. Government Collaboration:

NGOs would generally benefit from collaboration with the government (Forkuor & Agyemang, 2018). A partnership would alleviate financial burdens which arise with funding, as well as the resources required to follow up on and/or provide continued support to their beneficiaries after providing them with the initial support or education (Rajabi et al., 2020; Forkuor & Agyemang, 2018). Furthermore, government partnership would provide the opportunity to scale projects for NGOs (Borgarello, 2022). In a study performed on 9 NGOs operating in Southern Africa, researchers concluded that in 8 out of 9 NGO projects, government

collaboration proved to be critical for their long-term success (Rosenberg et al., 2007). Government partnership was essential in accessing grants and other government funding, providing critical support to community programs, as well as initiating changes in legislation which positively impacted the NGOs' goals.

2. Consider Hidden Factors Which Affect Program Objectives:

Additionally, the efficacy of government programs implemented in Peru were studied in order to analyze factors which hindered success and to make recommendations to improve future projects. Although these were government programs, lessons can be learned and applied in the context of NGO programs. For instance, researchers concluded that despite the existence of beneficial programs, women were hindered from participating due to social factors which were unaccounted for. These included, for example, gendered issues like women not attending nutrition education sessions for fear of domestic violence (Pillaca-Medina & Chavez-Dulanto 2017). Violence often stemmed from a negative social perception linked to poverty and malnutrition, thus leading some men to prohibit (or punish) female partners from participating to avoid affecting the family's reputation. Even if domestic issues were not present, some women may choose not to participate as they prefer to work to earn money. As noted in NGOs operating in Ghana, individuals may prioritize earning money quickly over attending sessions, highlighting the importance of considering poverty situations (Forkuor & Agyemang, 2018).

Suggestions to combat these issues were offered. Firstly, programs should change the connotation of programs, with a particular focus on equating participation with "responsibility", being "winners", and doing what's "best for boys and girls", rather than focusing on insufficient practices and the issue of malnutrition. Secondly, to combat issues of participation for all reasons, NGOs might consider in-home approaches, thereby limiting participation issues due to image, need for work, or inability of finding childcare (Pillaca-Medina & Chavez-Dulanto, 2017).

Case Studies: Unsuccessful or Low-Impact Efforts

Despite positive trends of CCM, undernutrition remains a serious burden in LMICs. Indeed, only a few programs tackling child malnutrition managed to achieve long-term results. Especially after COVID-19, the subsequent economic crisis and climate change, several countries have faced increases in CCM. Among them, Peru and Brazil must be considered. Both countries have been considered to bring forward some of the most successful policies during the first decade of the 21st century. However, recent research has demonstrated an inversion of the trend.

1. Peru

The aforementioned combination of efforts in Peru successfully cut stunting rates in half in just eight years from 2008-2016. However, challenges continue to remain in Peru: anemia affects over half of children in rural areas, and indigenous populations experience disproportionately high malnutrition rates (Jara, 2024). Moreover, chronic malnutrition has plateaued in more recent years, underscoring the need for simultaneous improvements in sanitation, water access, and waste management to sustain progress.

A recurrent issue in Peruvian social programs is the interruption of government intervention. The common pattern is that, once the goal is achieved, the government decreases the expenditure in the sector, without providing successful alternatives (Quispe, 2017). This leads to infiltration from third parties, as it happened with the program "Vaso de Leche". In the program, half of the people helped were not the targeted population. The infiltrations in programs can be explained by the reduced participation of the municipalities, which entrust the distribution to other institutions, which often do not have the technical skills to identify the correct target population (Comexperu, 2024). Other deficiencies were also verified, such as the lack of an adequate environment for the storage of food products and of a registration system for the entry and exit of food. In addition, the staff in charge of handling the food did not have health cards or appropriate clothing (Defensoría del Pueblo, 2017).

2. Brazil

Despite Brazil's prior success during the early 2000's, the markers for childhood malnutrition began to trend poorly once again after 2006. It is estimated that the downfall of Brazil's malnutrition rates can be attributed to a weak social protection system, as well as inadequate estimations of how malnutrition rates vary in more vulnerable populations, such as indigenous and families of color (de Albuquerque et al., 2023).

This regression in undernutrition rates in Brazil can be largely attributed to the limited government intervention and budget cuts. Studies indicate that if Brazil had intensified public policies focused on boosting the purchasing power of its poorest citizens and improving access to essential services such as education, healthcare, and sanitation, the prevalence of stunting among children under 5 years old would have decreased to below 3% by 2017. Achieving this milestone would have effectively ended stunting as a public health issue from that year onward (Monteiro et al., 2009; de Albuquerque et al., 2023). It must be highlighted that currently the most affected people are the indigenous communities from Amazonia. This is related to two recurrent factors that are often at the basis of unsuccessful implementation of programs, that is, lack of government intervention and uneven implementation, together with corruption and/or influence

by third parties. In the case of Brazil, government interventions and visits are rare, around one per year. Health facilities are lacking, and food provision, often provided by the few health facilities, was suspended in 2017, making people stop seeking treatments, since it implied long journeys across the amazons. Aid limitation is also related to the presence of illegal miners in the region, which recurrently threaten missionaries and volunteers, while at the same time, polluting the water of the region through their illicit activities (Oliveira & Agência Pública, 2021).

3. India

Despite being one of the most growing economies, malnutrition programs in India have not proved to be of great success. This again has to be attributed to how government intervention is brought forward. Indeed, the budget assigned to malnutrition has diminished in recent years, and various health facilities across rural regions were closed. In addition, it is necessary to note that India is an extremely heterogeneous country, thus national policies often prove ineffective, due to the large diversity present within India. The programs adopted should be region-specific, in order to concretely target the main issues affecting the area (Katoch, 2024). Moreover, another common issue for nutrition programs is that the food given does not contain all the necessary micro- and macro-nutrients, thus limiting their effectiveness (Kundan Pandey, 2013; Das & Mohanty, 2021; Daniyal, 2022; Biswas, 2024). Katoch, 2023, notes that one of the main reasons for nutrition program failure in India is related to food waste. Large quantities of food are lost due to inadequate warehousing and inefficient supply chains. In addition, he highlights that improvements in sustainable agriculture must be present for the successful implementation of programs. Sustainable agriculture is crucial to maintaining food security by ensuring consistent and equitable access to food. However, challenges such as climate change, land degradation, and resource mismanagement undermine these efforts. This means that in order to be effective, programs should not only focus on food availability itself but also on farmers' education on food management and sustainable agriculture, so as to limit the possible food losses (Katoch, 2024).

