

Food fortification and domestic small-scale food chains' actors – The case of Burkina Faso

Draft 1

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Abstract

Prevalence of micronutrient deficiencies and food fortification programmes

In Burkina Faso, the available data on micronutrient deficiencies suggests that the prevalence of **micronutrient deficiencies** is particularly high for iodine and zinc. In addition, the country records the highest prevalence of anaemia among West African with 86.1% of children 6-59 months affected by anaemia (Hb < 11g/dl) and 12.7 % affected by severe anaemia (Hb < 7.0 g/dl) (INSIDER, Task 1.1). The level of stunting, though in regular decrease over the last years, remains at a high prevalence (20-30%) with 27.3 % of children affected by stunting (SMART 2016).

Fortification has strongly developed in Burkina Faso over the past decade and represents one of the main strategies promoted by the Government to reduce micronutrient deficiencies (PNN, 2016). This development is also supported at the regional level as part of the regional integration through harmonised fortification standards, guidelines for quality control and assurance, and the creation of a logo (INSIDER, Task 1.2). Several **mandatory fortification programmes** (for the whole population) have been implemented since 2009.

	Year of adoption of national legislation	Added micronutrient	Coverage
Soft wheat flour	2012	Iron/ Folic acid (AC Folique)	61.5%
Refined vegetable oil	2012	Vitamin A	9%
Salt	2013	Iodine	95.9%

Source: Ouattara, L., INSIDER Report Task 1.2, Burkina Faso, February 2020.

Besides these mandatory programmes, a number of **voluntary programmes** are implemented at large-scale by NGOs and international organisations (UNICEF). The French NGO Gret is one of the most and historically involved NGOs in such programmes, with a long-standing project since 2005 called Nutrifaso which is implemented in rural and urban areas with the support of IRD and in collaboration with the Ministry of Health. This project delivers fortified infant flour (with a complex of minerals and vitamins, including iron, zinc, magnesium, vitamin A, vitamin C, etc.) based on local staple food and small-scale domestic processing enterprises to children from 6 to 59 months. Relying on local and small-scale actors, this development NGO claims that the production of fortified products contributes both to reduce infant malnutrition and support the domestic private sector and local economic development. The project ALTAAG led by GAIN and WFP in West Africa aims to achieve the same objectives. This argument suggests that fortification may involve different kinds of actors in food supply chains and may have diverse socioeconomic effects on domestic and small-scale actors.

The issue of socioeconomic effects of fortification programmes

Food fortification is promoted as a promising and cost-effective strategy to address micronutrients deficiencies in low-income countries (LICs) and lower-middle income countries (LMICs). However, **questioning whether and how the modes of production and delivery in fortification programs can benefit/jeopardize domestic food chains actors, in particular the small-scale ones, and generate**

inclusive socioeconomic development locally is a critical issue. First, these domestic actors involved in food processing and delivery may belong to the most vulnerable parts of the population who suffer from malnutrition, and second nutrition goal should not be considered in isolation from other socio-economic SDGs.

This document explores to what extent food fortification programs do/can foster/prevent an inclusive socioeconomic development among domestic food supply chains' actors while reducing micronutrients deficiencies. It also gives insights about the relevance of combining fortification with dietary diversity strategy and how such a combined strategy may help overcome the possible socioeconomic side effects of food fortification. More specifically, the research questions we want to document are: **To what extent fortification programs mobilize domestic food chains' actors and promote or prevent inclusive value chains in LIC/LMICs? In other words, does mandatory/large scale voluntary fortification constitute incentives or barrier to entry for small-scale actors? To what extent fortification and dietary diversity strategy could be combined to overcome potential negative side effects of fortification on domestic small-scale actors?**

The document provides an overview of the existing knowledge about the (potential) effects of food fortification programs on activities of domestic (in particular small-scale) food chains' actors, then the inclusiveness of such programs, and conceptual impact pathways that could be applied to the case of Burkina Faso. The analysis is based on a **scoping literature review**. The choice of such literature review is mainly justified by the exploratory nature of the research questions and the need to get an initial indication of the size and nature of available literature before further meta-analysis or qualitative systematic review. The search of scientific papers in two electronic databases (Web of Science and Science Direct), their analysis and the inclusion of additional documents from references lists and websites of key food fortification organizations resulted in 49 papers and reports.

Results from the literature review

We found that **little interest has been given to the issue of potential effects of fortification programmes on domestic food supply chains' actors in the literature.** The existing literature is primarily focused on the assessment of the effectiveness of fortification programmes on nutritional goals (SDG2), for which they have been designed, but side effects on socioeconomic aspects and synergies/trade-offs with other SDGs tend to be overlooked.

Two modes of production of fortified foods for mass fortification programmes are promoted as regards their cost-effectiveness and the facilitation of control and monitoring from public agencies to guarantee the quality of products:

- i) the import of fortified products (e.g. fortified rice for West Africa as claimed for instance by Muthayya et al. (2012))
- ii) the production by large-scale centralized units when fortified products are domestically produced.

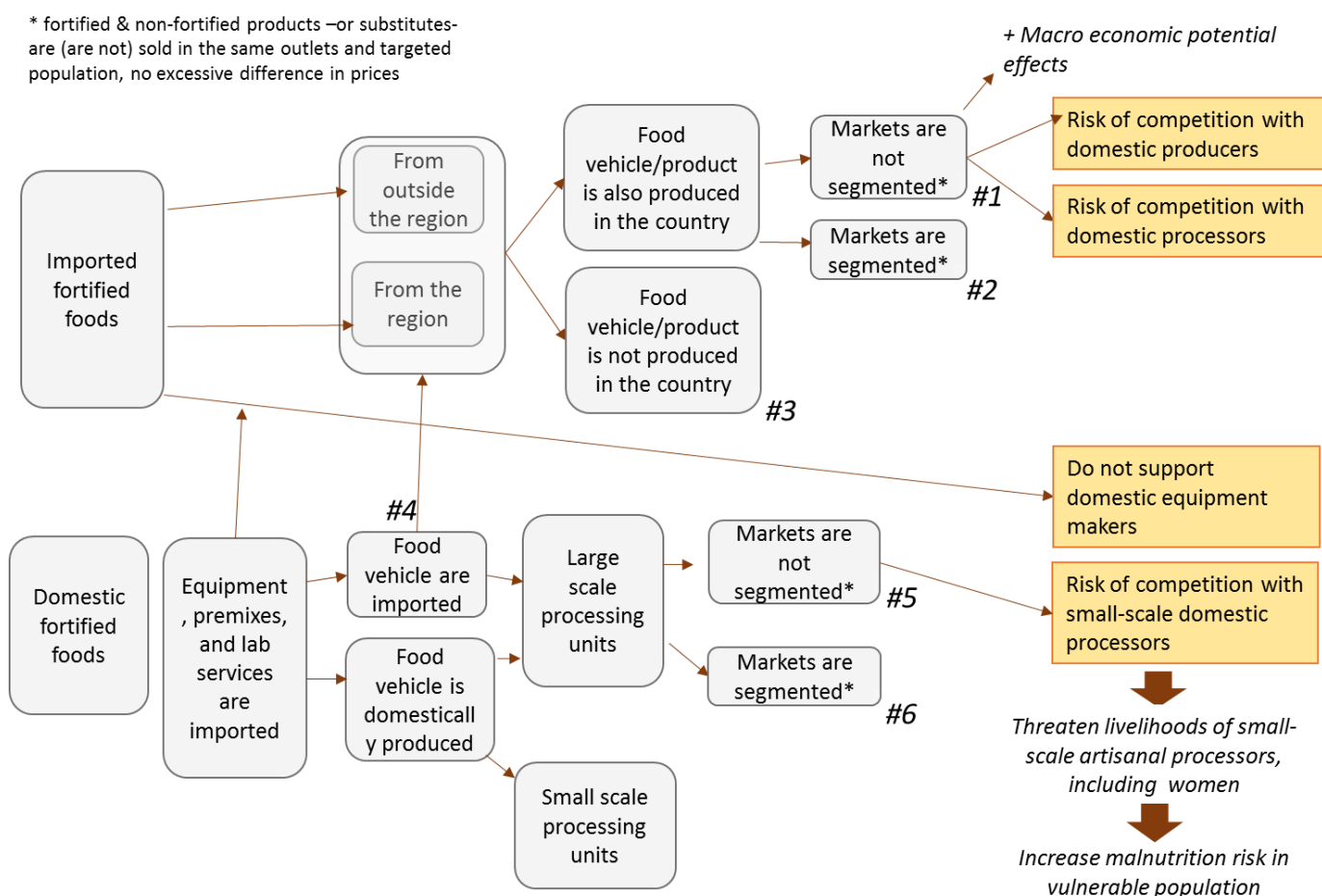
In addition, authors underline that the biggest challenge encountered by food fortification programs (both mandatory and voluntary, both mass and targeted programs) is the **issue of distribution**. For instance, in Sub-Saharan Africa, there is mixed evidence on delivery and coverage of fortified food despite the efforts made by many countries (Lalani, Bechoff, and Bennett 2019, Humphrey and Robinson 2015). While voluntary targeted (non-emergency) fortification programmes face difficulties related to price and retail outlets, mass fortification programs usually fail in reaching the poorest due to inadequate food vehicle choices, the market segmentation characterized by the importance of informal/traditional sector as well as poor compliance by food industries. **Compliance to fortification standards** is a critical issue for both imported fortified products and domestic industrially fortified products.

Although the effects on domestic and small-scale food chains' actors are not explored, the reviewed studies provide elements that allow to **drawing some assumptions** and to identify the **conditions**

under which fortification can contribute to inclusive economic development meanwhile contributing to nutrition.

As described in the conceptual framework below, each one of the promoted modes of production in the literature may have potential effects at business scale, on small-scale producers on one side, and on small-scale processors on the other side. In addition, as part of food policy and regulation (standards, control system) food fortification may also have effects at national scale, such as prices effects, food trade balance and import dependency.

Conceptual framework of potential socioeconomic effects of fortification programmes



The risk of competition of imported fortified products with domestic small-scale farmers and of large-scale processors with smaller ones may exist but mainly depends on market characteristics (market segmentation or not):

- In case of import of fortified products or of food vehicle for fortification, there is a **risk of competition with domestic producers** when the food vehicle is also domestically produced and when imported fortified products are sold on the same markets as non-fortified or domestically fortified products (same outlets and targeted population, no excessive difference in prices) (**#1**). For instance, rice producers in Burkina Faso may suffer from competition with fortified rice imported from South-East Asia. The risk of competition exists even when imported fortified foods are more expensive than domestic ones. This is the case for example for imported baby foods which are often preferred by consumers because of packaging, labelling, retail location, communication plans from sanitary authorities, etc. In Burkina Faso, Benin, Ghana and Senegal, Dimaria et al. (2018) found that imported complementary foods for young children were two to three times more expensive than the local products. When markets are segmented, with for instance imported fortified rice sold in supermarkets for wealthy consumers

and domestic rice sold in open markets or street outlets, the risk of competition is more limited **(#2)**. Also, when the fortified product or the food vehicle cannot be produced in the country there is no risk of competition (e.g. all salt brands are imported to Burkina Faso, from Europe, India and other African Nations (GAIN 2018))**(#3)**.

