West Africa Bouillon Fortification Initiative
Senegal Research Brief #1
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Bouillon Fortification in Senegal: Modeled Evidence

Key Policy Messages Related to Bouillion Fortification for Senegal

- The prevalence of micronutrient inadequacy is substantial for both women and young children in Senegal.
- Current national food fortification programs reduce vitamin A, iron, and folate inadequacies, but dietary gaps remain.
- Bouillon cubes are widely consumed throughout Senegal, including poor households in rural areas.
- Multiple micronutrient-fortified bouillon cubes can contribute to further reduce dietary gaps in micronutrients.
- Designing and implementing a bouillon fortification program will require public- and private-sector investments.
- Premixes will represent the primary cost of programs and will depend on the choice of micronutrients in the premix (part of program design); these costs are generally passed on to consumers, with pass-through managed by industry.
- Technical and other challenges remain to produce commercially viable fortified bouillon cubes.
- Modeling techniques can provide evidence to help inform policy discussions around bouillon fortification program

Rationale and Objectives

Rationale: Micronutrient deficiencies impact health, growth, and development.[1] Bouillon is widely consumed, including among rural and poor populations,[1] and hence has the potential to deliver micronutrients to at-risk individuals.

Objectives: This research used national data from Senegal to: (1) assess dietary inadequacy of iron, zinc, vitamin A, folate, and vitamin B12 among WRA and children 6-59 month of age; (2) model the contributions of existing large-scale food fortification (LSFF) programs to addressing micronutrient gaps; and (3) model the potential contributions of fortified bouillon to further meeting dietary requirements and to reducing child mortality. Fortification program costs and cost-effectiveness were also assessed.

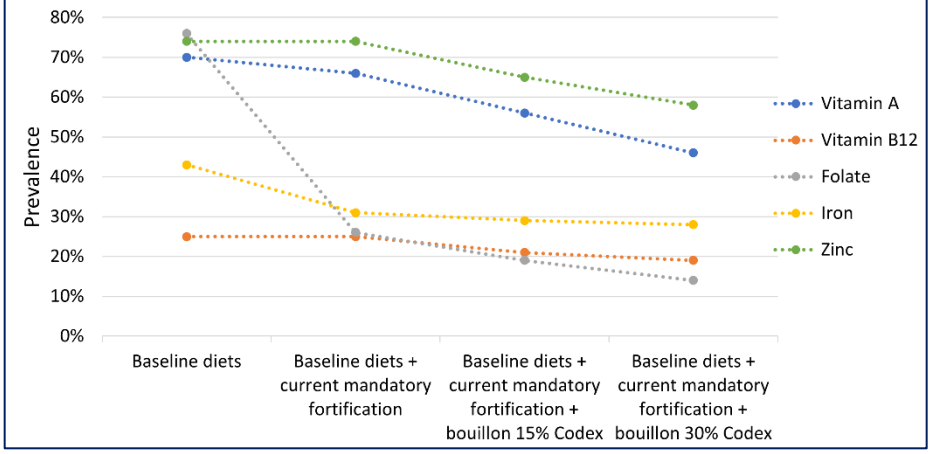
Methods

We used household food consumption data from the 2018/2019 Enquête Harmonisée sur les Conditions de Vie des Ménages[2] and the Micronutrient Intervention Modeling Project's nutritional benefits model (MINIMOD-SD) to estimate the prevalence of dietary micronutrient inadequacies and to model the contributions of various combinations of fortification programs to reducing inadequacies. The Lives Saved Tool (LiST)[3] was used to estimate the impacts of fortification on child mortality. The MINIMOD cost model[3] was used to estimate the start-up and operational cost of hypothetical bouillon programs over 10 years, separated by government costs, and industry costs, and premix costs.

