REGIONAL OPERATIONAL GUIDE ON MATERNAL ANEMIA

Leveraging the systems approach to protect women from anemia in West and Central Africa

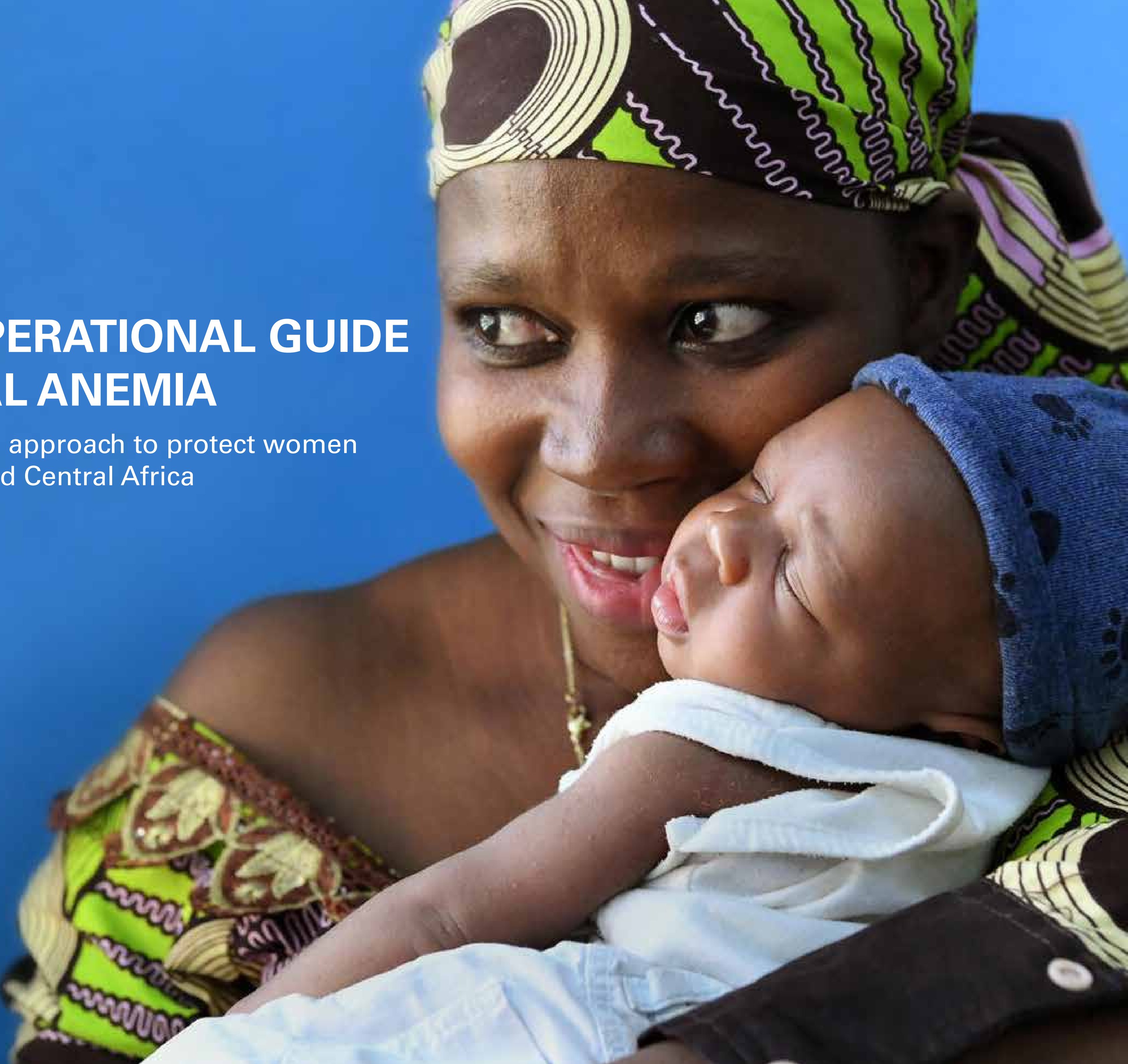

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TABLE OF CONTENTS

LIST OF ABBREVIATIONS

ANC: Antenatal Care

DOC: Directly observed consumption

IFA: Iron and Folic Acid

IFAS: Iron and Folic Acid Supplementation

GASPA: Group de Soutien pour l'apprentissage de l'allaitement du nourrisson et du jeune enfant

Hb: Hemoglobin

MMS: Multiple Micronutrient Supplements

NPW: Non-pregnant women

RIDA: Research for Inclusive Development in Africa

SDG: Sustainable development goals

UNICEF: United Nations Children's Fund

WASH: Water, Sanitation and Hygiene

WCA: West and Central Africa

WCAR: West and Central Africa Region

WHA: World Health Assembly

WHO: World Health Organization

WRA: Women of Reproductive Age[1]

1. In this guide, Women of Reproductive Age refers to pregnant and non-pregnant women and adolescent girls

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FOREWORD

West and Central Africa (WCA) is home to an estimated 142 million women of reproductive age (pregnant, non-pregnant and adolescents girls) representing 7.2% of the global population of this age group. However, at 11% WCA bears a large proportion of the global anemia burden in this age group. While the prevalence of anemia has stagnated at nearly 50% over the last two decades, the absolute number of women affected has increased from 40 million in 2000 to 61 million in 2019[2] due to the population growth.

Aiming to address these very high levels of anemia in the region, this regional guide is an output of a granular analysis of the most recent data from nationally representative surveys in WCA. The document aims to guide countries in WCA in making strategic programmatic decisions to improve the prevention and control of anemia and thereby accelerate reaching the global goals on anemia. It comes at an important time, two years before the 2025 endline of the World Health Assembly targets and midway through the era of the Sustainable Development Goals. This guide first takes stock of progress on maternal anemia in the region and shows that progress towards global targets is offtrack. It then underscores that the strategies to reduce anemia in WCA will require a significantly different approach. To do this, countries need to develop and deliver a package of context specific interventions that goes beyond pregnant women and beyond the health system platform thereby addressing the multi-dimensional drivers anemia in women of reproductive age.

Through production of this guide and ongoing support to countries in the region, UNICEF's regional office demonstrates its commitment to supporting countries in WCA to achieve their respective global targets of reducing anemia in women of reproductive age by end of the decade.