- In case of domestically produced fortified products, the potential socioeconomic effects mostly concern **the risk of competition between large-scale and small-scale processors**. Both kinds of processors usually import the premix and the necessary equipment for the fortification process and for quality control. It seems however that large-scale centralized food processing industries tend to source mostly on international markets instead of domestic markets to ensure food vehicle quality, and therefore contribute to generate risk of competition with domestic producers (see above, **#4**). Again, domestic large-scale industrial processing units may generate eviction of smaller-scale processors and informal actors, which cannot compete when markets are not segmented **(#5)**. Some authors warn about this risk for oil and wheat in Ethiopia (Head, et al. 2014), for sorghum and maize in Botswana (Seleka et al. 2000) and in India. In India, Fiedler et al. (2012) shows how voluntary fortification program for wheat flour led to increased market share of formal millers, and reduced market share of informal sector. Access to inputs and technical expertise can be a barrier for small-scale units to engage in fortification activities. Even if they undertake fortification activities, the costs of fortification are much higher for small-scale processors than for larger firms. When markets are segmented, the risk of competition and eviction of small-scale processors (usually in informal sector) by large-scale processing units appears limited **(#6)**. Control of informal small-scale processors is usually limited and does not prevent them to keep operating. For instance, Humphrey and Robinson (2015) reports that in Nigeria or Tanzania that mandate food fortification, most of agricultural produce does not reach the formal food chains. On-farm informal processing and milling/processing services at the villages are not threaten by mandatory fortification programmes. However, there is a **risk of missing population the most in need** because they do not rely on food chains that deliver industrially processed food.

In addition, the two promoted modes of production of fortified products raise some **issues at national scale**.

- The first issue is the one of **policy coherence** when nutrition programs encourage the imports of fortified food while at the same time national agricultural policy supports domestic production. This issue might be particularly critical for imported fortified rice in West Africa, as all governments of this region set ambitious programs to support their domestic production. However, there is no problem of policy coherence when fortified products are regionally sourced as countries are bound by regional integration agreements. This is the case for instance for fortified oil in Burkina Faso partly imported from Cote d'Ivoire.
- Another issue is **import dependency** and **vulnerability to international prices volatility** when the fortified foods or food vehicles are imported from the international market. In case of domestically produced fortified products, the issue remains for equipment and premixes, hence the advocacy from local processing enterprises for the removal of customs duties on these inputs.

Recommendations: conditions for inclusive fortification and combination with dietary diversity

Some recommendations are equivalent to the introduction of a kind of market segmentation to protect domestic small-scale food chains' actors from the risk of eviction with imported fortified products or food vehicle:

- **Restricting the promotion of imported fortified products to those that are not traditionally produced in the country (nor the substitutes)** and widely consumed by the rural and urban population (e.g. salt) is a way to segment markets with respect to the origin of products. When fortified products are imported from countries out of the regional integration area such

recommendation could also ensure coherence between policies of domestic agricultural production support and of nutrition.

- another market segmentation could be with respect to the **targeted population** by considering that fortified products should primarily target specific groups of population and at specific age such as children under two and women of reproductive age, while the whole population may cover its nutritional needs with diversified diets.

In case of no market segmentation, one might recommend to **support domestically produced fortified products**, especially from small-scale farmers and processors. However, although such fortification programmes would be particularly inclusive they also raise strong issues in terms of costs and budgetary support. The required support might concern small-scale farmers, equipment makers, small-scale processors, distributors, etc., as well as issues of quality, consumer confidence and price for poor consumers. One possibility is to encourage the scaling-up of existing and successful **organisational innovations** between large-scale processing units and domestic farmers (e.g. contractual farming when transparent and well-balanced), between large-scale and small-scale processors (e.g. Mkambula et al. 2020 report lessons from the cooperation of salt farmers and a large salt produced in Azerbaijan) or among small-scale processors. The latter refers for instance to interesting experiences from small-scale processors who try to pool the access to inputs (premix and equipment) and to services (quality analysis) to reduce their costs (e.g. in Tanzania, Robinson, Temu, et al. 2014 suggest this option for wheat flours or in Ghana, where Nyumuah et al. (2012) explains how salt producers organisations have been successful in helping small-scale producers to access to inputs and trading their produces).

The reduction of potential competition from fortified products/ food vehicle on domestic small-scale food chains' actors could also be envisaged through **combining or integrating fortification and dietary diversity strategies**. However, such combination is not straightforward to envisage and implement. For instance, supporting the fortification of staple foods may have negative side effects for farmers producing other than staple foods (as their products become "useless" for fortification). One area to be further explored to overcome these side effects on non-staple food production could be to promote food-to-food fortification for complementary foods for children and flours for example. Another area could be to develop fortification only for specific micronutrients that are hardly found in traditional crops and meals while deficiency is high, and to promote dietary diversity (including through supporting the processing of nutrient-dense foods) to address the other micronutrient deficiencies.

In conclusion, we argue that the **various strategies to tackle micronutrients deficiencies worldwide have to be discussed in light of their effectiveness to reduce deficiencies in the most vulnerable groups of population but also in light of their potential impacts on domestic socioeconomic development**. In this perspective we draw some potential socioeconomic effects of fortification programmes in the case of Burkina Faso. We recommend to developing multidisciplinary research combining nutrition and social sciences; to conduct economic studies to explore whether markets are segmented or not and how fortification programs are embedded in the domestic food value chains; and to assess whether it does jeopardize or support livelihoods opportunities for domestic actors, especially informal and vulnerable ones. In line with previous papers, we also recommend to assess such programmes in real market conditions instead of in experiments.

This would make it possible to analyse broader aspects of these strategies, not only the nutritional dimension and their effectiveness to reach SDG 2 in the short term, but also the long-term and sustainable impact (including cultural, social, political and market and value chain conditions to ensure the effectiveness and resilience of chosen production/delivery modes). This research area should be explored by distinguishing the different countries, food vehicles and current state of markets.

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1. Introduction

Micronutrient deficiencies are especially caused by insufficient intake of mineral and vitamins and have health consequences, including poor physical and cognitive development and poor neonatal and maternal outcomes. Micronutrient deficiencies affect predominantly women and children, as well as female adolescents (MicronutrientForum 2017). They also have negative national economic consequences, because of reduced work capacity of population. These micronutrients deficiencies are particularly spread in low-income countries (LICs) and lower-middle income countries (LMICs).

► A wide range of interventions to address micronutrients deficiencies in LICs/LMICs

Designing interventions for reducing micronutrients deficiencies is particularly complex. Many factors influence the concentration and bio-availabilities of micronutrients in food supplies and in the diets of individuals, at different scales from food system characteristics to individual characteristics (Miller and Welch 2013).

There are a very large number of strategies/interventions to reduce micronutrient deficiencies. Several typologies of interventions exist.

- › Some authors distinguish interventions according to the target group: a) adolescents, b) women of reproductive age and pregnant women, c) new-born babies and d) infants and children (Bhutta et al 2013). Specific micronutrients deficiencies affect particular types of population. Therefore, interventions must be tailored to specific target groups.
- › Another typology of interventions is suggested by Ruel et al. (2013). They distinguish interventions according to a nutritional approach, i.e. according to the determinants of nutritional status: a) *nutrition-specific interventions*, which target immediate determinants of nutrition (e.g. infants feeding, supplementation, fortification) and b) *nutrition-sensitive interventions*, which tackle underlying determinants of nutrition (e.g. such as poverty, promoting nutrient-dense varieties or women empowerment).
- › Another approach to distinguish interventions is suggested by Miller and Welch (2013). They identified three categories of strategies to prevent micronutrient malnutrition according to the segments of food systems targeted by the interventions, i.e. according to the actors/activities involved. They include a) *agricultural production strategies* (e.g. agricultural diversification, promotion of nutrient-dense varieties, soil fertility), b) *food processing strategies* (e.g. fortification, fermentations, food waste management) and c) *economic and consumer education strategies* (e.g. women education, cash transfer). This later approach is actors-oriented.
- › The World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO) have identified four main strategies for addressing micronutrient malnutrition (WHO and FAO 2006):
 - increased diversity and quality of diets;
 - food fortification and biofortification;
 - supplementation; and
 - disease control measures.

► Food fortification: nutrition-specific interventions focused on the food processing sector

Among the wide range of interventions, food fortification is spreading in LICs and LMICs after several decades of use in North and South America and Europe. Food fortification is part of *nutrition-specific interventions* involving the *food processing* segment¹. The Codex defines “fortification” as “enrichment”, i.e. the “addition of one or more essential nutrients to a food whether or not it is normally contained in

¹ Here we focus on food fortification through processing. Home fortification (i.e. the addition of micronutrients to food prepared at home) and biofortification (i.e. breeding/GM plants to produce micronutrient-enriched crops) are not under the scope of this study.

the food, for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups”².

The need to combine several strategies simultaneously is often acknowledged. Yet, food fortification is seen as one of the most promising strategy to prevent micronutrients deficiencies and improve nutritional status of population in the short term. The authors contributing to this literature describe food fortification as a safe and cost-effective strategy, with a long history of successful use in industrialized countries and a well-developed technology. In addition, according to the 2008 Copenhagen Consensus Expert Panel, micronutrient fortification is among the top three international development priorities (Lentz and Barrett 2013, Lalani, Bechoff, and Bennett 2019, Osendarp et al. 2018).

Fortification takes several forms. They differ according to their scope and according to their mandatory/voluntary characteristics.

- ★ **Mass or universal fortification:** this refers to the enrichment of food generally consumed by the whole population, with the aim of preventing/reducing micronutrients deficiencies when the majority of people is at risk. Mass fortification is usually mandatory (not always), mandated and regulated by the State. Mass fortification of staple foods is expected not requiring change in dietary practices. This is often acknowledged as a key advantage of fortification against other strategies to address micronutrient deficiencies issues (such as diversification).
- ★ **Targeted fortification:** this refers to the enrichment of food generally consumed by one particular group within a population (e.g. infants) with the aim of preventing/reducing micronutrient deficiencies of this group singularly at risk. Targeted fortification can be either mandatory or voluntary. Even when this is voluntary, governments are still involved since they regulate the production and trade of such fortified products (e.g. norms in terms of micro nutrients’ concentration). This type of fortification is for instance used in emergency situations. This type includes complementary foods for young children.
- ★ **Market-driven or industry driven or free-market or open market fortification:** this type of fortification refers to a manufacturer that voluntarily decides to enrich processed food with specific amounts of micronutrients as a business-oriented strategy. Although industry-led, this type of fortification has to respect governments’ regulation. The growing sports nutrition sector belongs to this type of fortification.