Common Features Which Hinder Success in Nutrition Programs

From the above-mentioned failed attempts we can extrapolate the common actions which hinder or do not support reductions in childhood malnutrition. The first can be considered as being the reductionist focus on undernutrition, which is not considered as a multisectoral issue. Programs are often driven by temporary solutions that do not tackle structural issues, limiting long-term impact. Moreover, they often fail to address sustainability, leaving vulnerable groups dependent on external aid. The second issue relates to the local staff needed to implement the program, who often are not qualified enough to address malnutrition (Mejía Acosta & Fanzo, 2012). Moreover, the staff, if they do not belong to the targeted community, may face language

barriers, because the target population commonly speaks the local language or dialect. In the case of Ecuador, it was found that, while many indigenous people can communicate in Spanish, a considerable number, particularly women, young children, and the elderly, either lack proficiency or have limited understanding of the language. To this language barrier, it is necessary to add that there is recurrent distrust of outsiders. This must be mainly attributed to the fact that outsiders have a limited understanding of traditional practices and may try to impose their knowledge on them. The distrust of outsiders highlights the importance of training community volunteers to deliver nutritional counseling and address harmful superstitions related to illness management (Walker et al., 2007). Another problem is funding, including inadequate or poorly managed resources and reliance on external donors, which further weaken program sustainability. Complex funding mechanisms often lead to inefficient and non-transparent operations. These non-transparent operations may be worsened by insufficient data collection and monitoring, which limit the ability to track progress, adjust policies, and integrate community feedback, which are essential for programs to succeed. The discrepancy reinforces existing social and economic inequalities, increased also by logistical challenges and weak infrastructure that hamper the delivery of aid. The result is that food aid, when it reaches these areas, may consist of low-quality, or expired food that do not meet nutritional needs and can pose public health risks (Mejía Acosta & Fanzo, 2012; Mejía Toro et al., 2023).

Artificial Intelligence and Chatbots

Artificial intelligence is being used to address childhood malnutrition by a number of organizations and practitioners to detect, prevent, and intervene in contexts where children suffer from, or are at risk of, malnutrition. AI models are currently being utilized in health care contexts, such as in the creation of Decision Support Systems (DDS), which assist professionals in making complex decisions, for instance in treatment plans (Janssen et al., 2024). Artificial intelligence has also begun to be deployed as a tool to more accurately measure a child's growth markers and to assess an individual for signs of malnutrition. For instance, a German organization, *Welthungerhilfe*, in conjunction with Microsoft, developed a smartphone app which uses a smartphone's infrared camera sensor to take measurements of a child. The motivation for the app stemmed from the lack of training in workers who conduct measurements of children in India. An article by Microsoft describes the issue that "(m)ost workers are ill-equipped or unskilled leading to flawed data." Furthermore, the hope of the app is to conserve and redirect funds which had been previously dedicated to collecting measurements manually (*Child growth monitor*, 2019).

In addition to providing tools for clinicians in a health care setting, AI has impacted individuals in their homes through chatbots accessible via smartphones. In India, a chatbot named *Poshan Didi* was developed to provide nutrition counseling to mothers with children under the age of 12 months old (Tomar et al., 2023). The bot provided guidance on nutrition according to the child's age, and was ranked highly by users as being a knowledgeable source of information. In addition to communicating with the bot's standard message programs, 64% of users utilized the bot's additional feature of being connected to a nurse through escalated messages. Similarly, a nutrition-centered WhatsApp chatbot piloted by UNICEF was deployed in Indonesia. The bot provided resources to families via text, video, or audio messages. Experts believe chatbots such as this may increase the efficacy of adherence to treatment plans, as parents are able to inform themselves through the bot. This accessibility may help to educate all members of the family, including cases where one parent may reject the idea of the treatment, or may be concerned with contacting medical professionals for fear of being accused of neglect (UNICEF Indonesia, 2021).

Similar chatbots have been developed worldwide in the general field of health care, ranging from bots specialized in the topics of sexual health to mental health. Big Sis, a WhatsApp and Facebook Messenger-based bot designed and implemented in South Africa, has counseled over 100,000 young girls through more than 1.2 million messages exchanged on the topics of sexual health and sexually transmitted infections (*Big Sis is here for you*, n.d). Similarly, in the field of mental health, a chatbot named *Wysa* was developed, reaching more than 3 million individuals (Tomar et al., 2023). Users self-reported improvements in mood, with a majority of users reporting conversations with the bot as "helpful and encouraging" (Inkster et al., 2018).

As the use of artificial intelligence remains a relatively recent development in health care, it remains to be seen how AI will impact rates of childhood nutrition. To date, no specific quantitative analysis has been reported on the efficacy of AI in reducing malnutrition rates, likely due to its novelty, limited data, and intersections with traditional methods of treatment. Regarding chatbots, the apparent success from self-reported evaluations of users as well as organizations using the technology must be considered, and elements incorporated into their bots can be used as a source of inspiration.

Findings and Analysis

Interviews with Key Informants

Following the systematic literature review, we initiated interviews with key informants in search of additional and supplementary information which could not be gathered from the literature. We interviewed the informants on four primary subjects: (1) WASH initiatives as they relate to malnutrition, (2) the impact and strategies of current and prior malnutrition-related initiatives, (3) other considerations not extensively or previously accounted for, and (4) digital solutions such as chatbot interventions.

WASH and Malnutrition

When focusing on malnutrition, we can affirm that the interviewed experts generally confirmed the literature, but some elements which were less considered in the previous analysis, were highlighted.

The most recurrent issue, flagged by several interviewees, has been the lack of implementation by the government of Quito. Professor Rivera Vásquez from the *Universidad Andina Simón Bolívar* clearly expressed the problem. He affirmed that what is missing the most is "trabajo territorial" (local work). Indeed, policies are usually well-designed in Quito, Ecuador's capital. For instance, the government has tried to establish several kinds of roundtables across the country (intersectoral, cantonal and parish), gathering civil society, the government, and corporations. However, in practice, public policies do not reach the locality, meaning that no government representative goes to give an example in the territory. This limits the effectiveness of public policies, as the main organ that should implement these policies stops before they fully reach smaller regions. On this point, it is essential to highlight that the *mesas parroquiales* are a recent phenomenon. These kinds of meetings are necessary to concretely understand the needs of the local population, being the form of government representation closest to the people. As highlighted by Veronica Cando, former Vice Minister of Social Inclusion at the Ministry of Economic and Social Inclusion (MIES), these *mesas* resulted to be one of the strategies adopted to truly understand the needs and difficulties of the population, and to understand the real targets of the government.

Another problem highlighted by Professor Rivera Vásquez is in regard to the weak regulatory framework. Indeed, despite the presence of several laws tackling malnutrition, they

are often adopted in the form of decrees, which means that whenever there is a new government, decrees can be modified or removed. To promote effective changes, laws should be approved by the State assembly in order to gain stronger regulations. This problem was underscored by Ms. Cando as well. She affirmed that in order to limit the institutional weakness of these decrees, it would be important to add in the constitution a dedicated governmental organ that strictly focuses on malnutrition, hence reducing the possibility of removal by a newer decree. Related to this volatile situation, Professor Rivera Vásquez revealed that under the last presidency, the funds and thus the intensity in tackling malnutrition decreased. The absence of state funding is worsened by the fact that funding by international organizations is limited, thus everything is dependent on government spending. Still, Mr. Byron Cunalata, President of the El Rosario Decentralized Autonomous Governments (GAD) in Ecuador, underscored that the most important help is provided by the central government, the Ministry of Health, and by the attention provided to children through several program, such as "Creciendo con Nuestros Hijos" (CNH). Through this program, educators from the community visit the homes of pregnant mothers and children under two, to give advice to allow and improve children's early development. The GAD supports the government and ministries in the organizational part, showing their political commitment in the fight against malnutrition. Furthermore, they have created complementary activities, such as endowing the population with some household goods, consisting of small animals, like guinea pigs, and plants which can be grown and used for nutrition.