2. Data from the Global Health Observatory is available up to 2019

EXECUTIVE SUMMARY

West and Central Africa Region (WCA) is off-track to achieve the World Health Assembly (WHA) target of reducing by half the number of non-pregnant women (NPW) affected by anemia by 2025. Due to population growth, the number of NPW affected by anemia increased by 20% from 45 million in 2012 to 54 million in 2019, setting the region off-track to achieve the WHA targets. To support countries in WCA to reverse this trend, it is important first to understand the reasons for no progress; second, to examine the context specific etiological factors of anemia; and third, to establish the coverage of programme interventions and assess their alignment to the contextual drivers of anemia and, last but not least, use this information to review programme design and delivery.

This programme guide is the first of its kind to consolidate the evidence specific to WCA on the etiological risk factors of anemia in women of reproductive age. It describes the outcome of a granular analysis of the underlying drivers of anemia and untangles their complex pathways to simplify programme decisions. Given the multi-dimensional nature of anemia, the programme guide describes contextual opportunities to seize and leverage the systems approach to reduce anemia. The guide aims at facilitating programme managers within and outside UNICEF to make informed decisions to coordinate actions and seize opportunities to reduce the burden of anemia.

This guide is a living document, subject to adaptation to national and subnational contexts, but also it is subject to reviews and update as new contextual evidence emerges.

KEY MESSAGES

1- There is a mismatch between the indicator of the WHA target and the one used to monitor the programme in WCA. The WHA indicator is specific to reducing the number of anemic non-pregnant women. Yet, the programme in WCA monitors the prevalence. Additionally, while the WHA population target is non-pregnant women, the programme focus in WCA is predominantly pregnant women. Thus, the scope of anemia control and prevention programme in the region needs to expand beyond targeting pregnant women to include and reach non-pregnant women through a systems approach. In addition to monitoring the prevalence, the absolute number of anemic women should be added to regional monitoring frameworks.

2- The etiological drivers of anemia in WCA are diverse, complex and may vary within the same country. To increase the complexity of the potential solutions, important gaps are remaining to understand the full range of risk factors and how they impact anemia. Additional evidence to characterize etiological factors is required to inform context specific programme design, implementation, and monitoring. However, in the context of limited resources to generate new evidence, the etiological risk factors described in this programme guidance can serve as good reference to inform the review and update of national programmes.

3- Existing opportunities within key systems can and should be leveraged as their accountability for nutrition to increase programme coverage. For example, the education system has a potential to provide a platform for micronutrient supplementation but also play its role of delivering nutrition education to learners that could impact intergenerational nutrition outcomes. Multisectoral community-based platforms such as the Mother-to-Mother groups (GASPA) can be used to reach out-of-school adolescents and adult women with micronutrient supplements and nutrition counselling.

4- For nutritional anemia, specifically, the current United Nations International Multiple Micronutrients for Antenatal Platforms (UNIMMAP) multiple micronutrient supplements (MMS) are only suitable for the prevention of anemia in pregnant women. Given the etiological complexity of anemia in WCA and especially nutritional anemia, global advocacy is needed to formulate MMS for non-pregnant women and girls that are affordable and accessible even to the most vulnerable groups. In this regard, the role of social marketing of micronutrient supplements to women needs to be explored.

5- Finally, women's nutrition is important for their health and wellbeing. A systems approach is essential in ensuring that women have access to affordable nutritious foods that meet their micronutrient and other dietary requirements.

PART I: PROGRESS ON ANEMIA REDUCTION

Taking stock on maternal anemia in WCA

West and Central Africa (WCA) region is home to 142 million women of reproductive age (WRA) representing 7.2% of the global population of women aged 15 to 49 years[3]. In 2019, nearly, 1 in 2 non-pregnant women (NPW) in WCA were anemic totaling 54 million women and 11% of the global burden of anemia in this age group. Nearly 50% of the anemia burden in WCA is the mild form (Hb 10-11mg/dl) while the prevalence of moderate and severe forms is 47% and 3%, respectively (Figure 1). Nigeria and DRC combined account for more than half (54%) of the regional burden of anemia.

In 2012, the baseline year for the monitoring of the World Health Assembly (WHA, 2012) targets, 45 million or approx. half of the total number of NPW in WCA were anemic (Le Dain et al, 2021., WHO, 2019). The 2019 data from the Global Health Observatory show that no country in WCA is on track to achieve the WHA target of reducing by 50% the number of NPW affected by anemia by the year 2025 (Figure 2).