The three most widespread deficiencies in the world are iodine, iron and vitamin A deficiencies. Others include Vitamin D, Niacin, Riboflavin thiamin, Folic acid, Vitamin B12, and Ascorbic acid. The choice of combination food vehicle/micro-nutrient depends on both technological and regulatory factors, as well as the type of fortification. Since mandatory mass fortification aims to prevent the micro nutrients deficiencies in the whole population, the food vehicle has to be a staple food widely consumed across the population, such as cereals, oils, beverages and condiments such as salt, sauces and sugar. They also must be affordable for the most needed population. In the case of targeted fortification, the food vehicle should be consumed by the targeted group.

	Condiments	Cereals	Dairy product	Fat and oils
Iodine	Salt			
Iron	Sauces (soy, fish)	Wheat flour, corn flour, pasta, rice	Milk (dry and fluid)	
Vitamin A	Sugar	Cereal flours	Milk	Oil, margarine

Mandatory fortification has spread out during the last decades. The iodization of salt is very widespread with 129 countries implementing national universal salt iodization programs³. Fifty African countries do

² CODEX ALIMENTARIUS: GENERAL PRINCIPLES FOR THE ADDITION OF ESSENTIAL NUTRIENTS TO FOODS CAC/GL 9-1987

³ Global Fortification Data Exchange. Accessed 13/04/2020. [<http://www.fortificationdata.org>.]

mandate salt iodization. Worldwide, 84 countries have legislation to mandate fortification of at least one milled cereal grain with iron or folic acid, including in Sub-Saharan Africa (26 countries). Most of West African countries have legislation for wheat flour alone, while eight East African countries and Nigeria have legislation for both wheat and maize flour (FFI website⁴). In addition, six African countries fortify more than half of their industrially milled wheat flour, two fortify at least half of their industrially milled maize, even though it is not mandatory. Worldwide, 45 countries fortify oils and fats with vitamin A. Almost all West African countries but Gambia have mandatory fortification of vegetable oil. Mali enforces voluntary fortification programs. Fortifying condiments such as fish/soy sauces is made mandatory in two countries in South Asia, while bouillon cubes fortification is voluntary in many West African countries, including Mali, Ivory Coast, Senegal, Benin, and Nigeria.

► INSIDER project, Lot 1, and this deliverable

The overall project INSIDER aims “to produce knowledge and evidence that can guide the planning and implementation of equitable, effective and sustainable food fortification programmes, as part of a wider set of public health interventions, and alongside the overall promotion of healthy and diversified nutrition-sensitive food systems” (document Lot 1 Annex 2 from INSIDER project). This deliverable contributes to the specific objective of Lot 1 aiming at *evaluating how different strategies to combat micronutrients deficiencies can be combined (alongside diversification of diets) to achieve maximal impact, particularly amongst the poorest populations.*

Although many researchers and stakeholders consider this intervention as being promising, limitations and adverse effects have already been identified. Potential adverse effects include the risk of overconsumption (e.g. iodine excess in ten countries (MicronutrientForum 2017)), the misinformation of consumers and risk to change their perception regarding non-fortified traditional foods (CoordinationSUD 2018, Kimura 2013), and the poor coverage rate in LICs (Aaron et al. 2017, Mkambula et al. 2020). Another risk refers to fixing the symptoms of malnutrition instead of addressing the root causes, hence preventing to build strong basis for long-term improvement in nutrition (CoordinationSUD 2018). According to Kimura (2013), fortification simplified issues to technical matters (with women becoming recipients of fortified foods, instead of active players of the solution), which is in line with Ansari who defines fortification programs as “technocratic optimism”, i.e. the “the belief that there are viable technological solutions to structural problems”. Moreover, by considering food as a package of nutrients (Kimura 2013, Robinson 2016) and by concentrating more nutrients in a few staples, hence further simplifying diets, the fortification strategy may marginalize the long-term diet diversification strategy (CoordinationSUD 2018).

A better understanding of the conditions in which food fortification (potentially in combination with other interventions) can achieve maximal impact, without prejudicing other aspects, is needed. Broader evaluative frameworks that make explicit some structural and institutional issues are needed (Ansari, Mehmood, and Gazdar 2018). Among such conditions, the modes of production and delivery of fortified foods are critical. They influence the capacity of fortification programs to produce, guarantee and deliver high quality nutrient rich foods to the most needed people (poor, vulnerable groups), and therefore achieving the expected impacts on nutrition and health (Lalani, Bechoff, and Bennett 2019, Humphrey and Robinson 2015). To reach these objectives, law as well as standards and food control system are used to regulate mass voluntary and mandatory fortification programs. They aim at ensuring compliance and impact on the most needed population.

In addition to their impact on fortified foods coverage, the organization of production and delivery promoted by fortification programs might have an effect on domestic food value chains. Indeed, food fortification programs are embedded in food systems as they directly mobilize the actors of food supply chains to produce and deliver fortified foods (processors and distributors in particular). Mandating or encouraging food chains actors to fortify foods raise issues of inclusions/exclusion from the markets.

⁴ Food Fortification Initiative Consulted April 1st 2020

This can constitute incentives towards innovation and facilitate access to markets. On the contrary, requirements and costs generated by striving towards compliance can represent a barrier to entry. Even if actors comply, this does not guarantee participation in the given market since other enterprises can benefit from better conditions and lower production costs so that they sell the same product at lower price.

Questioning whether and how the modes of production and delivery in fortification programs can benefit/jeopardize those domestic food chains actors, in particular the small-scale ones, and generate inclusive socioeconomic development locally is a critical issue.

First, these actors involved in processing and delivery of food may belong to the most vulnerable parts of the population who suffer from malnutrition. In particular, food processing is dominated by women and unskilled people; many of them working in the informal (and thus invisible) food economy (Allen, Heinrigs, and Heo 2018). Providing jobs and livelihood opportunities among the most vulnerable parts of the population does contribute to combat malnutrition, since economic poverty is part of the underlying cause of malnutrition (UNICEF framework of malnutrition). By benefiting or at least not damaging the domestic food chains actors' livelihoods, fortification can contribute to reducing malnutrition.

Second, the nutrition goal should not be considered in isolation from other Sustainable Development Goals (SDGs) and the way it is achieved should be sustainable, considering social and economic aspects. In 2015, all United Nations Member States not only engaged in ending all forms of malnutrition by 2030, they also engaged in achieving various SDGs, which include ending poverty (SDG1), contributing to decent work and economic growth (SDG 8), and reducing inequalities (SDG 10). Being related to fourteen out of seventeen SDGs, food systems⁵ constitute a priority line of action (Global Sustainable Development Report 2019). Food systems are not just contributing to producing and distributing food so that people benefit from good nutritional status and health. They also generate jobs, income, territorial development and environmental services. For instance, food processing sector represents 30% of total secondary sector employment in West Africa. Industries in the food-processing sector are more likely to locate in small cities or rural areas than non-food industries, hence contributing to a more balanced territorial development and providing jobs where population growth is going to be the more pressing (Allen, Heinrigs, and Heo 2018).

Therefore, strategies promoted to combat malnutrition should not be implemented at the expense of an inclusive socio-economic development in LICs. In other words, the issue at stake is to see how to articulate SDG 2 about nutrition with other SDGs by considering all the functions of food systems. Potential adverse effects of fortification programs should be recognized and mitigated, while potential synergies should be identified and reinforced.

Within Lot 1, this deliverable deals with the socio-economic aspects of fortification. It provides an overview of **the existing knowledge about the (potential) effects of food fortification programs on activities of domestic (notably small-scale) food chains' actors and then the inclusiveness of such programs**. More specifically, the research questions we want to document are: To what extent fortification programs mobilize domestic food chains' actors and promote or prevent inclusive value chains in LIC/LMICs? In other words, does mandatory/large scale voluntary fortification constitute incentives or barrier to entry for small-scale actors? To what extent fortification and dietary diversity strategy could be combined to overcome potential negative side effects of fortification on domestic small-scale actors?

The aim of the study is to contribute to understand the conditions under which food fortification could have long-term effects on micronutrients deficiencies reduction while contributing more broadly to SDGs.

⁵ In this document, food systems are defined as such: food systems encompass the range of actors and their activities involved along food chains (from production to consumption), including their drivers, their proximate environment as well as their outcomes and long-term impacts in main sustainability dimensions, that eventually result in feedback loops to drivers (Phase II Food system at risks, forthcoming).

The section 2 presents the methodology used and section 3 the main findings regarding the modes of production and delivery of fortified foods recommended in the literature in order to achieve maximal impact. We will then discuss them in light of our research questions in Section 4 and with the consideration of Burkina Faso as case study. Section 5 presents the main conclusions and provides some recommendations for future research.

2. Methods: A scoping review

Many types of literature review exist. They differ according to their overarching goal, scope of questions, search strategy, nature of primary sources, explicit selection, quality appraisal and methods used for synthesizing and analysing findings (Paré et al. 2015). A scoping review was conducted as this is the appropriate methodology for several reasons (Paré et al. 2015, Arksey and O'Malley 2005):

- Our work is exploratory in nature, which is a main specificity of scoping review. This type of literature review suits well with our primary objective that is to map the state of existing research and approaches in a broad topic rather than synthesize empirical results to answer a narrow set of research questions.
- We aim to provide an initial indication of the size and nature of available literature (broad coverage including conceptual and empirical studies from any discipline as well as grey literature) on an emerging topic.
- Scoping reviews focus more on breadth than depth. They allow however to summarize the primary findings in particular areas of the thematic and identify research gaps in the existing literature
- Unlike meta-analysis or qualitative systematic reviews, scoping reviews do not systematically evaluate the quality of individual studies methodologies, since documents may be widely heterogeneous.
- Scoping reviews provide narrative summary instead of comparing findings and making statistical findings (like does a meta-analysis).

Finally, a scoping review may help to determine whether a meta-analysis or qualitative systematic review is feasible and relevant: does sufficient literature exist on the particular topic.

We draw on Arksey and O'Malley (2005) recommendations to conduct the scoping review.

A scoping review has to be as broad as possible in its coverage strategy. Yet, we restrict the scoping review to Africa, Asia and Latin America. Studies must deal with mass fortification, targeted fortification, or voluntary market driven fortification but not sports nutrition sector or such. Neither, we include home fortification or biofortification (enrichment of foods through breeding or genetic engineering).

We adopt a three-fold strategy.

First, we searched for relevant studies in scientific electronic databases (Web of Science and Science Direct) by using the following key words: ("Latin America*" OR Africa* OR Asia*) AND ("food fortification" OR "fortified food*") AND ("domestic food chains" OR "value chain*" OR livelihood* OR job* OR SMEs OR market* OR "processing industries" OR "processing sector" OR milling).

We then use the following process and criteria to select or eliminate studies:

- ★ Written in English
- ★ Full texts available
- ★ Articles and reports from 2000 to 2020. We exclude PhD thesis and books due to time and full text access constraints
- ★ Concerned low income or lower middle income countries
- ★ Relevance of the abstract or of the full text content when the abstract was not clear enough.

The search by key words yielded 146 potentially relevant studies. After eliminating the studies that do not meet the inclusion criteria and duplicates, there were 17 papers.