One fundamental issue is the contradiction between standardized and localized policies. Indeed, on the one hand, we spoke with an organ of the Ecuadorian government dealing with child malnutrition, and it affirmed that policies are initially centrally planned and later shaped according to the needs of the various areas. On the other hand, Professor Rivera Vásquez noted that policies are generally standardized across the country. The organ of the Ecuadorian government stated that it has priority areas where it directs most of its actions. It affirmed that it tries to have some strategies, some specific policies, however this is heavily dependent on the territory because Ecuador has many different indigenous communities. Each community has different customs and traditions, to which policies have to be adapted, depending on the territory. Furthermore, this organ has to translate policies or advice into the language indigenous communities speak.

As previously mentioned, according to Professor Rivera Vásquez, policies in Ecuador are standardized. This leads to several problems, as Ecuador consists of four main regions (coast, highlands, amazons and islands) across which several differences exist, from geographical characteristics, composition of population, but most of all, availability of services. Ms. Cando

revealed that, in order to reach the largest number of areas in the country, some services are provided online, such as check-ups by the educator from the CNH, to substitute the in person ones when the situation becomes too dangerous to visit.

Professor Rivera Vásquez mentioned the "paquete priorizado", a set of goods and services intended to care for pregnant women and children under 24 months of age, which is part of the decree n° 1211 of 2020, approving the implementation of the national strategy "Ecuador Crece sin Desnutrición". Professor Rivera Vásquez underscored the fact that often the package does not focus on social determinants of malnutrition, such as the lack of potable water or mothers' unemployment, hence limiting the purposes of the *paquete,* which generally include mothers' check-ups and children's assistance. Moreover, given the remoteness of the area, several goods and services do not reach the highlands. He clearly highlighted how the existence of the package is limited by structural issues. Even if provisions like the "paquete prioritario" exist, the problem will not be resolved if prior to that, the government does not manage to provide basic services, such as access to clean water or garbage collection.

Nevertheless, both Ms. Cando and Mr. Eduardo Acosta, member of the GAD of Santa Rosa, a parish in the Tungurahua province, underscored the importance of the CNH and the Centros de Desarrollo Infantil (CDI), which are similar to a care space, where professionals attently monitor children's development. Children spend around 8 hours per day in the centers, which also serve food four times per day. These programs target around 280,000 children per year, which, according to Ms. Cando, is the number of children born each year. However, Ms. Cando highlighted that what truly helped the reduction of CCM, decreasing by 2.8% from 2023 to early 2025, was the recalibration of the programs' target. For instance, the CDI only dealt with children over the first year of age, when development is already compromised. The effectiveness of MIES under Ms. Cando was achieved by mostly focusing on pregnant women and children under the six months of age. The MIES also focused on the fact that children continued to attend programs, to make sure that they fully developed. As a matter of fact, one of the largest problems were the programs' dropouts, mostly due to the inattention and lack of knowledge of parents. To limit this dispersion and to monitor their progress, the MIES started to track children to check the effectiveness of the programs. Moreover, they tried to make the public aware of the importance of school attendance and they trained educators to the importance of healthy eating, to make mothers more aware.

Building up on this, it is important to share what Professor Rivera Vásquez has repeatedly highlighted regarding the idea that public policies in Ecuador sometimes lack cultural adaptation. Policies are not created to specifically address a single population, and the lack of

dialogue between indigenous communities and the government leads to the creation of barriers between the two sides. For instance, one of the most straightforward ways to limit illnesses is by washing hands prior to eating. The government has tried to introduce this simple measure, but as highlighted by Professor Rivera Vásquez, there may be limited availability of water. Dr. Denisse Calle Celi, country manager of Project Hope in Ecuador, added that if people have to walk three hours to get water, it is highly probable that people will not use that water to wash their hands, but rather for drinking, for cooking, and for their kids. Hence, these cultural barriers limit the effectiveness of nutrition policies and this has been confirmed by the organ of the Ecuadorian State dealing with malnutrition and by Ms. Cando, who highlighted how "the focus on details is what makes policies effective". This organ has shared that often the implementation of policies clashing with cultural beliefs requires more time. Hence, it developed "local communication plans". These plans have been developed to address the challenge of designing local plans and carrying out the diagnoses, together with their implementation which, as it has been affirmed, is slower and takes time, because, this new co-responsibility of the population implies a change in behavior, which needs time to take place.

However, despite the existence of these local plans, one of the main remaining issues relates to resources. This has been clearly underscored by Mr. Acosta, who affirmed that despite project development by the government, no specific funds to dedicate to them. He went on affirming that most of the times, money needs to come from the general funds of the GAD or they have to individually ask for funds to each of the directories part of the *mesa*. Mr. Acosta suggested that one way to solve this problem would be to go through private companies or banks. He highlighted how the money banks and private companies need to dedicate to the social sector, could be given to fight malnutrition. According to Mr. Acosta, funds from the private sector could become means to incentivize mothers to attend regular check-ups and improve children's nutrition, however other experts, such as the nutritionist from El Rosario, have agreed that this is often not the case. She affirmed that despite the recurrent incentives provided to mothers to attend regular check-ups, they did not work, due to the lack of awareness and to the distances they have to cross.

Nevertheless, it is essential to highlight the existence of the advisory council against chronic malnutrition in children, where all the actors involved in the fight against malnutrition are part of. The council is quite new, it was created in 2022, through a ministerial agreement, but it represents a first step towards the concrete cooperation of different spheres of society. The council includes civil society, NGOs, universities, the media and international agencies. The main aim of the council is to develop, participate and monitor the implementation of public policies. This organ is fundamental because it guarantees the institutionalization of the fight

against child malnutrition. It represents an initial step in the creation of stronger institutional frameworks in the reduction of CCM.

Finally, we need to address the idea brought forward by the president of the GAD. He highlighted how the section of the Ecuadorian State tackling child malnutrition should move beyond its coordinating and overseeing role across the ministries, and how it should be the entity responsible for the delegation of functions between the State and the municipalities. It should also have a sanctioning power, meaning that if the responsible body does not comply with its competences, it should have some kind of sanction, since right now there is no entity sanctioning them.

In addition to the governmental challenges regarding malnutrition, another element to be considered is the limited dietary variety. One of the main issues that experts have witnessed in the highlands region is the overconsumption of highly processed foods, carbohydrates and limited consumption of vegetables, often connected with the stigma derived from consuming indigenous food. A nutritionist working in the parish of El Rosario, one of the parishes with the highest rates of child malnutrition in the Sierra, highlighted the large consumption of carbohydrates, being mostly flour-derived products, potatoes, rice, and noodles. This is connected to three main problems:

1. Despite the presence of fruits and vegetables, there is limited consumption of them, especially of the latter. According to the President of the GAD, this can be attributed to the limited knowledge of communities on the importance of a balanced and nutritious diet, which is mainly connected with an adequate consumption of vegetables and proteins.

2. A recurrent problem is that, generally, what is produced by communities is sold on the market. For most of the local population, this is the main means to generate income. However, they receive little money from what they produce, meaning that their consumption is limited and hence can only afford carbohydrates or highly processed foods.