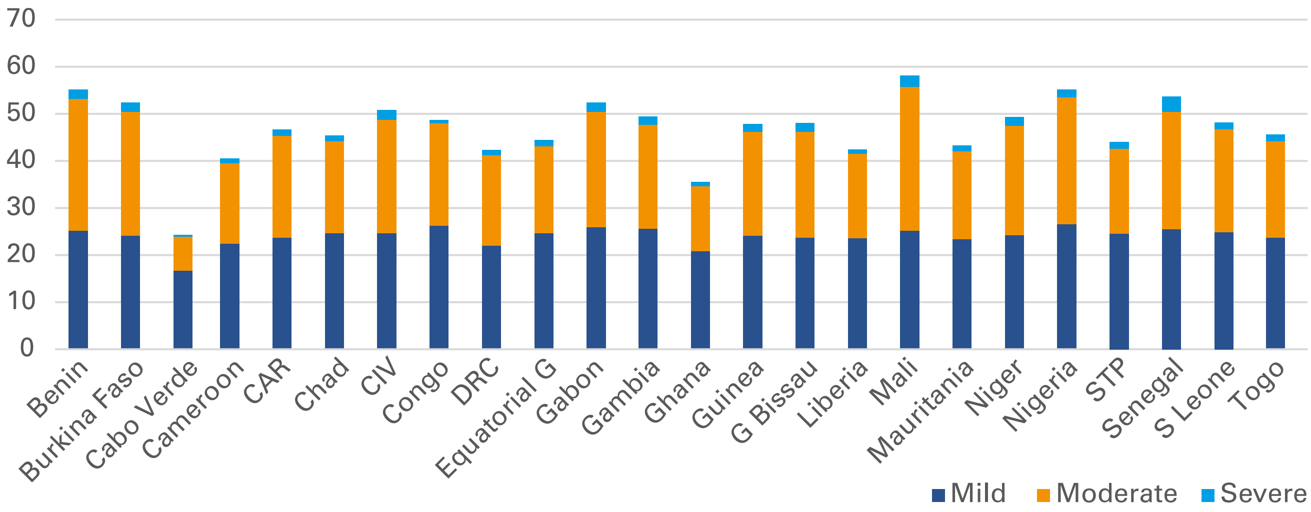

Figure 1: Anemia prevalence by severity among WRA in WCA, 2019

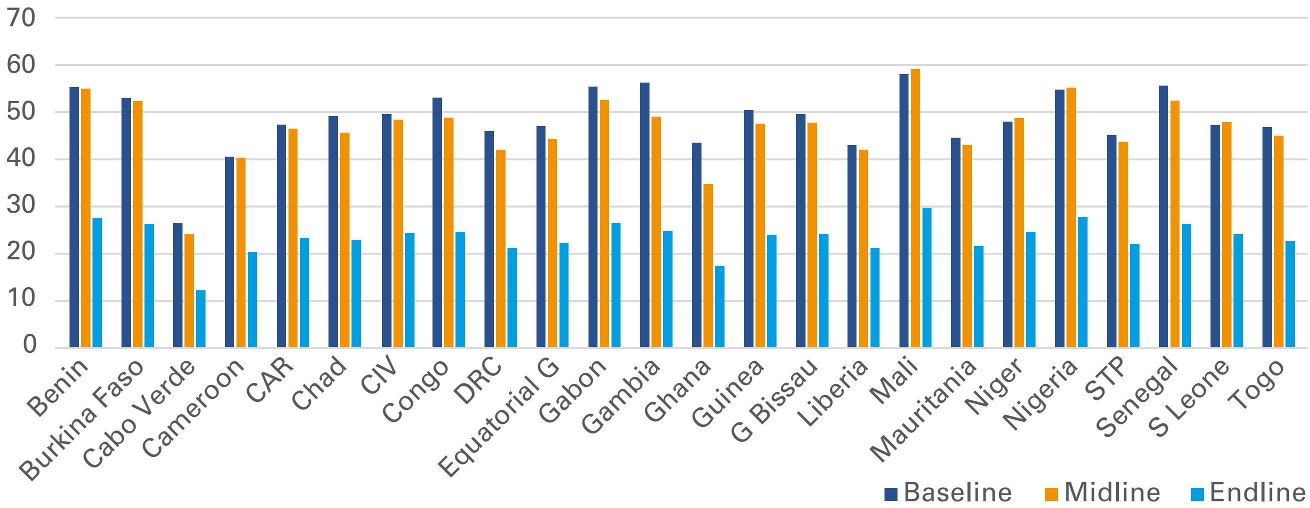

Figure 2: Prevalence of anemic NPW at 2012 baseline, 2019 midline and 2025 endline target

3. United Nations Department of Economics and Social Affairs, 2023

To reach the target in the remaining years would require a staggering annual average rate of reduction (AARR) of 15 percent, instead of the estimated 5.3% required at the 2012 baseline (Figure 3). If the current trends continue under the projected population growth, an estimated 62 million NPW will be anemic by 2025, i.e., 39.5 million more women than the target of 22.5 million. Clearly, the region needs a different programmatic approach on anemia prevention and control. To support countries to reverse this trend, it is critical to first understand the reasons for lack of progress. To achieve this, it is important to consider two stages of analysis; a) analyze the contextual etiological risk factors of anemia and, b) establish the coverage of programme interventions and assess their alignment to the contextual drivers of anemia. Then, use the information from the above analysis to review program design and delivery to accelerate progress.

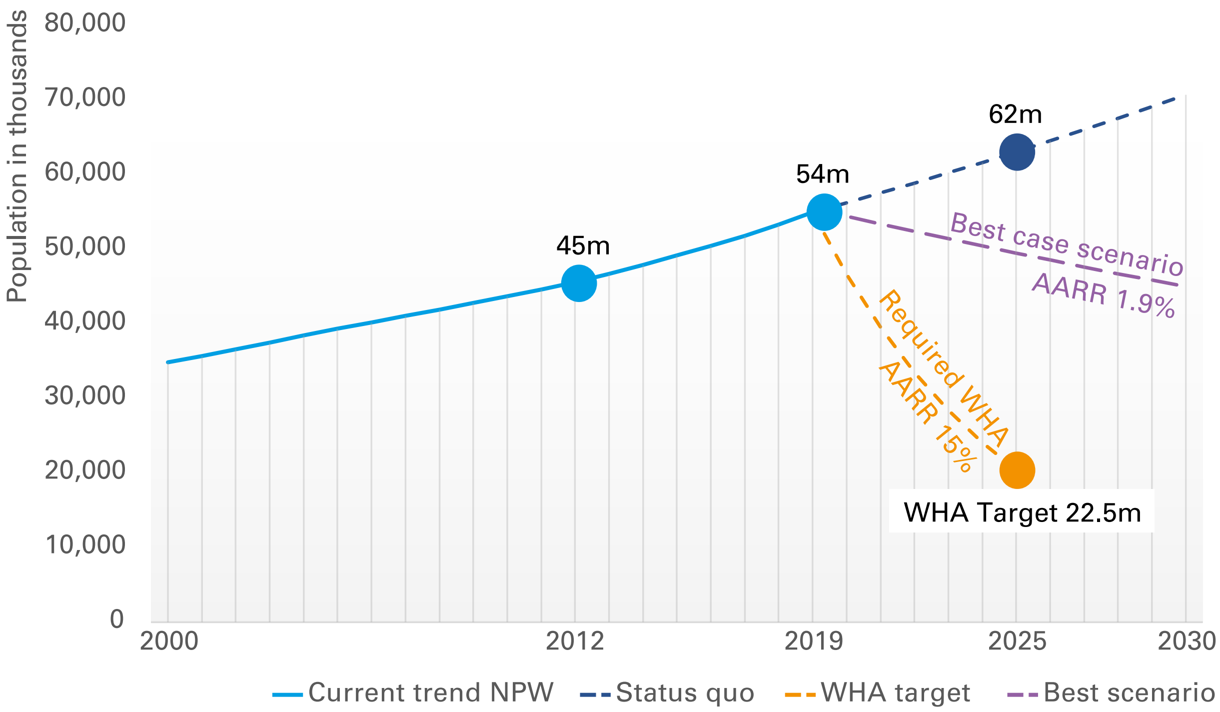

Figure 3: Actual and projected trend in number of anemic non-pregnant women in WCA