Second, we checked the reference lists of studies found in order to identify the studies that may be relevant to inform the research question under consideration. The same criteria were used. Third, we looked for relevant online reports or project documents provided by non-governmental organizations whose work either (i) focuses on the topic of nutrition and food fortification: Global Alliance for Improved Nutrition (GAIN), Food Fortification Initiative (FFI), Nutrition International (NI), Iodine Global Network (IGN); Scaling up nutrition SUN Network, or (ii) includes the topic of nutrition and food fortification: Global Nutrition Report from IFPRI, GRET, and IDS.

32 reports and academic papers found in the references lists and on the websites of key food fortification organizations are used in this report. The total sample of reviewed studies is therefore 49 documents.

3. Results

We found that little interest has been given in the literature to the question of how the promotion of food fortification affects the situation of domestic food system' actors.

The scoping review didn't allow to identifying studies that specifically assessing the impact of food fortification (either mandatory or voluntary programs) on domestic food suppliers (neither producers or processors nor distributors). There was also no study assessing the impact of fortification on food trade balance for products that have been subject to a mandatory and/or voluntary fortification program. Another example of this disregard is the scope used for cost-benefits analyses of food fortification—e.g.: (Miller and Welch 2013, Horton and Ross 2003). All the studies conclude that food fortification programs are very cost-effective. In terms of benefits, calculations take into account the health-related benefits in the short term (e.g. costs of treating nutrient deficiency diseases) and in the long term (e.g. the assumption of the value of a human life saved and the worker productivity). In terms of costs, they take into account the short-term costs of fortification: premix costs, installation and maintenance of equipment, training for personnel, government regulatory actions, social marketing etc. However, no consideration is given to potential costs or benefits related to food markets changes.

Most of papers focus on Africa or/and Asia, and report mass fortification initiatives. The main frequent research questions examined in the selected studies were the followings:

- (i) What is the coverage rate of food fortification schemes?
- (ii) What are the opportunities/constraints for businesses to deliver fortified foods and what are their business models?
- (iii) What are the most favourable food vehicles?
- (iv) What are the real or potential costs for processors to produce fortified foods?
- (v) What is the supply of fortified products on the market (origin, the real quality)?
- (vi) What are the prerequisites and success factors for a fortification program to be effective and maximize the impacts on nutrition and health?

The reviewed studies do not question the need to further develop fortification in LIC/LMICs. The research questions and the lessons they draw from their studies are aimed at making recommendations to improving production, delivery, coverage and impact of food fortification.

Their contributions deal with the identification of success factors in terms of (i) fortified foods' production and (ii) fortified foods' distribution, in order to maximize the impacts on nutrition and health.

First of all, we found that there is a consensus in the literature on the need to build strong private/public partnerships. Even in the case of private-led and voluntary fortification, support from the public sector is particularly important (Lalani, Bechoff, and Bennett 2019). This is apparently less important where mature, large-scale businesses already exist (Lalani, Bechoff, and Bennett 2019). These public-private partnerships sometimes involve several countries, like in the UEMOA for oil fortification (Sablah et al.

2012). This partnership involves the private sector, regional and national public sector, public/private bilateral and multilateral development agencies, and civil society organizations. Strong legislation, monitoring and quality control systems are also success factors. This is supported by the examination of past experiences in Latin America, Asia and Africa (Martorell and de Romaña 2017, MicronutrientForum 2017, Lalani, Bechoff, and Bennett 2019, Darnton-Hill and Nalubola 2002).

Beyond this primary result, we present the success factors identified for two stages of food chains: production and distribution. We will then discuss them in light of our research questions in Section 4.

3.1. Producing fortified foods

A prerequisite for maximizing the impacts of fortification on nutrition and health is the adequate choice of food vehicle. Several papers and reports are presenting a list of requirements for a food vehicle for fortification (e.g. (WHO and FAO 2006, MicronutrientForum 2017, GAIN 2018a).

Choosing an adequate food vehicle notably relies on the following prerequisite: the whole (or targeted) population, unrelated to socio-economic status, must consume the food vehicle candidate⁶ widely and constantly (in an appropriate form). For a given country, fortification programs can include either imported fortified products or domestically-produced fortified products. When fortified products are imported, the food vehicle has also been produced abroad. When fortified foods are domestically produced, the food vehicle can be either imported or domestically produced.

Two options are mostly promoted in the literature (their justifications are presented hereafter). Beyond the high consumption rate among the populations, the first option suggests to import fortified products, produced by a small number of countries. The second option is to rely on domestically and centrally processed fortified products, involving a small number of large-scale processing industries (Mkambula et al. 2020).

3.1.1. Imports of fortified products

Imports are presented as a window of opportunity to develop fortification schemes. A limit to fortification is self-consumption as fortification is based on food processing. Therefore, fortification programs cannot cover farmers who consume their own products. Choosing a widely consumed product, always bought on the market because it is imported, makes it possible to avoid non-coverage bias due to self-consumption. This increases the chance to cover both urban and rural populations.

Relying on imports is particularly acknowledged for bouillon cube (GAIN 2018a) and even more for rice (Muthayya et al. 2012, GAIN 2018a, WFP and International 2019, Mkambula et al. 2020). Rice fortification⁷ is seen as a great opportunity to address vitamin and mineral deficiency worldwide⁸. Rice is the staple food the most consumed worldwide, especially in countries where the prevalence of deficiencies remains high. Muthayya et al. (2012) consider that the global rice market is a key opportunity to develop internationally traded rice fortification, especially for West African countries. Indeed, 12 countries account for more than 90% of the global rice exports. The concentration of countries and the concentration of large-scale milling and exporters within countries are expected to facilitate fortification program monitoring. Mkambula et al. (2020) argues that even when the potential food vehicle is mostly produced “in small, village-level mills *that are not automated and do not have the capacity to ensure and monitor quality (...), there may still be an opportunity to leverage the benefits of Large Scale Food*

⁶ This can lead to paradoxical situations for staple foods. On the one hand, the fact that a wide range of population consumes staple foods in high quantity makes it adequate as food vehicle for fortification. On the other hand, when the food is mainly used for self-consumption rather than for sale, fortification will be useless for rural communities.

⁷ Eight (four) countries have mandatory (voluntary) fortification of rice. Global Fortification Data Exchange. Accessed 13/04/2020. [<http://www.fortificationdata.org>.]

⁸ Six countries have mandatory rice fortification (Costa Rica, Nicaragua, Panama, Papua New Guinea, Philippines and the USA), and Brazil, Colombia and the Dominican Republic have large-scale voluntary rice fortification programmes.

Fortification through the importation of the fortified product. This is particularly relevant to salt and rice. Many of the countries identified in the rice category above could benefit from mandating the importation of fortified rice due to the large volumes imported and the presence of sophisticated mills at the places of grain production/origination ». In addition, this is recommended to fortify rice at country of origin instead of upon arrival, for a price issue: fortification upon arrival would trigger additional costs in terms of handling and bagging (WFP and International 2019). This option is viewed as an immediate and big opportunity for Nigeria (GAIN 2018a) and Senegal (WFP and International 2019).

Relying on imports is expected to facilitate the control process led by governments. Governments and public agencies play a crucial role in ensuring that programs are effective, by having an effective quality control and monitoring system (Berry, Mukherjee, and Shastry 2012, Humphrey and Robinson 2015, MicronutrientForum 2017, Lalani, Bechoff, and Bennett 2019). In case of domestically fortified products, the governments are in charge of establishing standards to regulate the production of such products. They also play the role of quality control. They deal with the composition of the products, the labelling but also the control of fraudulent use of reputable brands. This is a crucial issue because fortified products are 'credence goods'⁹ for which a high information asymmetry exist between producers and consumers. Even in the case of mandatory schemes, guaranteeing the respect of law and that the standards are met is a challenge. When fortified products are imported, control is limited to customs which have to guarantee imported products are complying fortification standards. We will see that despite this supposed facilitation most of the imported products found on the market do not comply with regulations. We can notice that some initiatives aim at harmonizing standards in Africa in order to facilitate trade across country borders (e.g. Fortify West Africa initiative, supported by Helen Keller International among others) (FFI website¹⁰) (Sablah et al. 2012).

Finally, Theary et al. (2013) suggest that, in some contexts, the implementation of a mandatory fortification program based on domestic production can represent a non-tariff barrier to imports and thus protect domestic industries.

3.1.2. Production based on large-scale centralized processing units

The second option is to promote fortified products that can be domestically produced and centrally processed by a small number of large-scale processing industries; as well as based on widely consumed raw products.

There is a consensus in the literature that having centralized, industrial and large scale food processing facilities is a prerequisite for successful fortification program (Miller and Welch 2013, WHO and FAO 2006, Martorell and de Romaña 2017, Klemm et al. 2010, Head, Getachew, and Gabrehiwot 2014, Muthayya et al. 2012, Lalani, Bechoff, and Bennett 2019). Several reasons explain why large-scale industrial and centralized processors are promoted as the core actors expected to adopt fortification.

First, unlike small-scale processors, large scale processors have a better access to inputs and technical expertise (Mkambula et al. 2020). This reduces the costs of fortification with economies of scale. The modes of production that rely on large scale centralized processing units are expected to be less dependent on government/ NGOs/cooperation funds, than those relying on small-scale processing units. Secondly, rather than dealing with a high number of dispersed small-scale processors, a limited number of large-scale processors facilitates the monitoring and control activities and thus lower the resources required for governments.

⁹ Products of quality that can only be observed at prohibitive costs (e.g. laboratory analysis).

¹⁰ Consulted April 1st 2020.

- Access to inputs and technical expertise, economies of scale and lower dependence on external funds

Food fortification needs the provision of several inputs: raw materials, equipment, lab equipment for quality control, and premixes. The capacity of processors to supply and afford these inputs (in quantity and quality) is critical for programs to be successful (Lalani, Bechoff, and Bennett 2019); and most of these inputs are imported.

Equipment is usually imported and expensive with regards to the small-scale processors financial capacities. There is a lack of technology available locally. Some projects support companies that procure local equipment to small or medium-sized food processing factories in order to lower prices and support the local economy. However, there is usually a lack of effort to build fortification equipment suitable for small and medium scale food processors, and using existing manufacturing capabilities and local materials (Head, Getachew, and Gabrehiwot 2014). Head, Getachew, and Gabrehiwot (2014) and Mkambula et al. (2020) also found that processors industries that fortify rely on abroad services for nutritional analysis of fortified foods' samples, or on imports of test kits

Food fortification also heavily depends on the premix market. Premix can take two forms: powder and liquid. Premix are either vitamin, mineral or vitamin & mineral premix. Premix access can raise several issues for food processors, especially the small-scale ones:

- Costs generated by premix purchase: Premix purchase represent a high share of costs for firms, especially for the smaller ones (Seleka et al. 2011, Nyumuah et al. 2012, Lalani, Bechoff, and Bennett 2019, Fiedler et al. 2014). Duties and taxes on premixes or fortification equipment are one of identified causes of the increase in premix price (Osendarp et al. 2018, Lalani, Bechoff, and Bennett 2019). Some organization do advocacy to lower or delete duties and taxes on premix import, and some countries have removed tariffs on imported premix and equipment (Mildon et al. 2015, Sablah et al. 2012).
- Finding good quality premixes: Some companies have difficulty finding premixes of good quality (Fiedler et al. 2014, Robinson, Temu, et al. 2014). GAIN has created a premix facility to guarantee companies with good quality at reasonable prices for small quantities. GAIN supplies from certified premix suppliers. These suppliers are mainly located in Asia, Europe and the United States.
- Minimum purchase quantity requirement: Usually, a minimum supply of 25 k g is required for premix, while the shelf life spends only six months. Therefore, the premix market is not suitable for the numerous small-scale processors that are geographically dispersed and need small quantity of premix (Fiedler et al. 2014), Mildon et al. (2015). In Botswana, Seleka et al. (2011) examine the potential costs of mandatory fortification of sorghum and maize flour for processing firms¹¹. They found that supplying premix is difficult for small-scale processors. They conclude that small to medium firms would only participate to mandatory fortification program if diluted premix production is centralized, because they will be unable to buy premix on their own.