3. The last element to consider is tim**e.** As a matter of fact, most of the traditional and nutritious foods require a lot of time to be prepared, as Professor Rivera Vásquez and Dr. Stella Nordhagen, Senior Technical Specialist with the Global Alliance for Improved Nutrition (GAIN), have underlined. This means that people will tend to prefer quickly ready foods, like pasta.

Professor Ocampo, a registered dietitian currently coordinating the Nutrition and Dietetics program at the Universidad San Francisco de Quito, affirmed that processed food consumption has tripled, and the reason is mostly economic, besides cooking rapidity. As a matter of fact, she highlighted how the limited income of indigenous families allows them to only consume processed foods, which are cheaper but lack nutritional value. Moreover, one element to consider in food consumption is related to a stigma on indigenous food, especially when consumed outside of communities, because, as Dr. Nordhagen affirmed, people emerging from poverty often are aspiring to the lifestyles of the people who are just above them in the social hierarchy, hence they refuse traditional food to be easily accepted.

Another contributing factor to child malnutrition is considered to be WASH (water, sanitation, and hygiene). Access to safe water is one of the most important contributions to the reduction of child malnutrition. This was clearly underscored by Ms. Cando, who highlighted how, if the problem of water is not corrected, there will be no means helpful enough to solve the issue, meaning that despite correct nutrition and political will, CCM will persist. The MIES is training educators on the matter, for instance by having them recommend mothers to wash their children with boiled water, since most of the time, water is neither drinkable nor can be used to bathe children.

One of the main challenges related to access to and management of WASH in Ecuador lies in the population's limited perception of its importance for health. Many communities believe that simply installing a pipeline will solve the problem, without considering that access to safe drinking water involves much more: adequate water treatment, hygienic storage, and education on safe practices such as boiling water before drinking it. In several rural areas, such as the parish of El Rosario, barely 4% of the population has access to piped drinking water, and in many cases, there is not even a defined water project or a clear statement of intent to build from local authorities, as highlighted by the President of GAD. Dr. Calle Celi also noted that the infrastructure is precarious, and solid waste collection is also inefficient, contributing to the accumulation of garbage in the streets, the proliferation of stray dogs and mosquitoes, and a general deterioration of sanitary conditions. Furthermore, many homes lack sewage systems or adequate sanitary facilities, further exacerbating public health problems. Even when awareness-raising efforts have been made regarding the need to boil water, people often do not do so due to lack of time, resources, or simply out of habit.

In response, the State has promoted behavior change strategies based on community assessments, through local communication plans. However, policies implemented by the State require time. Dr. Calle Celi noted that, although the Ministry of Public Health and other entities

have protocols, manuals, and strategies on paper, these are often not effectively implemented in the country. Plans are written, but executing them is another story. Many NGOs and international organizations that have attempted to collaborate find themselves blocked by slow legal processes, a lack of political will, or a lack of coordination between institutions. It is important to underscore that NGOs, though seldom acknowledged, frequently achieve limited or suboptimal outcomes due to insufficient support from public authorities, which underscores the paradox inherent in their designation as "non-governmental", which implies expectations of capabilities beyond those of the state. This inefficiency of the State has led many organizations to choose to work in parallel with it, missing out on valuable opportunities for joint impact. As a matter of fact, many organizations end their collaboration with the government because, generally, the latter, despite theoretically working concurrently with NGOs, does not efficiently carry out projects, limiting their possible success.

According to Mr. Acosta, the most important cause of malnutrition is the lack of awareness of parents. In the majority of cases, parents have limited knowledge on the importance of prenatal check-ups, safe water consumption and healthy diets. This issue limits the opportunities parents have to improve their children's nutritional status. For instance, Mr. Acosta affirmed that, in the case of the parish of Santa Rosa, despite having the possibility for several pre- and post-natal check-ups, many mothers avoid going to controls because of their fear of the Public Health Ministry, which is generally caused by their lack of knowledge on the matter. According to Mr. Acosta, this limited awareness influences sexual education as well. Mr. Acosta underscored the recurrent problem of adolescent pregnancies in the parish, and highlighted how this is largely caused by limited knowledge people have on the subject. It is important to say that, according to the WHO, 2024, teenage mothers (that is, those aged between 10 - 19 years) face higher risk of eclampsia and systemic infections than women aged 20 -24 years, and babies of teenage mothers face higher risks of low birth weight, malnutrition, and severe neonatal conditions. Hence, one of the main objectives of the parish is to increase general awareness through workshops and home visits.

The last element we found having a negative impact on nutrition is the absence of pre and postnatal controls, as underlined by the nutritionist of El Rosario. One of the key findings was that many women in rural areas hide their pregnancies, which prevents early detection by the health system and delays the start of prenatal care. This situation limits the ability to adequately monitor fetal development and maternal health from the early stages, increasing the risk of low birth weight and subsequently developing chronic malnutrition. It was also identified that, although there are extramural care strategies, such as home visits, these are not applied consistently or frequently enough. Ms. Cando affirmed that during her tenure as Vice Minister at

MIES, one of the largest issues was the fact that sometimes educators did not pay enough attention during their home visits or the time dedicated to mothers and children was less than supposed to be. They also had some cases in which they discovered that educators never performed check-ups on the children they were supposed to visit. To solve this problem, they started using GPS systems on the educators cell phones, which were regularly checked.

Moreover, it was observed that many mothers do not attend postnatal checkups, and that health centers in these areas often have medical presence only once a week for a few hours, which hinders regular access to basic services. Moreover, Professor Ocampo highlighted that when more complex care is needed, families must travel long distances to reach larger hospitals, often without support for lodging or transportation. Even upon arrival, public hospitals frequently lack adequate equipment, medical supplies, and medicines, leading to long wait times, sometimes up to a year, for diagnostic tests or specialist visits. Although public healthcare is legally free, access is increasingly restricted for the uninsured, and private insurance or out-of-pocket costs are unaffordable for many: a C-section, for example, costs over half the minimum monthly wage of $400 USD.

Furthermore, it was evident that the emotional and social component, such as the "embarrassment" some mothers feel when visited in their homes, can play a positive role in raising awareness about their children's health. Finally, although programs such as "Ecuador Crece sin Desnutrición" exist, it was found that their implementation in the field lacks consistent monitoring, adequate coordination, and sufficient resources to achieve a sustained impact.

Current and Prior Malnutrition Initiatives School Programs

In Ecuador, the national school feeding program was originally implemented not as a public health or nutrition initiative, but primarily as a social policy aimed at increasing school attendance and preventing dropouts, particularly among children from low-income households. The program provides free meals to public school students, but the food is often ultra-processed, such as cookies, sweetened yogurt, and cakes, supposedly fortified with iron, as it was clearly underlined by Professor Ocampo and the representatives of the Ecuadorian State dealing with child malnutrition. Despite health ministry guidelines on sugar and fat content, these items fall short of addressing the broader issues of malnutrition, including both deficiencies and excesses. In contrast, private schools, which are not beneficiaries of the public program, generally have access to higher quality and more diverse food options.

An alternative to the free meal provision exists in the form of school cafeterias, which are regulated to offer more natural, regionally appropriate foods such as corn and ceviche. However,

these healthier options come at a cost to students, making them inaccessible to many low-income families who rely on the government's free provision.