Results: Micronutrient inadequacies in Senegal and programs to address them

Nationally, based on natural food sources alone, inadequacies in vitamin A, vitamin B12, folate, iron, and zinc are common among children (**Figure 1**). Folate, zinc, and vitamin A (VA) show the highest inadequacy levels, with iron and B12 also problematic but to a lesser extent. Wheat flour fortification (with folic acid and iron) notably reduces folate inadequacy, refined oils fortification modestly addresses VA inadequacies. Bouillon fortification

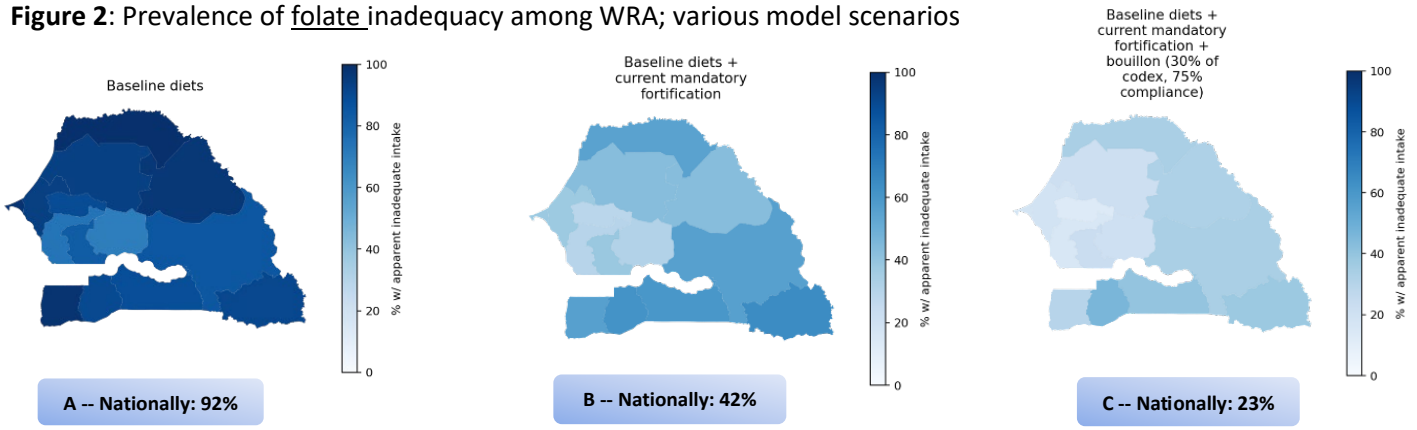
Figure 1. Prevalence of micronutrient inadequacies among young children, by group of intervention programs



would substantially decrease inadequacies among children in VA, zinc, and folate, with modest gains for B12 and minimal impact on iron inadequacy.

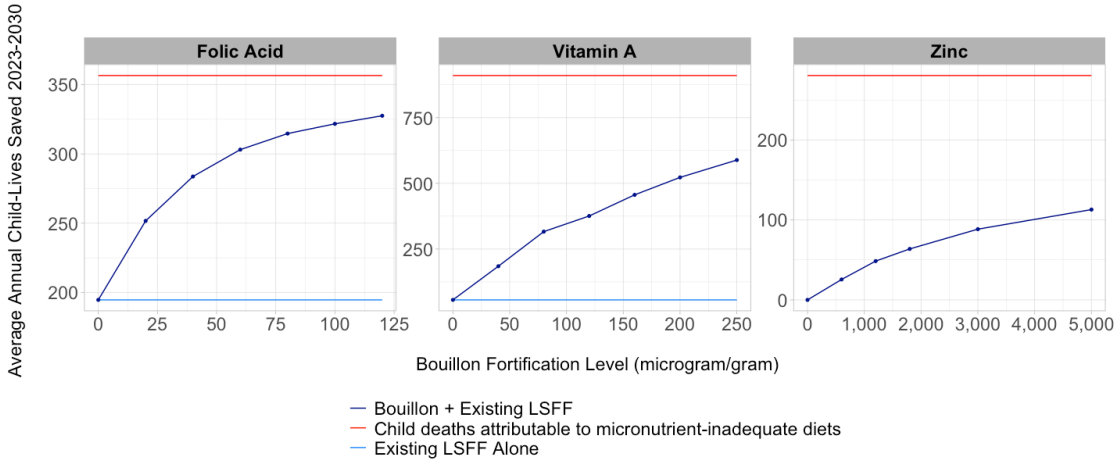
Regional variations exist in both inadequacy levels and the impacts of LSFF and potential bouillon fortification. For example, based on natural food intake alone, 92% of WRA nationally have dietary inadequacy of folate (**Figure 2A**), ranging from 99% in the north to 64% in the center-west. Wheat flour fortification reduces national inadequacy to 42% (**Figure 2B**). Bouillon fortified at 30% (**Figure 2C**) of Codex Nutrient Reference Values would decrease national inadequacy to 23%, with similar subnational patterns of improvement.