PART II: ETIOLOGICAL FACTORS AND DRIVERS OF ANEMIA

Current evidence on the etiological risk factors of anemia in WCA

In 2022, UNICEF WCARO in collaboration with Research center for Inclusive Development in Africa (RIDA) conducted a review on etiological risk factors of anemia among women of reproductive age in WCA (Anato et al., 2023, under review). The analysis classified the documented risk factors in four categories: i) nutritional deficiencies, ii) inherited hemoglobin disorders, iii) infections including malaria, intestinal parasites, and inflammation and, iv) exposure to contaminants. A summary of the findings is presented in text box 1. While this analysis improved our understanding of anemia etiology, there are still major evidence gaps on the full scope of context specific anemia etiological factors. For example, as illustrated in figure 4, countries such as Guinea, Guinea Bissau and Togo do not have published studies on the etiology of anemia while countries including Burkina Faso, Ghana, Mali, and Niger the evidence is mixed for some etiological factors.

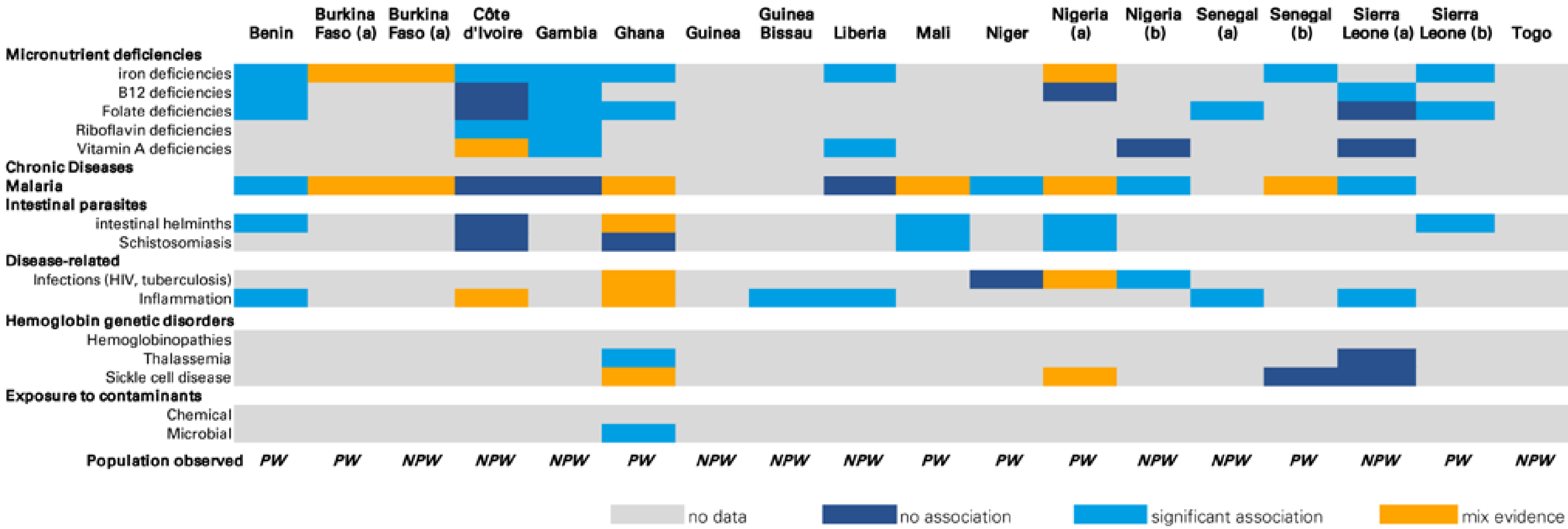

Figure 4: Summary of evidence of factors contributing to anemia among WRA in West Africa

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Summary findings of UNICEF WCARO and RIDA analysis

A) Nutritional deficiencies

- *While Iron deficiency accounts for 10% to 20% of the anemia among women of reproductive age, it is not the only cause of anemia in the region.*
- *The prevalence of folate deficiency is high and variable ranging from 18% in Benin, 79.2% in Sierra Leone and 86.1 % Cote d'Ivoire.*
- *In contrast to folate deficiencies, the prevalence of B12 deficiency is much lower in the region but showed variations within and between countries.*
- *Vitamin A deficiency was associated with anemia in studies from Liberia, Ghana, and Nigeria, but showed a high level of geographic heterogeneity and thus its contribution to the anemia burden is likely to vary geospatially.*

B) Infections

- *Malaria, intestinal worms, and schistosomiasis are prevalent in WCA and associated with anemia.*

C) Hemoglobinopathies

- *While inherited hemoglobin (Hb) disorders are associated with anemia, the main stay of their management is clinical including but not limited to addressing symptoms, prevent complications, and improve the overall quality of life.*

D) Contaminants

- *The role of microbial contaminants such as aflatoxin and air pollutants need further investigation. However, these contaminants and pollutants are linked to anemia through inflammation and red blood cell destruction.*

PART III: FACTORS CONTRIBUTING TO LACK OF PROGRESS IN WCAR

Limited understanding of the etiological drivers of anemia

World Health Organization estimates that Iron-deficiency anemia represents anywhere between 10% to 60% of total anemia among the general population globally (WHO, 2014). Studies from a few countries in the region show that the contribution of iron deficiency to anemia varies widely: Sierra Leone 5%, Cote d'Ivoire 17%, Cameroon 29%, and Liberia 36% (Petry et al, 2016). Although these studies are not representative of the region, these figures suggest that while the proportion of anemia due to iron deficiency is variable there are clearly other etiological factors accounting for the remaining proportion of anemia in the region. While iron supplementation remains the backbone of nutritional anemia prevention and control programmes in WCA, unless the full range of etiological factors is adequately investigated and documented to inform programme design and implementation, the region will not be able to achieve the desired progress on anemia reduction.

Narrow scope of studies on the etiology of anemia

Most of the studies conducted in WCA investigated the association between anemia in pregnant women and two risk factors, malaria and iron deficiency (Baye et al., 2023 under review). Of the 73 studies included in the analysis, 35 (48%) examined the association between anemia and malaria while 22 (30%) analyzed the same association for only iron deficiency. Forty-nine (67%) and twenty (27%) studies respectively included pregnant and non-pregnant women. Clearly, there is limited research on the risk factors beyond iron deficiency and malaria and most importantly non-pregnant women receive less attention. The limited focus of studies among NPW is a missed opportunity to put an advocacy spotlight on this population group to inform a comprehensive anemia agenda in the region.