Furthermore, we spoke to Mr. Carlos Cisneros, a professional with experience in the direction of public policies on social development, education, and public health to provide us with further background on school feeding programs in Ecuador. It should be noted that Mr. Cisneros's statements reflect his personal capacity and not that of his current or previous employer. He noted that, while there were efforts to transition towards healthier, locally sourced meals (e.g., incorporating a fruit per day) by decentralizing the program implementation, these faced logistical, financial, and political challenges, mostly related to budgetary constraints and cost-effectiveness concerns. Decentralizing the system and involving local communities in both planning and production was envisioned as a sustainable, culturally sensitive solution, but implementation remained stalled. He noted that although an intersectoral committee and a proposed national law were important achievements, the model has largely remained unchanged over the years, with the same providers and minimal progress.

The main problem related to school meals is the fact that programs arrive too late to reverse early malnutrition, as the most critical window for intervention is before the age of five, as highlighted by Mr. Cisneros. Hence, government efforts are more focused on reducing stunting among children under five and improving the health of pregnant and breastfeeding women. According to Professor Ocampo, this has diverted attention and resources away from school feeding programs, despite their potential role in supporting child health and development beyond the critical early years.

Other Considerations : Dietary Diversity, Cultural Beliefs, and Education

As previously highlighted in this report, a common theme of successful interventions in malnutrition often recognize the multisectoral, multifaceted nature of childhood malnutrition. This is to say the recognition that malnutrition is not due to any single factor alone, but from the culmination of a variety of factors. In addition to the aforementioned gaps in policies and interventions, additional factors which became recurring points of consideration from many of our interviewees were the issues of poverty and its secondary effects, as well as cultural considerations, such as when working with indigenous communities. Besides limited financial resources, poverty creates additional factors affecting nutrition, such as lack of diversity in diet, time constraints, or WASH-related issues as previously discussed.

Regarding dietary diversity, this factor may be linked to food deserts or the issue of selling what food is produced to earn money quickly, rather than using the harvest for personal

consumption. This fact can be associated with the reality that in Ecuador, UNICEF's 2023 Country Report notes that "only around 35% of the economically active population are adequately employed…[and] income poverty stood at 27%, surpassing the pre-pandemic level of 25.5%." The Country Report specifically notes that children are in particular the most affected by poverty (*UNICEF* Ecuador, n.d.). As a potential remedy for low nutrient diversity, a few of our interviewees particularly focused on the concept of agroecology or small home gardens in order to inject additional diversity and fresh foods into the diets of those affected by poverty and malnutrition. We spoke with a professional with a diverse background in the areas of WASH and malnutrition on the issue, who has previously worked with an organization promoting regenerative agriculture in rural communities within Latin America. Our conversation included practical recommendations for successful farming-based interventions, such as the fact that shared group gardens are often more successful than individual family gardens. Furthermore, we spoke with Dr. Larissa Da Silva Araujo, a Postdoctoral researcher specializing in agroecology, and who has also worked extensively alongside Los Kayambis in Northern Ecuador during her PhD thesis. During our conversation with Dr. Da Silva Araujo, she revealed insights about her time living in Northern Ecuador. She discussed habits observed, such as the popularization and "trendiness" of consuming processed, non-local foods. Through anecdotes of the women she worked with, she revealed how the consumption of traditional, local foods are often discriminated against, as the women recounted their children returning home from school having not eaten their packed lunch due to discrimination. We discussed how through agroecology and community gardening, it is possible that the consumption of local, traditional foods may once again become popularized.

Furthermore, when working with indigenous communities, it is essential to consider culturally rooted dietary practices, belief systems, and other behavioural patterns. In separate interviews, both the nutritionist and CNH Educator working in the Ecuadorian central highlands discussed dietary elements which may be culturally-influenced in indigenous communities, such as eating little to no meat, or consuming primarily dried grains and beans. Regarding indigenous values, Dr. Denisse Calle Celi, the previously introduced Ecuadorian-based public health specialist, shared with us her experience working in these communities. She stressed that when working with indigenous communities, it is critical to approach any intervention first with the desire to understand the local beliefs and needs. She recounted an experience working with the Awá people in Ecuador, and how they believe that nature is the ultimate protector of human beings. Thus, when told to boil water, the people were in disbelief in understanding how the substance meant to provide life should be killed through boiling. Dr. Calle Celi stressed that in these instances, it is crucial to respect and understand beliefs, and from this point only can you develop solutions to effectively transform people's practices.

Habits and practices–whether they stem from indigenous worldviews, cultural traditions, or simple routines–can at times be a critical barrier to lasting change. Eduardo Acosta from the GAD in Santa Rosa recounted difficulties in encouraging constituents in his parish to adopt safe water practices. "We do recommend boiling water. But we don't do it, no? We go to the faucet, we turn on the tap, and we take a glass of water and we drink it. So those are things that are part of our culture that we have not been able to change…It is a very, very drastic, very big barrier. And it is an issue of educating people." Similarly, Verónica Cando Benavides described how during her tenure as Vice President of Social Inclusion in Ecuador, it was challenging to transform the habits of locals. For instance, she mentioned that Ecuadorians are culturally accustomed to eating soup with meals. She noted that despite this deeply-rooted habit, in their program design, main dishes were prioritized rather than soup to ensure proper nourishment. A greater challenge, she explained, was changing the widespread habit of feeding children "colada" (a sugary, flour and fruit-based drink drink). Despite her team's efforts, this habit proved resistant to change. Additionally, she argued that drinks such as this caused bloating, rather than balanced nutrition, in the children. Parents confused this bloating for chubbiness, and were thus unconvinced that their children could be affected by chronic malnutrition. As previously mentioned, Gloria Ramirez (the CNH Educator) supported this observation. She described how families often do not know how to recognize malnutrition in their children, and that families eat diets centered around refined carbohydrates, such as colada, noodles, and flour-based foods. She recounted how she hears families often saying their child is chubby and thus cannot be malnourished. The families do not realize that body mass is not an indicator of health, and that they can indeed still be affected by stunting and malnourishment.

President of the GAD in El Rosario, Byron Cunalata, noted that access to nutritious foods is not a barrier in the region. From his point of view, a primary issue is that people are not aware of nutritional properties and lack the knowledge of what constitutes good nutrition. Despite the access and availability of healthy options such as vegetables and legumes, families choose not to prioritize these foods. Eduardo Acosta from the GAD in Santa Rosa echoed this sentiment. From his point of view, due to lack of awareness on nutrition, parents are overly flexible when it comes to food for their children. He describes: "A child will say, 'I don't like beets', without knowing the nutrients that beets have…And we, as parents with ignorance [regarding nutrition]..feed them with other artificial things that in the future will not serve as nutritious food for our children." Insights such as these highlight the critical role of nutrition education to combat chronic childhood malnutrition in the region.