Figure 2: Prevalence of folate inadequacy among WRA; various model scenarios



Reductions in folate inadequacy among WRA, and in VA and zinc among children, can lead to reductions in child mortality.[3] **Figure 3** illustrates the potential child-lives saved at different levels of fortification of bouillon (independently) with folic acid, VA, and zinc, respectively. The red line in each figure shows child deaths attributable to dietary inadequacy of each micronutrient. The lower blue line shows child-lives saved by existing large-scale fortification programs (LSFF; none include zinc). Bouillon fortification with any of these micronutrients would save children's lives, although folic acid and VA fortification would be more effective than zinc.

Figure 3: Lives saved by different levels of bouillon fortification among children 6-59 months in Senegal



Results: Bouillon fortification program costs and cost-effectiveness

Public-sector and private-sector investments will be required to design, launch, and manage bouillon fortification programs.[4] Planning costs are substantial for government (**Figure 4A**), while equipment investments are the main cost driver for industry (**Figure 4B**). Operational costs for government for bouillon fortification programs (**Figure 4C**) are mainly comprised of training/retraining, social marketing, and factory and household monitoring. Operational costs for industry (**Figure 4D**), on the other hand, are dominated by the management of premix flows (management, etc.) and by the fortification process internally (fortification and QA/QC activities). Once operational, the annual cost of the flow of premix required by a program designed to meet 30% of Codex NRVs for all five micronutrients for adults consuming 2.5g of bouillon per day is ~$3.25m, or ~$0.001 per 2.5 gram serving.

Figure 4A: Hypothetical bouillon fortification program: start-up costs, by cost category, Government

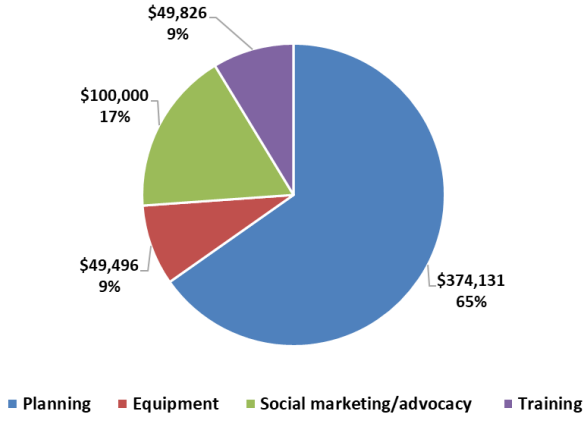


Figure 4B: Hypothetical bouillon fortification program start-up costs, by cost category, Factories

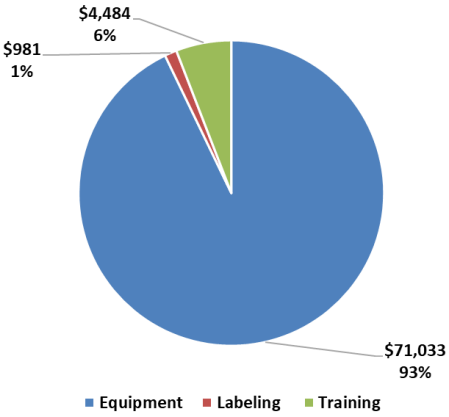


Figure 4C: Hypothetical bouillon fortification program non-premix operational costs, by cost category, Government

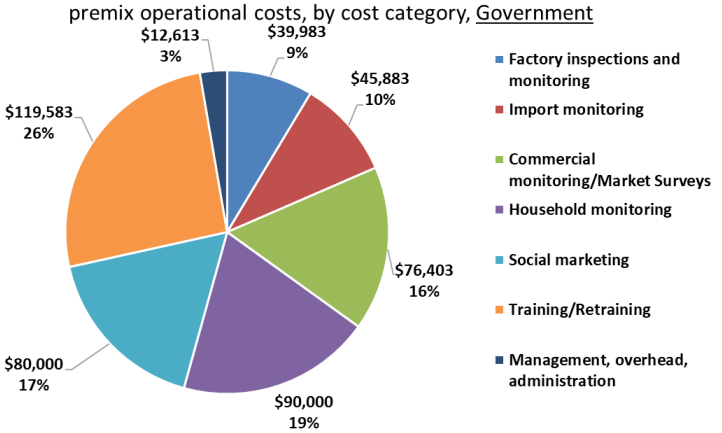


Figure 4D: Hypothetical bouillon fortification program non-premix operational costs, by cost category, Factories