For these reasons and because they have more budget and technical expertise, large scale processing companies are able to fortify products at a lower cost per unit compared to small-scale processing units (Seleka et al. 2011). This option is therefore more efficient and cost/benefits ratio are better (Mildon et al. 2015).

Finally, these reasons also explain why large-scale centralized processing makes it possible for countries and actors being less dependent on UNs/NGOs/cooperation funds. Small and mid-size

¹¹ The government of Botswana currently implements a targeted fortification programme for vulnerable groups using maize and sorghum. This is a voluntary program and fortified flours are sold through non-profit delivery mechanisms. However, voluntary fortification of maize, based on South African standards are implemented by large scale firms.

processors encounter difficulties in inputs procurements (raw materials, premix). There are some initiatives where NGOs, donors or governments helped small to mid-size processors to fortify food. They contribute to upgrade these businesses' capacities and facilitate the production and delivery of fortified products (Nwuneli et al. 2014, Robinson, Nwuneli, et al. 2014, Mildon et al. 2015). But, they often conclude that small and mid-size processors still face challenges in the production and marketing of fortified foods to reach poor population. This is exacerbated when supporting programs stop (e.g. Mildon et al. 2015). They hence require private/public partnerships with NGOs or public agencies: non-profit procurement and distribution has been recommended in Nigeria (Nwuneli et al. 2014), mobilizing existing food distribution network together with the promotion of fortified products and nutrition education programs led by local authorities to raise awareness among poor families has been recommended by Bruyeron based on lessons learnt from Nutridev Program. When fortification is voluntary, exploring the feasibility and impact of launching certification schemes has also been recommended (Nwuneli et al. 2014, Temu et al. 2014). Even if this has been demonstrated that small-scale production is possible (see below), the costs of trying to include the small-scale processors in a fortification program may be prohibitive. This has been reported for instance by Robinson, Temu, et al. (2014) and Fiedler et al. (2014) for maize flour in East Africa. On the contrary, large scale industrial food industries are supposed to be less dependent on donors/NGOs funds (Lalani, Bechoff, and Bennett 2019), even if they operate in strong partnership with public sector.

► **Facilitating monitoring and control activities and so reducing the resources required for governments**

Having a relative small number of large-scale centralized processing firms does help policy actors to reach the purpose of monitoring and controlling firms. This is much easier compared to controlling a myriad of small-scale processing units, dispersed across the territory. Moreover, even if these registered SMEs may be inspected by the State, the wide informal processing units are blind for governments and spread in rural areas.

It is important to note that the issue of control is crucial. Several studies conclude that some of the products that should be fortified (either because they are marketed under a mandatory fortification program or because they advertise this on their packages) are either not fortified or are fortified in quantities well below required standard. This failure also exists for imported products.

This has been observed in Africa for targeted-fortification schemes such as complementary foods (Dimaria et al. 2018), as well as for mass fortification schemes based on staple foods such as flour, oil and salt (GAIN 2018b). In Benin, Burkina Faso, Ghana, and Senegal, 22% of processed cereal-based blends were not nutritionally satisfactory (Dimaria et al. 2018). Half of imported complementary foods studied were not nutritionally satisfactory (Dimaria et al. 2018). In Burkina Faso, despite a mandatory fortification legislation, GAIN (2018b) revealed that only 23%, 27% and none brands of respectively oil, salt and wheat were fortified in compliance with fortification standard. Half of imported brands were not fortified to any extent. Given the proportion of imported brands among such food vehicle in Burkina Faso, it seems that inspections at customs/border levels fail to enforce the legislation. In Nigeria, between 60 and 90% of products do not meet the required level of fortification, because of poor premix quality (Lalani, Bechoff, and Bennett 2019). This situation can be caused by poor shipping and storage conditions, or by insufficient level of nutrient enrichment. In 2009 in Ivory Coast, Sablah et al. (2012) reveals that 81% of oil samples were adequately fortified in the South of the country and only 12% in the North, despite a mandatory fortification programs. This was due to the political situation at that time. This is why mandatory policies have to be complemented by an efficient enforcement of the standards (Sablah et al. 2012). These non-compliant foods labelled as fortified are misleading consumers on vitamin and nutrient content.

In the case of voluntary targeted fortification programs, labelling is important to ensure the right information is provided to consumers. Again, it is often not satisfactory. Labelling in complementary food for young children appears to be unsatisfactory most of the time regarding to the information provided to consumers, as reported by Dimaria et al. (2018) in West Africa and by Sweet (2012) in South Africa.

Finally, fraudulent use of reputed brand of fortified food has been observed in sub-Saharan countries. This is likely to discourage food businesses to maintain their commitment in fortification programs (Nwuneli et al. 2014).

3.1.3. What about small-scale food fortification?

While centralized large-scale production is clearly recommended for mass fortification, some organizations and programs support small-scale processing units to fortify food, for voluntary targeted fortification (complements foods) or mass fortification. They demonstrate that this is feasible and sustainable -e.g. (Bruyeron et al. 2010; Trèche, Mouquet-Rivier, and Avallone; Head, Getachew, and Gabrehiwot 2014).

Simple small-scale affordable technology seems necessary for preserving the capacity of small-scale processors to afford equipment facilities and compete in the market (Seleka et al. 2011). Head, Getachew, and Gabrehiwot (2014) explores the possibility of building fortification equipment suitable for small to medium-sized food processing factories using local labor and materials available in domestic markets. They conclude that domestic production is technically feasible and likely to decrease the initial capital costs. This is likely to lowering a significant entry barrier of food fortification for small-scale millers. This is also expected to promote domestic manufacturing sector, thus favoring jobs and incomes for workers in this sector.

Mildon et al. (2015) document the process and assess the feasibility of implementation of community-based fortification of staple grains in rural communities in Malawi, Tanzania, and Senegal, based on medium-scale/small or home fortification. They conclude that community-based fortification has great potential for ensuring fortified foods consumption, consumers' knowledge and engagement around nutrition, while providing income opportunities. However, some barriers to feasibility of implementation were identified: "mixed mandate charity vs business" which compromise the production potential, limited quality control monitoring, lack of support and economic incentives from national fortification agenda/legislation, inadequate financial capacities, dependence on subsidy from external funds, mill equipment breakdowns. Equipment breakdowns and the lack of autonomy to repair them caused small-scale mills' cessation. They argue that the mid-scale units in Malawi succeeded in supporting operating costs and supplying a regional market.

Bruyeron et al. (2010) show that targeted fortification programs (complementary foods) have been successfully implemented in small- and mid-scale processing units Burkina Faso, Madagascar and Vietnam. This was possible thanks to public/private partnership as well as strong technical and organizational support from the Nutridev program's team. Dependence to external funds challenges the financial sustainability of such programs (Bruyeron et al. 2010).

A limitation of supporting small-scale processors is the mixed nature of these small businesses. Some of them are only selling a service (milling service) not a product. This can limit the interest in fortification for these small businesses (Fiedler et al. 2012, Seleka et al. 2011).

Partnership between processors has been identified as successful factor. In Malawi, cascading partnership between mid-scale, small scale and home fortification units makes it possible that the home fortification units benefit from the small-scale ones, which were also supported by mid-scale fortification units which provided pre-blended (Mildon et al. 2015). Some papers show that clustering of small-scale processors is necessary for fortification programs to be successful. This has been promoted in Tanzania (Robinson, Temu, et al. 2014). In Ghana, Nyumuah et al. (2012) also show that the establishment of a

salt bank cooperative helps the small-scale salt producers to contribute to considerably increase the coverage of the population consuming fortified salt. The cooperative results in the centralized premix procurement and fortified salt delivering. In Azerbaijan, a cooperation between small-scale salt producers and a large domestic food company was successful to increase salt fortification and coverage, while ensuring the inclusion of small-scale salt producers (Mkambula et al. 2020).

Robinson, Temu, et al. (2014) also conclude that if donors, the Tanzanian government and partnerships are encouraging small-scale processors to undertake fortification, they should (i) simplify regulations to make compliance easier and allow businesses to pursue fortification even if they are not able to meet the whole requirements and (ii) explore “franchising models” (i.e. where small-scale processor are licensed by a franchise owner, providing equipment, training and monitoring).

Despite these local efforts to support small-scale processors, the main limit is the absence of economy of scale. With the benefits and easier implementation of large-scale fortification, small-scale level fortification have been discontinuously supported (Mildon et al. 2015). Also they depend on long term funding commitments.

Our review of the literature shows that two production modes are favoured to maximise the impact of mass fortification programs: i) the import of already fortified products and ii) centralized large-scale production. Small-scale fortification is being experimented for targeted fortification, most often with NGO support. We now turn to a review of distribution modes.

3.2. Delivery constraints and coverage

Many papers are exploring the coverage rate of food fortification schemes and the related constraints for businesses to deliver fortified foods and maximize the impacts on nutrition and health.

According to many authors, the most important challenge for food fortification programs remains the issue of how to deliver fortified foods to the most needed people (poor and vulnerable groups) (Humphrey and Robinson 2015). This is acknowledged that fortification is more likely to be successful (i.e. higher coverage rate of fortified products consumption) where a rise in income, change in consumption patterns and urbanization are observed (Martorell and de Romaña 2017, MicronutrientForum 2017). In Sub-Saharan Africa, there is mixed evidence on delivery and coverage of fortified food despite the efforts made by many countries (Lalani, Bechoff, and Bennett 2019, Humphrey and Robinson 2015).

There are various networks used for distributing fortified foods. They depend on the food vehicle, type of fortification (mass fortification/targeted fortification) and the countries' regulation level. Delivery modes range from public-sector financing to open markets (Lalani, Bechoff, and Bennett 2019).

Targeted/emergency fortification: In the case of targeted and/or emergency fortification schemes, NGOs, United Nations Organisations or national public health agencies are in charge of distributing fortified foods to the most needed population. This is the case of ready to use therapeutic foods such as Plumpy'nut. Such value chains are characterized by vertical coordination and a monopoly of aid agencies. These products achieve in reaching the poorest population through NGOs and UNs distribution, which support delivery costs.