When designing education-focused initiatives, several practitioners emphasized the need to tailor nutrition interventions to the daily realities of families, particularly in indigenous

communities. When working with indigenous populations in nutrition education, for instance, the previously introduced WASH and malnutrition professional recalled offering workshops with cooking demonstrations to show different ways to prepare common foods in nutritious ways. They noted that due to various reasons, be it time constraints or other, women generally lack the time to be creative in the kitchen. Therefore, they recommended offering a few "go-to", practical recipes, rather than a large amount of information which might feel overwhelming. These recipes could be designed based on optimal protein, iron, or other nutrient targets, while being economically conscious. Dr. Stella Nordhagen similarly echoed this approach. She highlighted the importance of ensuring that recipe and dietary recommendations are in line with the local context. When designing these interventions, she stressed that the availability, seasonality, and affordability of food must be considered. Additionally, it is important that the recipes can be prepared in a way that families are used to preparing food, making them more likely to be adopted and sustained. Dr. Nordhagen particularly underscored the issue of convenience in families' food choices. Indeed, while many nutritious foods are locally available, these foods often require additional time to prepare. She noted a key consideration in recipe design: "How can we make some of these nutritious local foods less inconvenient?". She also encouraged considering family food dynamics, such as if separate meals are prepared for young children, or if the same dish is shared by the family. Together, these ideas reaffirm a central theme: successful nutrition education must balance cultural and practical relevance. By minimizing disruption to families' routines and recognizing the constraints (time, financial, or other) that they face, initiatives can create sustainable improvements in dietary practices and malnutrition rates.

Digital Solutions and Chatbots

Given the aforementioned barriers–such as weaknesses in policy implementation, deeply-rooted cultural practices, and limited education on nutrition–digital solutions like chatbots can serve as an effective tool to bridge knowledge gaps in a way that is tailored to the needs of individual communities. Chatbots provide accessible, on-demand, and easily understood information, making them valuable for time-constrained families or communities with limited access to health services. Furthermore, unlike traditional educational materials, digital tools can cover a wide range of topics at once—from child feeding practices, to recipes using local ingredients, to hygiene, water, and food safety tips. As Byron Cunalata, President of the GAD in El Rosario, described: "Above all, there is more efficiency because in the chatbot situation, as soon as I have a requirement, a question, I just consult and the answers are immediate." Individuals worldwide are increasingly engaging with technology, even in rural communities, which makes the use of digital solutions in treating issues such as malnutrition increasingly relevant. When thoughtfully designed with the local cultural context in mind, chatbots can

complement traditional public health interventions and help create more inclusive solutions to chronic malnutrition from within people's own homes.

To build upon our initial research in prior digital solutions, we spoke with professionals with expertise in the area. Namely, we spoke with Namrata Tomar, a professional who played a key role in the development and implementation of the previously discussed nutrition and health-focused chatbot *Poshan Didi* in rural India. Through our conversation, Ms. Tomar provided us with more specific information about the implementation of the chatbot from development, to onboarding of users, to details of its use by users. She noted that when developing *Poshan Didi* (meaning "Nutrition Sister" in Hindi) (Tomar et al., 2023), an approachable, non-demeaning personality of the chatbot was desired by the developers to match the needs of the users and promote engagement. Thus, much effort regarding language and phrasing was put into the bot to ensure this persona was achieved. We additionally spoke with a professional who has extensive experience working in the field of digital solutions. She confirmed the importance of language, noting that if the language is too formal or complex, users will quickly disengage with the tool. Furthermore, it is important that the tool features the correct language for the users, such as any indigenous dialects.

When initially implementing Poshan Didi, a brief onboarding (of less than 1 hour) was provided to users to ensure a basic understanding of the chatbot. No specific incentives were provided to encourage user engagement, however there were snacks present at the onboarding meeting. Regarding user participation, Ms. Tomar highlighted that while implementing the chatbot, their team recognized the importance of gaining male participation and support, as male family members were typically the ones owning the smartphone or having primary use during working hours. In relation to this point, it should be noted that mothers were typically most active in conversing with the chatbot during evening hours, as male family members were most often home at this time and the smartphone became available (Tomar et al., 2023). On the theme of implementing chatbots, Dr. Stella Nordhagen additionally noted the importance of generating interest and exemplifying "usefulness" when users first interact with the tool. In her opinion, when launching a chatbot, there is a "thin margin of error"; if users do not find the technology useful enough, they will quickly disengage after the first few uses. Once an individual becomes disengaged, it will be even more challenging to re-convince them to try the tool again. To promote engagement with the chatbot, one feature to consider is push notifications. *Wysa*, the previously mentioned chatbot focusing on mental health coaching, utilizes a notification system which "checks in with patients every morning and evening" ("Wysa AI", n.d.). Notifications can serve as a useful reminder to re-engage users with the bot should there be a lag in activity as well as to build rapport ("Wysa AI", n.d.).

Similarly, the Poshan Didi chatbot was equipped with a functionality for users to type numbers corresponding to specific questions or themes. For instance, typing the number "2" brought up the content on "Importance of nutrition status and its knowledge with respect to your child", and typing the number "8" led to a "Quick Quiz" (Tomar et al., 2023). This keycode feature has been similarly used in other chatbots worldwide, such as the chatbot deployed in Indonesia by UNICEF to educate caregivers on nutrition (UNICEF Indonesia, 2021). Ms. Tomar noted that this proved to be a useful feature as not all users possessed the literacy to type full messages, or some users felt hesitant to type imperfectly phrased messages for fear of judgement. Ms. Tomar also noted that in addition to questions regarding recipes or nutrition, a common theme of questions asked by mothers were on the subject of seasonal illnesses. It should be noted however, that many mothers primarily engaged with Poshan Didi only when they had a specific question or issue they were facing (Tomar et al., 2023). Furthermore, an additional theme on contraception was added to the chatbot's functionality. She noted that contraception is a sensitive topic in India, and thus this feature was appreciated by users due to the access of information, as well as the sense of privacy and confidentiality they felt with the bot. Dr. Nordhagen similarly highlighted the value of expanding a chatbot's subject matter. She noted that "it's about demonstrating value to people", emphasizing the importance of addressing users' most pressing questions, even if they are not directly related to nutrition. Understanding what information the community seeks–whether related to contraception, illnesses of their child, cooking techniques, or even how to better support their child in school–is essential to the engagement of a digital tool. She noted that by incorporating topics users care about, it becomes possible to create natural connections and entry points for nutrition-related information, while still promoting the tool's core nutrition objectives. Finally, despite the bot's AI-based design, Ms Tomar recommended that a human continue to monitor the script as a safeguard to ensure accuracy. Regular monitoring of the script by a professional ensures the information provided is accurate, context-appropriate, and sensitive to users' evolving needs.