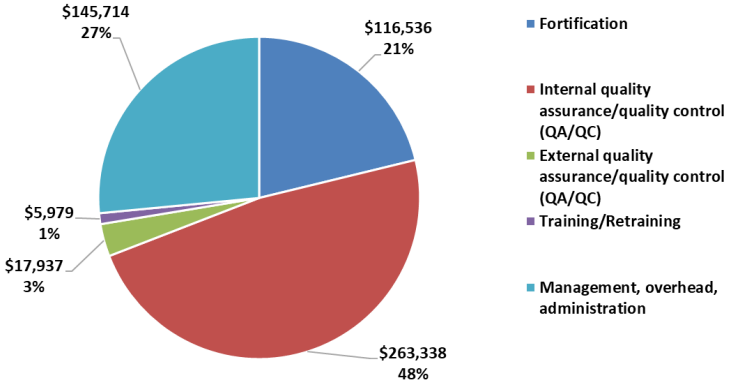
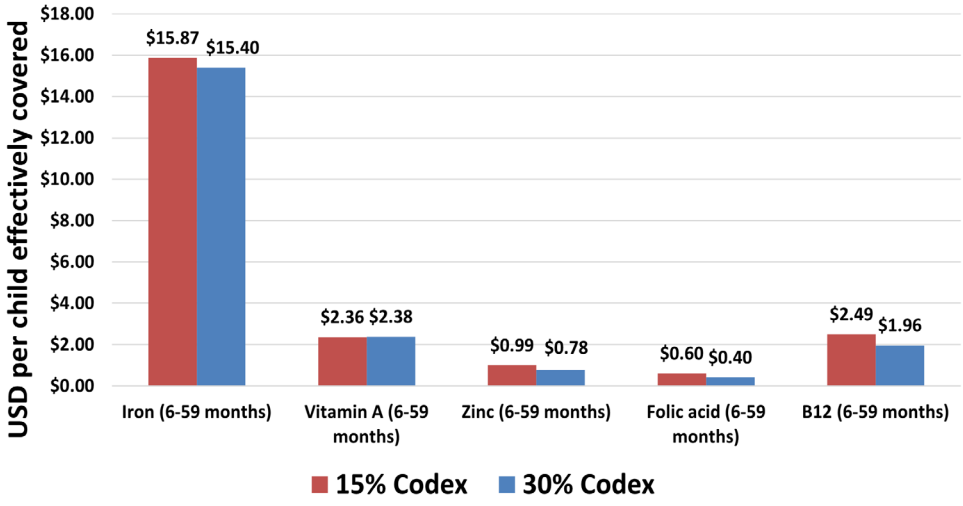


Figure 5 reports the cost-effectiveness of bouillon fortification for each of the micronutrients included in this study. Fortificant costs and (especially) absorption make iron the least efficient. VA is more cost-effective, with zinc, folic acid, and B12 being the most efficient in terms of reducing dietary inadequacy per dollar invested.

Figure 5: Cost-effectiveness of alternative micronutrient intervention programs, young children, by micronutrient



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Further information

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References

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[3] Thompson, L., et al. (2024). The Impacts of Bouillon Fortification on Child Mortality: The Cases of Burkina Faso, Nigeria, and Senegal. *Annals of the New York Academy of Sciences*, Special Issue on Bouillon Fortification. forthcoming

[4] Vosti, S.A., et al. (2024.) The Cost-effectiveness of Adding Multi-fortified Bouillon to Existing Large-scale Food Fortification Programs: The Cases of Burkina Faso, Nigeria, and Senegal. *Annals of the New York Academy of Sciences*, Special Issue on Bouillon Fortification. forthcoming