Narrow target for service delivery

The World Health Assembly target 2 aims to achieve "A relative reduction of 50% of the number of non-pregnant women of reproductive age (15–49 years) affected by anemia by the year 2025." Although this target is specific to non-pregnant women of reproductive age, anemia interventions tend to be mostly focused on targeting pregnant women. While this approach is justified due to the adverse impact of anemia on pregnancy outcomes, it should not preclude from prevention and control of anemia in non-pregnant women, who represent the largest proportion of affected women. As illustrated in figure 5, the population group with the highest anemia burden in WCA are non-pregnant adult women, followed by adolescent girls, and pregnant women (see annex 1 for more explanation to interpret the analysis). This analysis shows that nearly half of the women in WCA start their pregnancy with low (<12 g/dl) hemoglobin concentration—Figure 5A and nearly 3 out 5 pregnant women are anemic (Hb <11 g/dl)—fig 5B. Although IFA supplementation helps reduce anemia in pregnant women, alone, it will do little to reduce the number and prevalence of anemic women at national and regional scale due to the complex etiological factors of anemia which transcend iron and folate deficiency.

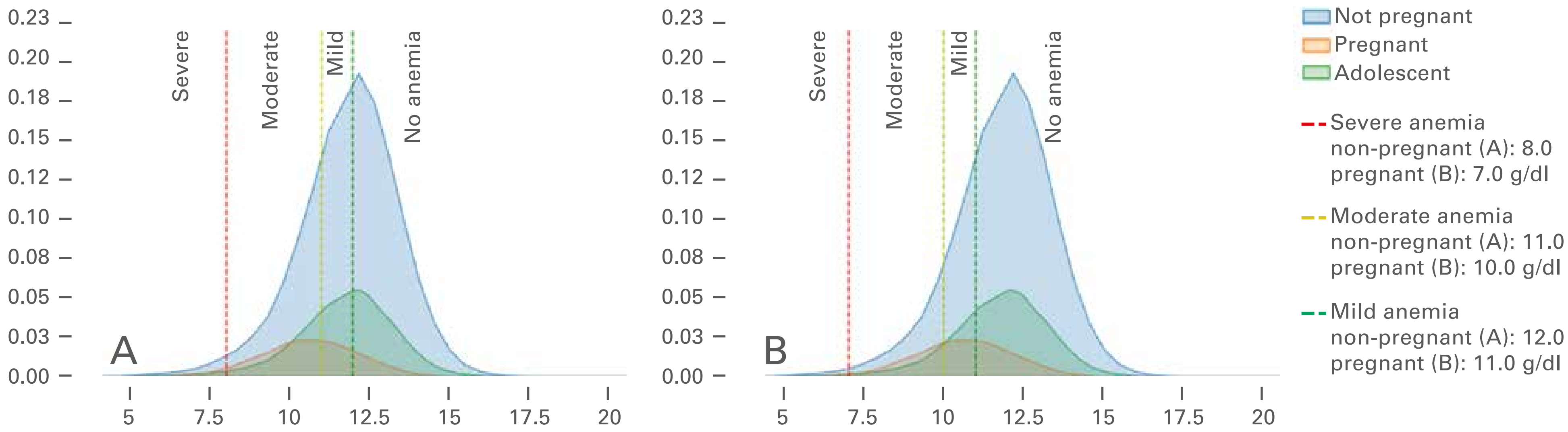


Figure 5: Hemoglobin concentration (g/dl) distribution by pregnancy status, West Africa

To substantially reduce anemia incidence and achieve the WHA target, non-pregnant women should be the primary target, followed by adolescents. To achieve this, a package of context specific interventions that goes beyond IFA supplementation and leverage other platforms than just the health system is required (see annex 2 for country specific graphs).

Insufficient analysis of available data to inform decision making

The absence of granular analysis and mapping of the geospatial distribution of anemia to inform targeted strategies towards areas of greatest need remains a considerable bottleneck. In 2022, UNICEF WCARO in collaboration with the Research center for Inclusive Development in Africa (RIDA) pooled DHS and MICS data and conducted a multilevel and spatial analysis of the distribution of prevalence and burden of anemia among women of reproductive age in 12 high-burden anemia countries[4]. Figure 6 presents the subnational distribution of the anemia prevalence (A) and caseload/density (B), by severity. As illustrated in figure 6A, both moderate and severe anemia are quite prevalent in the region while severe forms are more prevalent in countries in the north-western part of the region but also countries like Nigeria, Gabon, Mali, Benin, and Cote d'Ivoire exhibited widespread areas with very high prevalence of any anemia exceeding 60 percent.