Mass fortification and some case of targeted fortification (non-emergency): However, mass mandatory and voluntary fortification that is spreading in LICs and LMICs is based on the principle of 'marketization'. This relies on an assertion that businesses and markets should play a role in delivering nutrient rich

foods and that people will “purchase nutrition through markets” (Robinson 2016)¹². Expanding the emergency/targeted fortification approach to the whole population, by selling rather than freely distributing the fortified products, raises some delivery and coverage issues.

We present the challenges encountered by voluntary/mandatory fortification regarding to delivery.

3.2.1. The challenges encountered by voluntary & mandatory fortification in reaching the most needed population

Voluntary (targeted) fortification based on market distribution has resulted in a failure in reaching the poor (Lalani, Bechoff, and Bennett 2019). High fortification/delivery/promotion costs increase products prices. Dimaria et al. (2018) showed that access to fortified and non-fortified complementary foods for young children in Benin, Burkina Faso, Ghana, and Senegal were insufficiently reaching the surveyed points of sale. In addition, they found that most of complementary foods for young children available in the 275 points of sale surveyed were imported. They are also two to three times more expensive than the local products.

Nwuneli et al. (2014) examines the case of two mid-size enterprises in Nigeria, which target middle class and/or poor population. They conclude that distribution costs to reach the poorest part of population are too important and cannot be supported by the companies. They suggest that NGOs or government to buy and distribute such products. In the same vein, while the domestic production of quality complementary foods is feasible, Bruyeron et al. (2010) shows that marketing of such products remain a challenge. The results are positive when products are sold in small units, affordable and close to consumers (door-to-door, neighbourhood sales). However, when the products are sold through market players, the promotion and distribution costs, which are added to the final consumer prices, make the products too expensive in relation to the purchasing power. This conclusion builds on the lessons learnt from the Nutridev project in Burkina Faso, Madagascar and Vietnam. In Pakistan, Zuberi, Mehmood, and Gazdar (2016) conclude that food value chain interventions aiming at improving consumption of nutrient-dense foods (including fortified) among the poor do not work with informal sector neither small mills or informal vendors. Therefore, interventions often fail their objectives since small millers and informal distributors are the channel through which the poor access food. Ansari, Mehmood, and Gazdar (2018) also report that industrially milled wheat flour does not reach most of consumers in both rural and urban areas in Pakistan. They do prefer freshly milled flour from artisanal mills. Initiatives to voluntary fortify yogurt (e.g. in Bangladesh), biscuits (e.g. India) (parsar) or oils were unable to reach the poor because of high prices (compared to cheap alternative foods) (Lalani, Bechoff, and Bennett 2019).

For such voluntary fortification schemes, there is the issue of unobservable quality. Fortified foods are credence goods that require signalling of quality. Selling fortified food requires consumers' willingness to buy such products over others, while people have low purchasing power. The distribution costs for fortified products are high because the poorest population live in remote areas where distribution of food require transport and logistic that make the price of foods increasing (Robinson 2016, Nwuneli et al. 2014, Darnton-Hill and Nalubola 2002).

Therefore, the price is a key factor determining fortified foods purchase, by the poorest population as well as by food industry as raw materials. For poor consumers, slight increase in price can reduce their use of fortified staple foods (WHO and FAO 2006), including through substitution effects (Robinson, Temu, et al. 2014). Some retailers may decrease their margins to retain their consumers as reported by Parasar and RV (2018) in India and by Ansari, Mehmood, and Gazdar (2018) in Pakistan. But, this can undermine the long term sustainability of the value chain. For business to business purchases, although mandating processing firms to use fortified ingredients (such as using iodized salt, fortified wheat flour

¹² This idea is also supported in CoordinationSUD, which argues that people are mostly considered as “consumers” instead of citizens; as well as by Kimura arguing that fortification fits with the “economization of nutrition”: fortification proponents describe people as consumers and micronutrient strategies as “on the shelf” or “cost effective”.

in instant noodles or fortified vegetable oil in biscuits) could contribute to increase intake of micronutrients (Spohrer et al. 2013) (Mkambula et al. 2020), food processing industries are likely to reject this option if the costs of such fortified ingredients are too high. The WHO and FAO (2006) estimates that mass fortification in open economy market is more successful when the increase of price does not exceed 1-2 % compared to the unfortified one.

The reviewed studies suggest a dual situation: in the case of targeted-fortification (especially complementary foods for infants) the imported brand are more expensive than domestic products; while in the case of mass fortification imported products are expected to be cheaper (e.g. rice sector).

Another determining factor (although often linked to price) is physical availability (Tran et al. 2015, Parasar and RV 2018). Condiments and oils fortified with vitamin A, iron or zinc are branded and available mostly in supermarkets in Vietnam, where the most vulnerable population do not supply (Tran et al. 2015). Mass communication campaign has been conducted to increase consumers' demand, which is necessary to incentivize food industries to produce fortified foods. But businesses are still reluctant to fortify and deliver in other places.

Mass (mandatory and voluntary) fortification is based on the idea that neither the market nor voluntary fortification schemes are able to provide enough nutrient dense food, especially for the most vulnerable groups. Indeed, the most vulnerable groups may not be able to afford nutrient-rich or fortified foods that are promoted through voluntary programs if cheaper non-fortified foods are supplied by the market. Changes in consumers' food behaviour are complex and require a long-term period. To deal with these challenges, mandatory fortification requires all producers to enrich their products with micronutrients. Mass and mandatory fortification aim to eliminate non-fortified food from the market and therefore reaching all consumers.

A successful example of mandatory legislation in several countries is salt iodization (MicronutrientForum 2017, Mkambula et al. 2020). The coverage and impacts on iodine deficiencies are promising (Lalani, Bechoff, and Bennett 2019, Zimmerman et al. 2014). While mandatory fortification is more likely than voluntary schemes to reach a high proportion of the population and have greater impact on nutrition and health (Zimmerman et al. 2014), they also face challenges in reaching the most needed parts of population. In LICs/LMICs mass fortification schemes have been less successful in delivering foods to the poorest than in industrialized countries.

Some evidence suggest that large-scale centralized programs based on market distribution, do not succeed in reaching the poor (Humphrey and Robinson 2015, Robinson, Temu, et al. 2014) and consumption remains low (Aaron et al. 2017, Mkambula et al. 2020). Aaron et al. (2017) examine the coverage of 18 large-scale food fortification programs of edible oil, wheat flour and maize flour, in eight countries. While most of these programs mandate food processors to fortify, only two out of 18 have a satisfying coverage rate. The others fail to cover a wide part of consumption across the countries.

Mkambula et al. (2020) use the standardized methods Fortification Assessment Coverage Toolkit (FACT) to measure the coverage and quality of products in 16 countries, regarding to four food vehicles: wheat flour, maize flour, oil and salt. They highlight the following gaps:

- The “use gap” is the share of households in a population not consuming the food vehicle chosen for fortification. This indicates a poor choice of food vehicle.
- The “feasibility gap” is the “difference between the proportion of households consuming the food vehicle in any form and those consuming the vehicle in a fortifiable form”. This indicates a poor choice of food vehicle form, partially due to a mode of production or delivery of the food vehicle which does not meet the poor' practices (e.g. processing is made by small-scale units or this form is not delivered by informal actors).
- The “fortification gap” is the gap between the proportion of households that consume a fortifiable food and those that consume a fortified food. This indicates the non-compliance of food industries in the case of mandatory fortification.

- The “quality gap” is the “difference between the proportion of households consuming a food fortified to any extent and those consuming a food fortified in accordance with the relevant national fortification standards”. This indicates a failure in fortification process, storage of food products and a poor system of control/enforcement of the regulations.

These four types of failure exist. Figure 1 shows the results from this study (Mkambula et al. 2020).

The choice of food vehicle can be unsuitable for at least two reasons.

- The type of food in itself is not suitable (i.e. not widely consumed and purchased by the population). For instance in Tanzania, Robinson, Temu, et al. (2014) report that flour was selected for a mandatory fortification program whereas, only 18 percent of consumers in the bottom three wealth quintiles bought flour. Looking at 16 countries, Mkambula et al. (2020) shows that the “use gap” is null for salt and oil (because almost 100% of surveyed households consume oil and salt), while it reaches 27% for maize flour and 60% for wheat flour.
- The second pitfall is when the type of value chain that delivers this food is not used by the poorest (i.e. when the poorest do not purchase this food vehicle through channels supplied by large scale industrial food processors). This is often the case for staple foods. Most of poor consumers are relying on informal traditional food systems channels to supply food (Osendarp et al. 2018, Lalani, Bechoff, and Bennett 2019). Mkambula et al. (2020) found that the “feasibility gap” is bigger, especially for wheat and maize flours. This is consistent with other studies suggesting that the artisanal small-scale sector is widespread.

The program can also fail if compliance is limited. In Nigeria, a study found that levels of compliance were very low: between 10% and 38% of products were fortified despite mandatory programs (Robinson, Akinyele, et al. 2014). GAIN (2018b) shows also very low compliance for wheat flour, salt and oil in Burkina Faso. Mkambula et al. (2020) highlight the fortification and quality gaps. This is noteworthy that even for salt only 31% of households consumed adequately fortified salt, 1% for oil and only five and three percent for wheat and maize flour respectively. It is difficult to believe that fortification can have nutrition and health effects under these conditions.

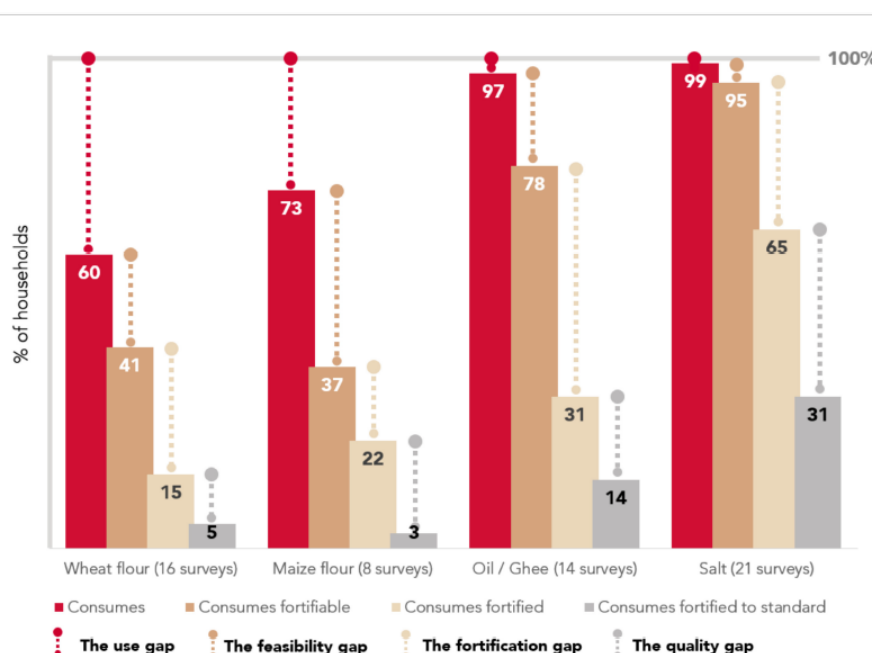


Figure 1: Aggregated data on fortification coverage and corresponding bottlenecks/gaps across multiple surveys (source: Mkambula et al. 2020)

Garett and Luthringer from GAIN also alert about the critical gap between fortification legislation (mandatory programs) and compliance. They identify several issues leading to poor compliance¹³. They include unclear food laws and regulations related to monitoring inspection and enforcements. The perceived probability of control is too low, the level of sanctions is low, the enforcement of control at customs levels when fortified food is mainly imported is limited and the resources dedicated to fortification are limited. The latter factor is critical where resources are limited and where other critical food safety issues need to be controlled as well. Governments tend to prioritize them and under-control fortified foods. Mkambula et al. (2020) also raise this issue. Last, poor compliance is due to the lack of capacity for some firms or the deliberate under-fortification of some processors wishing to improve their profits.