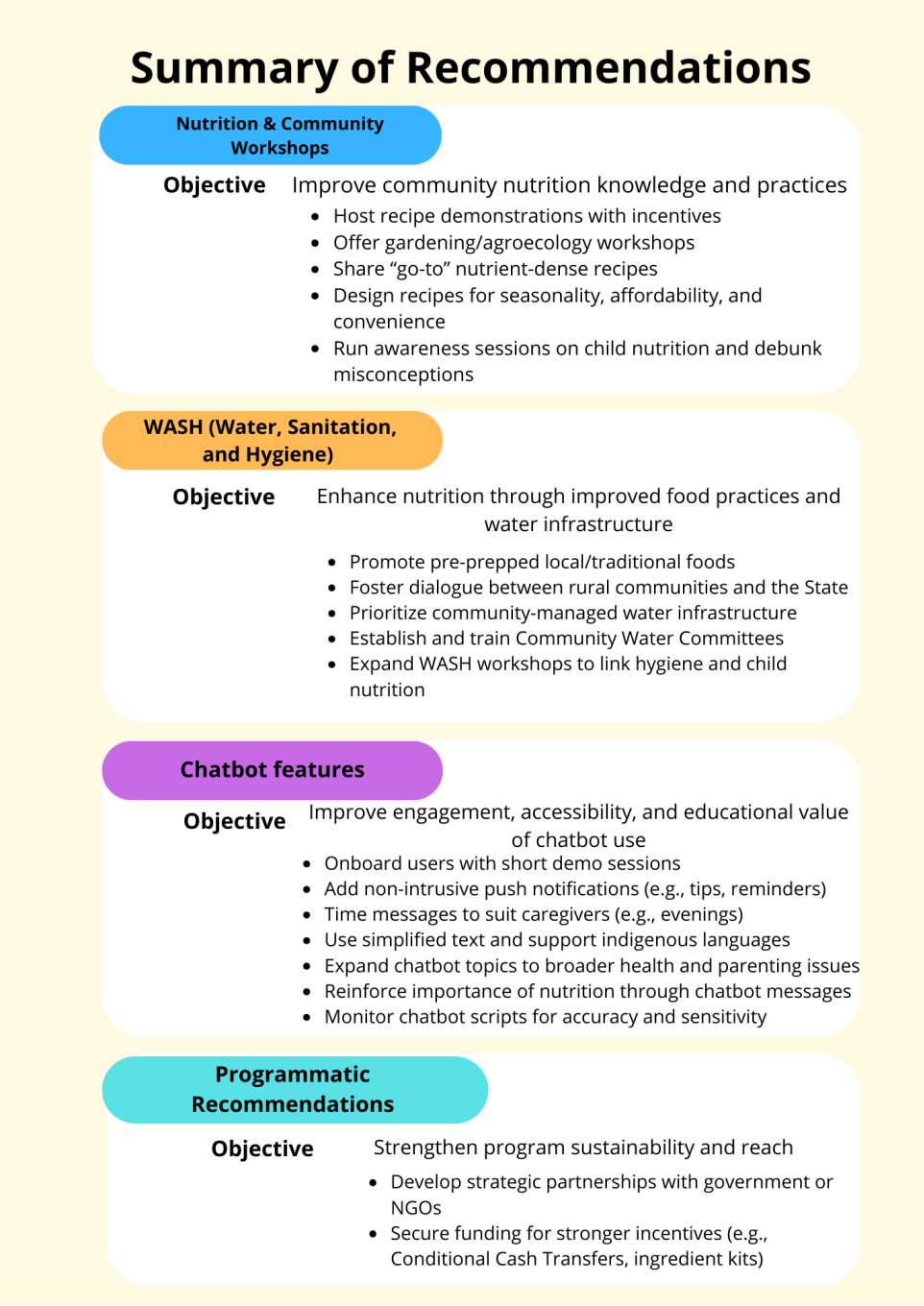
Possible Limitations to the Findings

Potential Biases:

Specialists interviewed may have presented an idealized view of their interventions, which might not fully align with on-the-ground realities. The interviewees likewise may have presented a viewpoint representative of their employer and not necessarily their own opinion. Inaccurate information reporting for questions which may require recollection of specific details, such as frequencies, percentages, or events which occurred years ago (e.g. in recalling the details or outcomes of a specific nutrition intervention) may also have been a factor.

Summary Recommendations

The following recommendations are based upon findings in the Literature Review as well as information gathered from interviews with key informants. Recommendations are organized according to their relevant category of Fundación ADHA's operations:



1. Nutrition & Community Workshops:

- **Recipes**: Empower caregivers to prepare affordable, nutritious meals through recipes that emphasize practicality, cultural relevance, and nutritional value.
    - **Activities:**
    1. **Simple, Nutrient-Focused Recipes:** Develop a small set of easy, "go-to" recipes for caregivers to prepare. Recipes can be designed to address nutritional needs (i.e. recipes high in iron, protein, or other nutrients). Ensure ingredients are locally available, affordable, seasonal, and culturally familiar. For instance, design a recipe around legumes, which are locally available and offer high levels of antioxidants, fiber, and nutrients like folate, iron and magnesium, while also requiring minimal time and effort to prepare.
    2. **Recipe Demonstrations:** Conduct cooking demonstrations during community workshops. Highlight time-saving methods and practical cooking tips to improve convenience.
    3. **Incentives:** Serve the cooked dishes to participants to build trust and encourage adoption. The dishes can double as an incentive to attend, especially in areas with low engagement.
    4. **Take-Home Materials:** Share simple recipe cards or other visual guides (especially for caregivers with low literacy). Include nutritional benefits of each recipe to demonstrate the nutritional advantages.
    5. **Collect Feedback:** Use informal surveys or group discussions to gather feedback on taste, ease of preparation, and likelihood of home use. Modify recipes based on gathered feedback.
- **Gardening and Agroecology:** Promote food security and nutritional diversity through agroecology and home gardening initiatives.
    - **Activities:**
    1. **Distribute plants, seedlings, and small animals:** Provide interested families with local seeds, plants, and small animals (i.e. chickens or guinea pigs) to inject additional diversity into their diets, as demonstrated by the GAD of El Rosario. Families with children under 5 could be prioritized, as this age range is critical to combating chronic malnutrition. In addition to serving as an immediate food source, these plants and animals can be cultivated and raised with relatively low maintenance, while receiving essential nutrients from, for instance, eggs provided by chickens.
    2. **Tailored Workshops:** Specific workshops may be designed to teach the basic elements of gardening and small animal care. Ensure the sessions are practical, designed with resource and time constraints in mind. Highlight the relevance and

link to nutrition throughout workshops, explaining for instance how specific plants or animal proteins support child nutrition.

- **Awareness-Raising**: Communicate the importance of nutrition to the local communities. Integrate educational sessions that explain *why* a child's nutrition matters—highlighting its impact on growth, cognitive development, school performance, and long-term health. Frame messaging positively, focusing on responsibility and "doing what is best for your children, rather than on insufficient practices and the issue of malnutrition which may be linked to feelings of shame. Consider addressing common misconceptions as well, such as how "chubbiness" can coincide with malnutrition.
    - **Activities:** Integrate a dedicated module of "Nutrition Matters" into the existing workshops. The session might include, for example: (1) Visual aids (i.e. growth charts, brain development diagrams) to show how nutrition impacts the body and mind over time, (2) An interactive game, such as "Myth vs. Fact", where participants compete to identify common misconceptions (i.e. A child can be chubby and still be malnourished = Fact), or (3) Testimonials or storytelling to demonstrate how nutrition matters through lived experiences.

2. WASH:

While Fundacion ADHA's primary focus is nutrition, research indicates that incorporating basic WASH elements can significantly improve nutritional outcomes. Some recommendations, such as for water infrastructure, are offered for consideration and future opportunities, should any future WASH programs arise (for example, in a government or organization-led piped water project).