4. Benin, Burkina Faso, Cote d'Ivoire, DRC, Guinea, Liberia, Mali, Niger, The Gambia, Senegal, Sierra Leone, and Togo

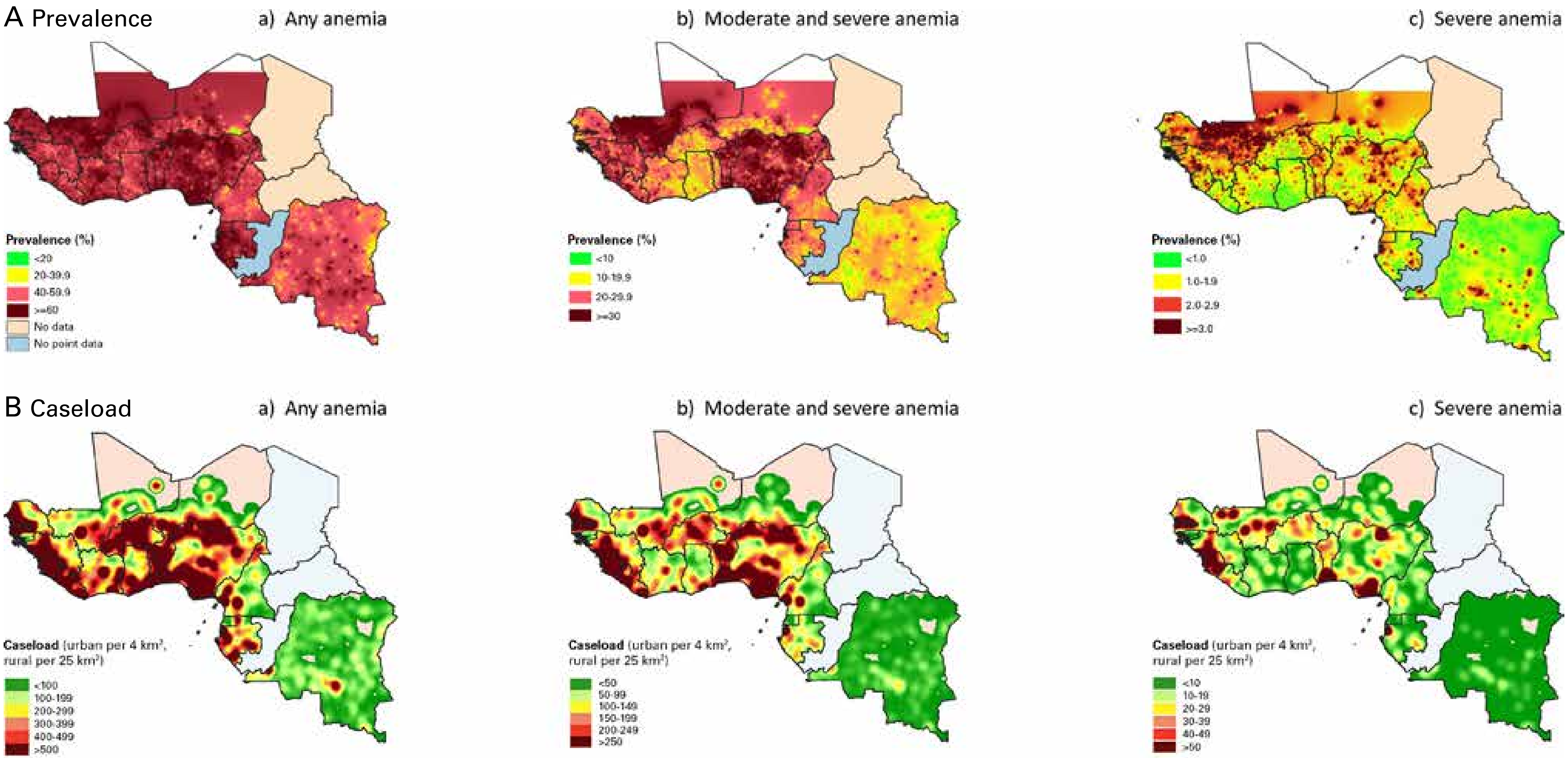


Figure 6: Mapping of anemia prevalence (A) and caseload density (B) in West and Central African countries by severity

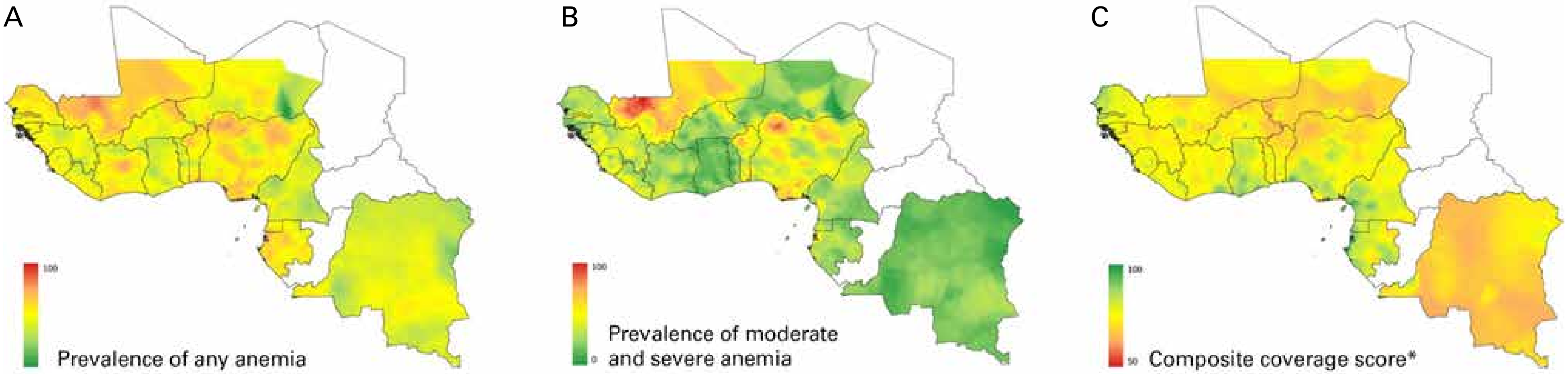
By contrast, the highest density of (any) anemia cases were found in the coastal areas of the region, and most of Benin, Togo, Burkina Faso, and northern Nigeria (Figure 6B and country maps in Annex 3). This level of analysis is critical in informing the design and prioritization of interventions and the decision to focus on areas of high prevalence or caseloads, which will depend on contextual factors including the availability of resources. However, considering that the WHA target is on the numbers rather that the prevalence, paying attention to caseloads as opposed to the current focus on prevalence may be needed[5].

5. Detailed country maps and analysis are accessible in annex

PART IV: COVERAGE OF ANEMIA PREVENTION AND CONTROL INTERVENTIONS

Geospatial coverage of anemia prevention and control services

Anemia prevention and control interventions were mapped for 12 countries that had recent data from nationwide survey such as DHS. The key interventions-related indicators assessed included i) sleeping under bed net; ii) attending ANC for 4 or more contacts; iii) consumption of IFA 90+ tablets; iv) access to improved toilet facilities and access to improved water. Using the interpolation statistical model, geospatial coverage maps were generated (annex 4). The data were then pooled to generate a regional composite coverage score map (see annex 5) for the package (Figure 7). A comparison of the composite coverage and the prevalence of any degree anemia reveals missed opportunities to achieve optimal coverage of anemia prevention and control interventions in geographical zones with high prevalence of anemia. For example, in countries with high prevalence of moderate and severe anemia such as Nigeria, Mali Benin, Senegal and Cote d'Ivoire, the coverage of anemia control and prevention services is low and needs to be accelerated. In Gabon where the composite coverage of interventions is moderately good, the prevalence of anemia remains high which suggests that the package of interventions being delivered is not aligned to the contextual risk factors.