In conclusion, as it is often acknowledged that micronutrients rich foods such as fruits and vegetables, dairy or fish are often inaccessible to the poor, because of poor physical availability or affordability (Maestre, Poole, and Henson 2017) with low infrastructures and high delivery costs, food fortification does not escape this constraint. Evidence suggests that mobilizing existing high-volume distribution network in both urban and rural areas often fails to significantly increase coverage of fortified food products, even in the case of mandatory fortification schemes. It seems that fortification fails to be profitable and fortification programs fail to raise the interest among retailers/producers. In addition to these delivery issues, fortification faces the other big challenge of ensuring compliance in a context where the so-called “fortification” and “quality” gaps are comprised between 35 % for wheat flour to 64% for salt and oil.

3.2.2. Few novel delivery options are suggested in the literature

Maestre, Poole, and Henson (2017) argue that research should explore more deeply the effectiveness of interventions aiming at favouring the performance of food markets to deliver affordable, available, acceptable foods to the poor, in particular to infants and women. Based on a recent literature review, funding and sustainability of delivery modes are identified as key issues of fortification (Lalani, Bechoff, and Bennett 2019). Two options are often suggested in the literature for fortification.

► Non-profit distribution?

Some authors invite NGOs, United Nations and public sector to facilitate or being in charge to distribute fortified food to the poorest parts of population, especially in the case of targeted fortification (Nwuneli et al. 2014, Temu et al. 2014). Bruyeron et al. (2010) shows that funded distribution systems (such as door-to-door delivery by voluntary women supported by NGOs program) has good results in terms of awareness and consumption. In Senegal, WFP and International (2019) argue that social safety net programs operated under WFP or by the State should be “a first step to introduce fortified rice in Senegal”. Public procurement is also identified as a way to encourage processing firms to fortify for Berry, Mukherjee, and Shastry (2012) in South Asia.

However, non-profit distribution involves its own challenges, including the necessity of long term funding commitments. When funding stop, distribution channels can disappear and business stop fortifying products. This happened in Nigeria. Two largescale processing firms produced micronutrient fortified complementary foods under donor-funded projects. Donors distributed these products for free. Yet, when donors stopped purchasing, processing firms stopped producing because they fail to secure a market for these fortified products (Robinson, Nwuneli, et al. 2014).

¹³ Blog written by Greg S. Garrett & Corey Luthringer, GAIN <https://globalnutritionreport.org/blog/urgent-need-improve-compliance-national-fortification-programmes/>, consulted April 1st 2020

► Delivery through existing informal market?

The fact that most of consumers are relying on informal traditional food systems channels to access food is a crucial reason why fortification fails to significantly increase its coverage. Some authors argue that food fortification schemes should work in and through informal markets (Robinson and Humphrey 2015, Humphrey and Robinson 2015, Zuberi, Mehmood, and Gazdar 2016). People working in informal food delivery are perceived as critical target of fortification: they both serve the poor and are usually among the poorest segment of population (Robinson and Humphrey 2015).

This is also supported by Gómez and Ricketts (2013). The authors examine how the transformation of food value chains may increase or prevent the triple malnutrition burden in developing countries. They argue that modern to traditional value chains are the most likely to target micronutrient deficiencies with processed and packaged fortified foods. Modern to traditional value chains are value chain where modern food producers (large-scale national or multinational manufacturers) use traditional distributors to deliver food.

On both cases, non-profit distribution and informal market, UNs, NGOs, donors, and the local and national authorities are invited to invest in nutrition awareness communication campaigns, in order to raise awareness and demand for nutrient rich and fortified foods (Nwuneli et al. 2014, Robinson, Akinyele, et al. 2014). This is especially true when voluntary fortification is promoted. Marketing and promotion costs are high. Local authorities are expected to support these costs to build demand and motivate producers/distributors to commit in fortified foods markets.

Our review of the literature shows that the issue of product distribution is crucial and is not yet completely satisfactory. Voluntary (especially targeted) fortification programs have difficulties in reaching the poorest, in particular due to their cost/price. Mandatory fortification programs aim to overcome this problem by excluding all non-fortified products from the market. But beyond the observed under-compliance (see section 3), it seems that the choice of vehicle is often unsuitable from a distribution perspective. Moreover, in countries with a large informal sector and poverty, it seems that programs are not able to overturn the commonly used food provisioning practices, via the informal/artisanal sector or self-consumption, which limits coverage.

4. Discussion: towards potential impacts pathways and illustrations in the case of Burkina Faso

The impact of fortification programs on domestic food chains' actors and organizations has not been clearly studied as such. However, the existing studies provide interesting elements for the discussion although their primary objectives are different. Hereafter, we discuss main findings from this literature in order to inform our research questions in the case of a LIC such as Burkina Faso. We distinguish two levels: the macro level regarding the effects on food trade balance and import dependency of fortification programs and the micro level regarding the effects on inclusion/exclusion and relative livelihood opportunities for domestic small scale actors.

4.1. Macro-level: food trade balance/import dependency

4.1.1. Issue of policy coherence

The fortification strategy based on imported products can conflict with national agricultural policy which aims at reducing food imports. Most of developing countries are trying to support their agricultural sector, especially when they have negative food trade balance for staple foods (including rice). They invest in domestic agriculture in order to increase production, reduce dependency to imports, and prevent effect

of rise in international staple food prices on their domestic market that can generate food and political crisis. Even national and international food aid programs now mostly source their supplies from domestic markets, in surplus areas instead of donor country (Lentz and Barrett 2013). Promoting a product that has negative impact on national food trade balance may rise some concerns among governments' officials and local businesses (WHO and FAO 2006).

Fortification strategy based on imported products can also conflict with national health policy when the fortified product has non-healthy properties. Indeed, this is recommended to select a fortifiable product that is widely consumed and purchased (to avoid non-coverage bias due to self-consumption) by the general population. Many imported products meet these criteria (e.g. bouillon cube) but are not healthy and over processed. This can lead to overconsumption of nutrients (such as salt) and create confusion among consumers.

4.1.2.Import dependency?

► Market shares for imported vs domestic products

The fortification strategy based on imported products to bring fortification into a market could have consequences on food markets: Does the share of imported products increase or decrease as a result of such a policy? There is no clear evidence. This constitutes a research gap which should be relevant for policy makers who wish to support their domestic food systems.

Some West African countries are mandating oil and wheat fortification. GAIN (2018b) carried out a market assessment in eight market hubs in Burkina Faso in order to document the presence of fortified oil, salt and wheat flour that corresponds to three mandatory fortification schemes. They conclude that imported brands make up the majority of available brands on the market (from 84% for wheat flour to 100% for salt). This shows that imported products are very strongly available on the market. It is not surprising for products that are not produced in the country (such as salt/bouillon cube). But, for other foodstuffs, this may indicate a progressive exclusion from the market for domestic products. However, data does not make it possible to conclude about the effect of Burkinabe mandatory fortification program on the market shares (of domestic vs imported brands). It would be necessary to have knowledge of the state of the market beforehand and to understand whether the motivations/constraints of domestic actors to produce and sell these products are linked (or not) to the fortification programs. Most research is needed to explain these dynamics.

The issue of guaranteeing fortified foods' quality (incl. safety) seems also important in order to support domestic processing firms over foreign ones. Indeed, consumers usually prefer international brands to those made by small-scale national businesses because of concerns about quality (Robinson, Nwuneli, et al. 2014). Actions that can help increase consumer confidence in local products will benefit the local economy.

Regional strategy are implemented to deal with this issue of imports: this has been the case on West Africa where Sablah et al. (2012) report that regional industries cover an estimated 70% of the demand for cooking oil in the region.

► Import dependence on fortification inputs

The literature shows that most of inputs needed for fortification are imported. This includes equipment, lab equipment for quality control, premixes, and sometimes raw materials (food vehicles). In particular, the premix market is global. In Sub-Saharan Africa, only South Africa has food industries producing premix. The South Africa food fortification premix market is going to rise, driven by the market in Middle East and Africa (16% of global market). Other countries are dependent on imports to fortify foods and thus to implement their national fortification strategy to address micronutrients deficiencies.

4.2. Micro level: potential effects on domestic small-scale actors

There is no clear evidence on this issue.

4.2.1. Potential effects on processors

On the one hand, some authors find that small-scale food processors would be evicted from the market if mass fortification programs are implemented. Access to inputs and technical expertise can act as a barrier to adopt fortification. There are processing units, which lack budget and expertise to fortify¹⁴ (Robinson, Temu, et al. 2014). This has been reported for instance by Head, Getachew, and Gabrehiwot (2014), which surveyed eight flour and oil processing facilities in Northern Ethiopia.

Because of the constraints generated by fortification, we can assume that the network of small, often informal processors (and their raw materials suppliers), which provide the majority of food to the poorest populations cannot afford to participate in food fortification programs (Glover and Poole 2019). Based on a literature review, Lalani, Bechoff, and Bennett (2019) report that costs of fortifying maize through large-scale mills is seen as more cost efficient than upgrading small mills in East Africa. The latter will not be willing to maintain activities in such a market, given that large-scale food industry benefit from economy of scale to lower production costs (Mildon et al. 2015). In Botswana Seleka et al. (2011) found that unit average fortification costs is higher for small firm compared to larger firms. They conclude that if government mandate fortification of sorghum and maize this will be feasible only for large and perhaps some medium firms. They conclude that mandatory fortification program will lead to the collapse of the small and some mid-size processing firms if they are not supported to be able to adopt the fortification scheme, at reasonable costs so that they can compete on the market face large scale companies that benefit from economies of scale. Indeed, Fiedler et al. (2012) examine the effect of a public/private partnership, which carries out a voluntary fortification program for wheat flour. An “open market test” (selling through bakeries and hoteliers) was implemented. They conclude that the program dramatically affected the wheat flour market. This led to increased market share of formal millers, thus reducing market share of informal sector (Fiedler et al. 2012).