- **WASH and Workshops:** Expand the already present workshops to help people understand the critical connection between WASH practices and child malnutrition. Address and educate on its importance as well as symptoms to try to fill the current knowledge gap.
    - **Activities:** Host monthly interactive sessions for caregivers (especially mothers) with a focus on WASH practices. The workshops could be held by identified and trained volunteers of the community, in order to enhance trust and closeness to the culture of the community. These workshops will use visuals, storytelling, and demonstrations to connect poor WASH practices with child malnutrition symptoms. Sessions will include practical demonstrations on handwashing, food hygiene, and safe water handling, followed by take-home materials to reinforce learning.

- **Water Infrastructure**: Prioritize community-level water infrastructure over individual solutions, such as piped systems managed collectively, which tend to be more sustainable and impactful in the long term than household-by-household approaches. Establish and strengthen Community Water Committees facilitates democratic selection, clear roles (finance, maintenance, water quality), and defined term limits to promote local ownership and continuity.
    - **Activities:** Organize a multi-day training workshop for selected members of the Community Water Committee. The training should cover governance (roles, responsibilities, and term limits), basic system maintenance, financial management (e.g., tariff collection and budgeting), and water quality monitoring. The final day should include a public handover ceremony to officially install the committee and build community trust and ownership.

3. Chatbot Features:

- **Initial Use**: Improve initial engagement of users through strategic onboarding.
    - **Activities:** Provide a short, engaging onboarding session to familiarize users with the chatbot. Focus on demonstrating the tool's usefulness and practicality to prevent early disengagement.
- **Push Notifications**: Strengthen user retention and engagement through follow-ups.
    - **Activities:** Enable reminders or push notifications to engage users after inactivity, while ensuring they are not overwhelming or intrusive. As follow-up messages are already incorporated in the *MANKA* chatbot, consider expanding the prompt to additional types of messaging, such as quick nutrition tips, or demonstrating additional ways to engage with the chatbot. For example: "Hi! Here is a quick tip from *MANKA*: Did you know that *x* food provides *y* percent of your daily requirement of iron?" or "Hi! It's been a while since we last talked. You can ask me anything, such as questions on recipes or on common seasonal illnesses in children". Furthermore, consider increasing the frequency of follow-up messages to a minimum of every 24 hours.
- **Enhance Use and Access of Primary Caregivers**: Recognize any family or gender considerations, such as male ownership/use of phones, to improve access to the chatbot and its features for primary caregivers like mothers.
    - **Activities:** Conduct group discussions or interviews to understand phone access dynamics and preferred times of use (for instance, in the evenings), particularly for women caregivers. Time chatbot activities, such as push notifications, accordingly around these preferred times of use.

- **Accessibility:** Enhance ease of use of the chatbot through additional features and considerations for local and indigenous languages.
    - **Activities:** Consider literacy levels by integrating a numbered text system to simplify user interactions while reducing the need for lengthy text inputs. For example, (e.g., "Reply with 1 for more tips or 2 for additional recipe suggestions" or "Reply with 1 to access content on recipes, 2 for content on food safety tips, or 3 for a quick quiz"). Furthermore, integrate additional dialects where needed and simplify phrasing to ensure it is not overly-complex.
- **Content Expansion**: Consider future content expansion that addresses the broader concerns and needs of the community.
    - **Activities:** Gradually integrate additional content on topics such as contraception, seasonal illnesses, and/or parenting according to the observed needs and interests of users.
- **Awareness-Raising:** Complementing the previous recommendation regarding *Community Workshops*, emphasize content that explains *why* a child's nutrition matters—highlighting its impact on growth, cognitive development, school performance, and long-term health—to build understanding and deepen user motivation to engage with the chatbot. Frame messaging positively, focusing on responsibility and "doing what is best for your children, rather than on insufficient practices and the issue of malnutrition which may be linked to feelings of shame. Consider addressing common misconceptions as well, such as how "chubbiness" can coincide with malnutrition.
    - **Activities:** Incorporate these messages into both chatbot responses and community workshop materials to reinforce learning.
- **Human Oversight**: Regularly monitor the chatbot script to ensure accuracy, appropriateness, and cultural sensitivity.
    - **Activities:** Set up a regular review cycle (e.g., monthly or quarterly) for chatbot scripts to check for accuracy of health information, cultural appropriateness, and user dynamics. Local health workers may be engaged to provide feedback on script or suggest integrations of new topics according to the observed needs of users.

4. Programmatic Recommendations:

- **Partnerships**: To enhance long-term impact and strengthen funding, consider establishing strategic partnerships with relevant government or other entities. Similarly, to address the multifaceted causes of childhood malnutrition, additionally consider pursuing partnerships with organizations that offer complementary expertise.
    - **Activities:**

1. **Facilitate Discussion and Mutual Understanding:** Facilitate roundtables or meetings with strategic entities (e.g. local or state governments, NGOs, etc.) to identify shared goals, coordinate and outline overlaps and gaps, and explore opportunities for coordinated programs or funding.
2. **Seek Complementary Partnerships**: Collaborate with, for instance, WASH-focused nonprofits to integrate clean water and sanitation solutions alongside nutrition education within the region.

- **Funding and Incentives**: Through additional funding (government-sourced or otherwise), more costly incentives for workshop and chatbot participation could be implemented as well, such as ingredients for cooking, or even Conditional Cash Transfers as seen in Peru and Brazil.
    - **Activities:** For example, implement an incentive program where participants earn points for attending workshops or engaging with chatbot content. Points can be redeemed for practical items like cooking ingredients, hygiene kits, or even accumulated for larger prizes like food baskets. With strong monitoring, if the initial pilot proves successful, the model can evolve into a Conditional Cash Transfer system if partnered with government funding.
- **Local-State Dialogue:** To the extent possible, promote increased dialogue between the local and state governments. In addition to the presence of the local communication plans (roundtables) implemented by the Ecuadorian State, facilitate additional dialogue between rural communities and the State to clarify actual living conditions.
    - **Activities:** Facilitate bimonthly forums where representatives from rural communities (selected by local leaders or councils) present their realities, challenges, and priorities directly to relevant State officials dealing with child malnutrition. Use participatory tools like community maps, testimonials, and short video diaries created by locals to vividly convey living conditions.

Conclusion

Childhood malnutrition is a multifaceted issue requiring urgent and sustained attention, particularly in countries like Ecuador, where chronic child malnutrition rates remain among the highest in Latin America. This study highlights the complexity of CCM, driven by inadequate diets, poor sanitation, limited healthcare access, and socio-economic inequalities. Rural and indigenous populations are often disproportionately affected, which additionally must be considered. Through the analysis of global success stories, such as in Peru, Brazil, and Thailand,

as well as through interviews with key informants, key lessons emerge: multisectoral collaboration, community engagement, education, and incentivization such as conditional cash transfers play critical roles in reducing malnutrition rates. Ecuador's efforts to combat CCM, while significant, have been hindered by inconsistent implementation, limited community involvement, and gaps in policy integration. Leveraging traditional foods, improving maternal education, and adopting innovative technologies like AI and chatbots offer promising avenues to achieve the goal of reduction of childhood malnutrition. To ensure sustainability, these approaches must be complemented by stronger public-private partnerships, targeted investments, and culturally sensitive considerations. By drawing from global best practices and combining them with localized strategies informed by key informants and community input, NGOs such as Fundación ADHA and their strategic services have the potential to make a meaningful impact in reducing CCM in Ecuador.

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Conflicts of Interest

None

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