* Composite coverage score of potentially anemia preventive interventions composed of: ANC4+, taking 90+ IFA tablets, sleeping under bed-net, imported toilet, water, and use of non-polluting cooking fuel at cluster level

Figure 7: Mapping of the prevalence of anemia, any (A) and moderate and severe (B) among WRA and composite coverage of interventions for pregnant women and households (C)

Leveraging multi-system approaches to address maternal anemia

Figure 8 illustrates the different pathways and linkages between the risk factors and anemia derived from the analysis of available data. The figure underscores the fact that anemia risk factors are non-linear, complex, and diverse and that without working in synergies, no single intervention or system acting alone can achieve the desired goal. Therefore, countries should include a review of programme design to prioritize a multisystem approach to effectively break the etiological pathways to anemia maximizing the potential contribution of each system.

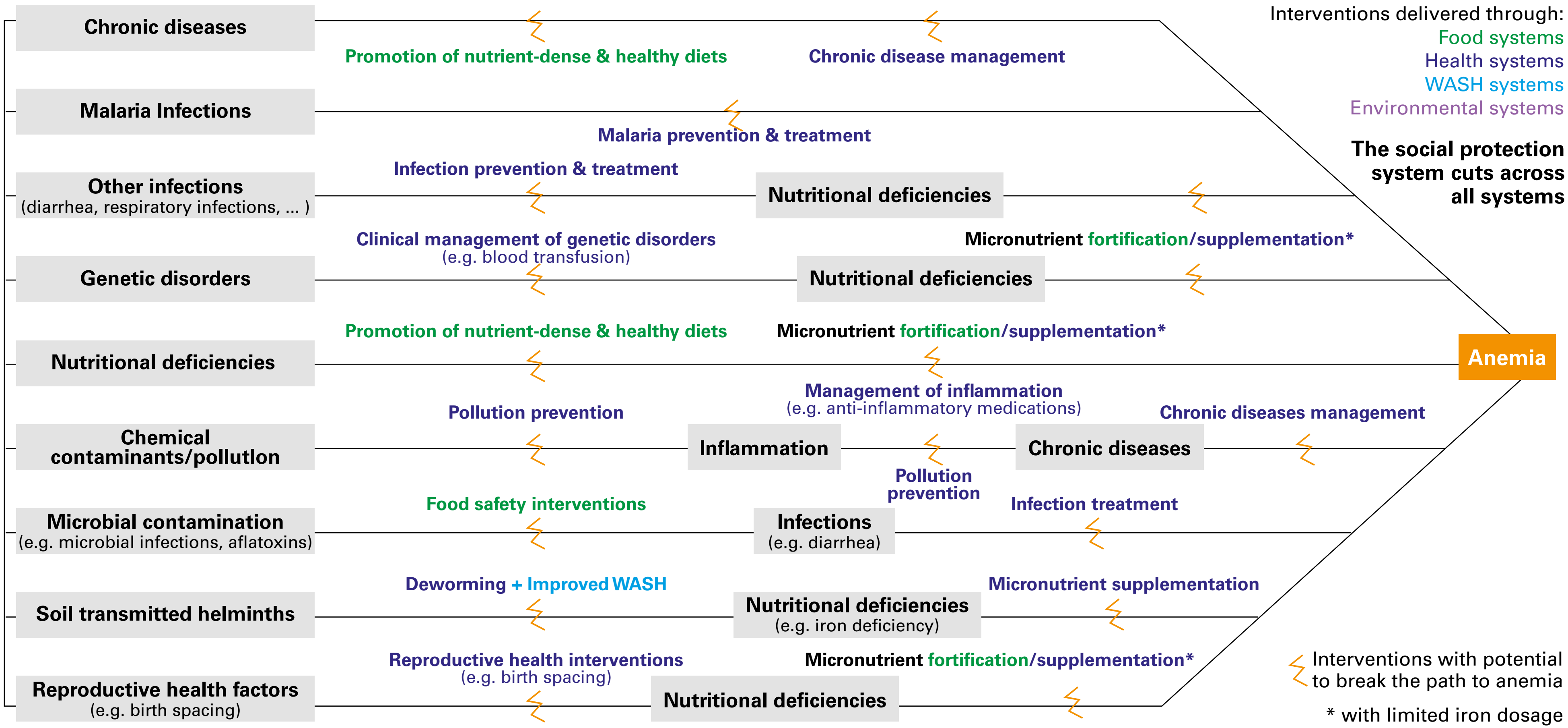


Figure 8: Systems approaches to break the impact pathway to anemia

To achieve the greatest impact, WHO recognizes the intersectoral drivers of anemia and recommend a comprehensive scope of interventions, beyond nutrition to include interventions delivered by health, education, food, social protection and water, sanitation, and hygiene (WASH) systems (WHO, 2023). A systems approach contributes to anemia reduction through two pathways; i) increasing programme coverage of services adapted to the local context and ii) working in synergy to break risk pathways to anemia.

The **health system** can contribute to anemia control and prevention by addressing several-related causes such as treating inflammation, clinical care of malaria and other parasites. However, structural bottlenecks of this platform have resulted in low coverage of health system specific interventions. For example, in Cote d'Ivoire, despite the moderately good national coverage of ANC4+ (57%) especially in the southern and the western part of the country, the coverage of pregnant women consuming 90 or more tablets of IFA is 29% (Figure 9). The difference could be due to several systemic bottlenecks such as supply chain breaks, IFA not being delivered for free and the poor quality of services, including the quality of contact between the beneficiaries and service providers. However, to fully understand the underlying drivers of low service uptake, a systematic analysis to understand contextual bottlenecks is highly recommended. The outcome of such analysis should inform programme adjustments to increase access to anemia prevention and control for all women, not only those who are pregnant. This can be achieved by exploring delivery systems beyond the sole health system and include the Education and Social Protection among others. In countries where the package of anemia prevention and control is subject to cost recovery, the social protection system could provide solutions such as universal health care or free access to services targeting the most at-risk women.