On the other hand, some authors find that where strong informal and artisanal processing and delivery sector predominate there is no chance the mass/mandatory fortification program will be successful. Humphrey and Robinson (2015) argue: *“In many countries the majority of poor people source food from informal producers and traders, and it would be wrong to assume that informal sector food provision will be replaced by modernized value chains. Evidence from African countries does not support such an idea”*. Indeed, African countries that mandate food fortification such as Nigeria or Tanzania have made little progress due to the importance of informal food sector. Most of agricultural produce does not reach the formal food chains. It goes into home consumption, on-farm processed or through milling/processing services at the villages (Robinson, Temu, et al. 2014, Robinson, Akinyele, et al. 2014, Seleka et al. 2011). In Pakistan, Ansari, Mehmood, and Gazdar (2018) also shows that large-scale voluntary wheat fortification programs were not successful because of the high share of the artisanal value chains, that are still targeted by most of consumers. After analysing the feasibility for developing rice fortification in Senegal, WFP and International (2019) also conclude that mandatory fortification may be impractical since the rice milling industry is highly fragmented.

To sum up, this review of the literature suggests that domestic small-scale processors may be included in the markets only if they are supported by public agencies/NGOs for both access to inputs and distribution and if they pool a part of their activities, particularly to access to inputs and services (premix, equipment, analysis) and for delivery.

¹⁴ Blog written by Greg S. Garrett & Corey Luthringer, GAIN <https://globalnutritionreport.org/blog/urgent-need-improve-compliance-national-fortification-programmes/>, consulted April 1st 2020

4.2.2. Potential effects on producers

Whether or not food fortification can benefit domestic producers partly depends on the current food trade balance of the selected vehicle. This also depends on the capacity of domestic farmers to supply high quality of raw materials and respect of other terms of their contract (deadline, volume, etc.). Indeed, fortification requires products of good and consistent quality. Otherwise, processing costs increase (Nwuneli et al. 2014, Robinson, Temu, et al. 2014, CoordinationSUD 2018).

There is no clear evidence whether the mode of production and delivery of fortified foods that rely on large-scale food processing industries will benefit/jeopardize small-scale domestic farmers.

Large scale centralized food processing industries tend to source on international markets instead of domestic markets (Robinson, Temu, et al. 2014). This could be detrimental to domestic farmers and conflict with national policies, which often aimed to increase self-sufficiency for staple foods. Several studies show that companies fortifying their products supply at least partly on international markets (Head, Getachew, and Gabrehiwot 2014, Seleka et al. 2011). In Ethiopia, the five processing industries that do fortify wheat rely on import for their supply of raw wheat. According to processors, supplying locally has some constraints, including inconsistent wheat quality, instability of prices and risk of aflatoxin accumulation (Head, Getachew, and Gabrehiwot 2014, Nwuneli et al. 2014, Robinson, Temu, et al. 2014) (IDS64 Nigeria, ER90). This is due to the limited access to improved storage facilities for small-scale producers.

Small-scale artisanal and sometimes informal processors are more likely to source locally from smallholders, even if the quality is lower. However, large-scale processing firms are often more likely to coordinate with producers through contracts, in order to secure quantity and quality of raw material supply (Nwuneli et al. 2014). Yet, there is no clear evidence about the effects of such vertical coordination in supply food chains on smallholders' inclusion and income. Some evidence suggests that less endowed farmers are being excluded from these supply chains, and when included, smallholders may not always benefit from contracts (Soullier, 2019, FOOD SYSTEM AT RISK).

Fortification programs can be threatened if raw materials availability is insufficient. For instance, Sablah et al. (2012) report that in Mali the lack of cotton seed for vegetable oil production has been a major problem for fortification program. Because of the low international market price, Malian cotton farmers have started growing other crops. In India, Parasar and RV (2018) report that food industries face challenges in increasing sales of fortified 'infant milk substitute' products since they are in competition with other purchasers when supplying milk.

These examples show how food fortification programs are embedded in current food system.

5. Conclusions and recommendations for future research

In this deliverable, we provide an overview of the existing knowledge about the (potential) effects of food fortification on domestic food systems' actors and on food fortification capacity to foster/prevent an inclusive socioeconomic development. Based on this knowledge and information related to the case of Burkina Faso we also provide some insights about the potential effects of these programmes on the domestic food chains' actors in this particular country. This reflection can contribute to understand under what conditions food fortification is likely to generate significant and long-term effects to prevent micronutrients deficiencies and contribute more broadly to SDGs

The following are conclusions and recommendations on the potential consequences of the modes of production and delivery of fortified foods on (small-scale) domestic food value chains actors, based on desk scoping review.

5.1. Main conclusions

There is a wide literature available on fortification but apparently a limited interest of this literature on socio-economic issues and effects of fortification programs on domestic food chains actors, notably small-scale ones. Authors are primarily interested in assessing the effectiveness of fortification programs on nutritional goals, for which they have been designed, but potential side effects seem neglected. We show that evidence on whether and how the modes of production and distribution used for food fortification can contribute or threaten domestic food chains is scarce and un-consensual. The reviewed studies focus on the ability of fortification strategy to contribute to nutrition and health through increased consumption of fortified foods by vulnerable population. When they deal with the issue of domestic food value chains actors, they analyse and discuss how they can improve their production/delivering system to reach the most vulnerable and increase the consumption of fortified foods (not to maximize the effects on livelihoods/income or inclusive development). The lessons learned they draw from their studies are aimed at making recommendations to improving delivery, coverage and impact of food fortification that are intended for donors, NGOs, governments and/or private sector.

The issue of the implications of such food policy on the ability of domestic (including small scale) food chains actors to comply with requirement and to generate income and jobs is poorly discussed. The existing data do not allow to analysing how the expansion of food fortification strategy, at large scale of even in the case of mandatory schemes, can bring on national food values chains transformations.

A number of difficulties to carry out such research can be highlighted:

- Most of authors are nutritionists and most of journals publish papers in nutrition, health or food sciences. Therefore, research focus on assessing the impact of fortification on nutrition and health.
- This issue raises the tension between the short term and the long term. This tension often leads to prioritizing strategies likely to have an impact in the short term for reasons of the severity of the issue and its consequences (micronutrients deficiencies affects every generation of children) as well as for reason of funding and political credibility. Impact assessments are also likely to assess short-term effects. However, questioning the various strategies in light of their longer-term effects would make it possible to analyse whether they preserve/build the basis for moving towards a sustainable and inclusive future, considering several dimensions of sustainable development.
- There is a lag period between the implementation of a mandatory/voluntary fortification schemes and effects on food systems. It may take a few years for processors to comply (or not) with the legislation and to enforce the law for all the processors. Therefore, they are not easy to capture and authors focus on direct food consumption and nutrition outcomes.
- The complexity and uncertainty of real food markets fit not very well with the production of evidence based on highly controlled trials or assessments, as require the so-called 'medicalization' principle¹⁵ supported by food fortification programs (Robinson 2016). Robinson (2016) argues that the control required to assess the impact of fortification programs does not go hand in hand with uncertainty and complexity of markets. This type of impact assessment methodology is also likely to focus on short-term and direct effects (instead of long term, indirect or domino effects).

Our review has some limits. First, the key words method may have missed relevant references. Second, we found the same authors for several studies. Few of them are affiliated with foundations or NGOs, which promote fortification (e.g. GAIN, Helen Keller International). This limits our ability to determine impartial converging/diverging ideas in the scientific literature. Third, we found the same academic

¹⁵ Robinson (2016) argues that the promotion of food fortification is based on both medicalization and marketization. Medicalization builds on an assertion that evidence-based food enrichments can lead to improvement in nutritional status. Marketization builds on the idea that businesses and markets should play a role in delivering nutrient rich foods and that people will "purchase nutrition through markets".

journals for many studies (e.g. Food and Nutrition Bulletin). Fourth, selected papers do not aim at precisely documenting our research questions. So, the insights provided in this report are mostly assumptions not evidence.

Yet, the reviewed studies provide elements to draw some assumptions about the potential effects and the conditions in which fortification can contribute to inclusive economic development meanwhile contributing to nutrition.

First, the authors agree on the need to build strong private/public partnerships as well as involving civil society organizations.

Second, the authors promote two modes of production of fortified foods: the first one based on imported fortified products and the second based on large-scale centralized production. These two modes are promoted because they are cost-effective and because they are expected to facilitate the control and monitoring role of the public agencies to guarantee the quality of products.

Third, the authors mainly argue that the biggest challenges encountered by food fortification programs (both mandatory and voluntary, both mass and targeted programs) is the issue of distribution. Mass fortification programs usually fail in reaching the poorest due to poor food vehicle choices, the importance of informal/traditional sector as well as poor compliance by food industries.

Fourth, the effects of fortification programs on domestic small scale food chains actors are not explored. There is a knowledge gap while it may be relevant for policy makers to have evidence on these effects when deciding to support such program against (or on top of) other strategies. We found that food fortification as part of food policy and regulation (standards, control system) may have consequences on domestic food markets. They include effects both at national scale, such as prices effects, food trade balance and import dependency, and at business' scale, such as business sustainability, jobs and incomes. And these two levels of effects are interconnected.

We assume that mass fortification programs, by not explicitly promoting and supporting the inclusion of domestic small-scale and mid-size processors, risk to threaten their activities by putting them in competition with domestic large players who benefit from economies of scale or with imported products.

5.2. Recommendations

The various strategies to tackle micronutrients deficiencies worldwide have to be discussed in light of their effectiveness to reduce deficiencies in the most risky part of the global population but also in light of their potential impacts on jobs, incomes and reduction of inequalities. Even if food fortification is able to get good results in the short term, it must not compromise an inclusive development locally and prevent local producers and processors to make a livelihood.

In order to address the research gap, we recommend that economic studies should be conducted to explore how fortification programs are embedded in the domestic food value chains; and assess whether it does jeopardize or support livelihoods opportunities for domestic actors, including informal and vulnerable ones.

This can contribute to understand under what conditions food fortification is likely to generate significant and long-term effects to prevent micronutrients deficiencies, while ensuring local inclusive economic development. One of the research questions to explore is also about the resilience of food systems that support fortification: to what extent a decentralized mode of production based on a myriad of small-scale producers could be more resilient than a centralized largescale industrial mode of production or than relying on imported food items, when one considers the volatility of international prices.

These results call for changes in terms of approaches and methodologies. Food fortification strategy needs to be evaluated under real market conditions (Robinson, Nwuneli, et al. 2014, Berry, Mukherjee, and Shastry 2012). Some assessments use RCT to assess the real impact of fortification on nutrient status. However, this does not mean that the fortified products will reaching poor households in real

conditions (Berry, Mukherjee, and Shastri 2012). This does not ensure that value chains' actors will comply with standards. Food fortification programs in real market conditions might even compromise plenty of small-scale (informal) food processors to maintain their livelihoods. Since income and poverty are part of the key underlying cause of malnutrition and because such informal FS actors are among the poorest population, jeopardizing their activities may have the reverse effect of the one hoped for.

The strategies used to combat micronutrient deficiencies should be based on multidisciplinary teams combining nutrition but also social sciences. This would make it possible to analyse broader aspects of these strategies: considering not only the nutritional dimension and their effectiveness to reach the second SDG in the short term but also identifying the conditions favouring a long-term and sustainable impact (including cultural, social, political and market and value chain conditions).

This research area should be explored by distinguishing the different food vehicles and current state of markets.

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