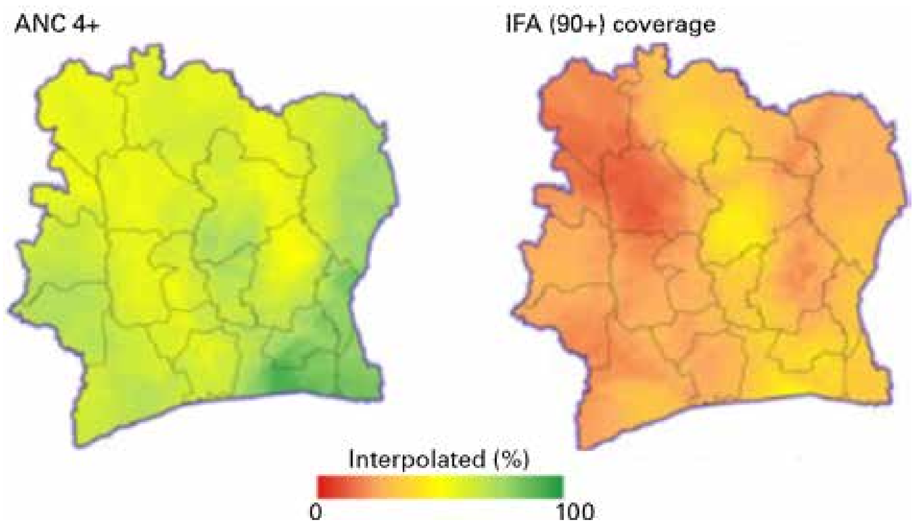


Figure 9: ANC4+ and IFA 90+ coverage in Cote d'Ivoire (DHS 2021)

The social protection system can contribute to anemia prevention and control by removing barriers to access to services and diets for the most vulnerable groups. In the context of WCA, Mauritania's integrated social protection model has a promising approach to address deep-seated vulnerabilities, chronic poverty, and shock-related food insecurity and malnutrition (UNICEF WCARO, 2023). The model targets community-based Mother-to-Mother Groups (GASPA) comprised of pregnant and breastfeeding women with unconditional cash transfers and infant and young child feeding (IYCF) counselling. The 2022 UNICEF process evaluation of the model in the Guidimakha region showed that the GASPA platform has the potential to deliver multisectoral interventions aimed at reducing undernutrition. Considering that some countries in the region have adopted the GASPA model, it is important to explore the integration of anemia prevention and control package that will go beyond pregnant and breastfeeding women in community-based platforms and ensure a package for non-pregnant women is also proposed (diet counselling, supplementation for the most vulnerable, deworming, bednets, etc.). The ongoing regional initiateve to support the social registry in at least 12 countries including Mauritania, Mali and Niger, is a promising opportunity for advocacy to include at risk women and adolescents in service provision.

The WASH system can contribute to improving the environment by breaking the pathways linked to malaria, soil-transmitted helminths (STH), and other drivers of inflammation. Unfortunately, in many countries in WCA, there is inadequate integration of services delivered by the WASH system in the anemia prevention and control package. For example, in Niger the highest burden of anemia is in the southwestern part of the country however, there are gaps in the coverage of access to improved water in areas which host the highest burden of anemia (Figure 10). The same gaps are observed between the coverage of improved toilet coverage and anemia burden. A dedicated strategy to integrate WASH services in anemia prevention and control package is necessary. The strategy should include social protection to remove barriers to access to safe sanitation services and practices such as handwashing especially after toilet use and when preparing and eating food and ending open air defecation. This is particularly important considering that in 2022, an estimated 21% of the population in WCA practiced open air defecation (UNICEF 2022).

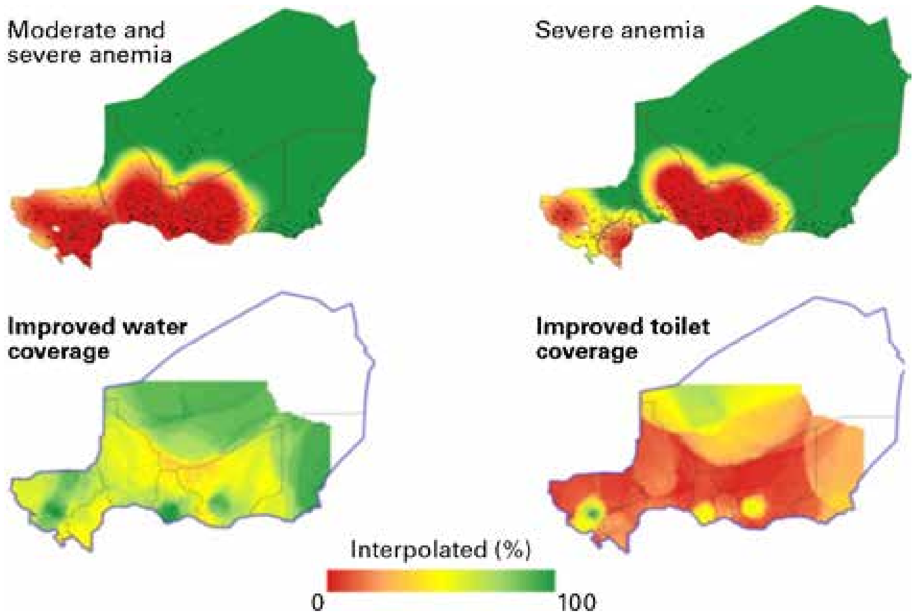


Figure 10: Improved water and toilet coverage versus anemia in Mali

The **food system** can contribute to improved access to nutritious diets by breaking the pathways linked to nutritional deficiencies. The implementation of large-scale food fortification in WCA is an opportunity to ensure that widely consumed staples are fortified with micronutrients that address contextual anemia risk factors. In addition, strategies addressing factors that expose the population, especially school age children and adolescents to unhealthy foods and beverages are needed.

In 2022 UNICEF WCARO conducted a study in Gabon to profile the food environment in and around schools. A nationally representative sample of 74 schools were include in the study. Open advertisement of unhealthy foods was observed in 12 schools of which, 9 were in the province of Woleu-Ntem in the north. Furthermore, 30 to 50% of adolescents reported availability of highly processed foods and sugar-sweetened beverages in and around schools while nearly 1/3 of the adolescents nationally reported consuming unhealthy foods 1 to 3 times a week (Figure 11). The study underscores the need to advocate for actions in public sector policies and programmes to regulate private sector practices and food in and around the school environment. Synergies with the social protection system are needed to ensure that the most at-risk groups have access to affordable nutritious foods rich in essential micronutrients.

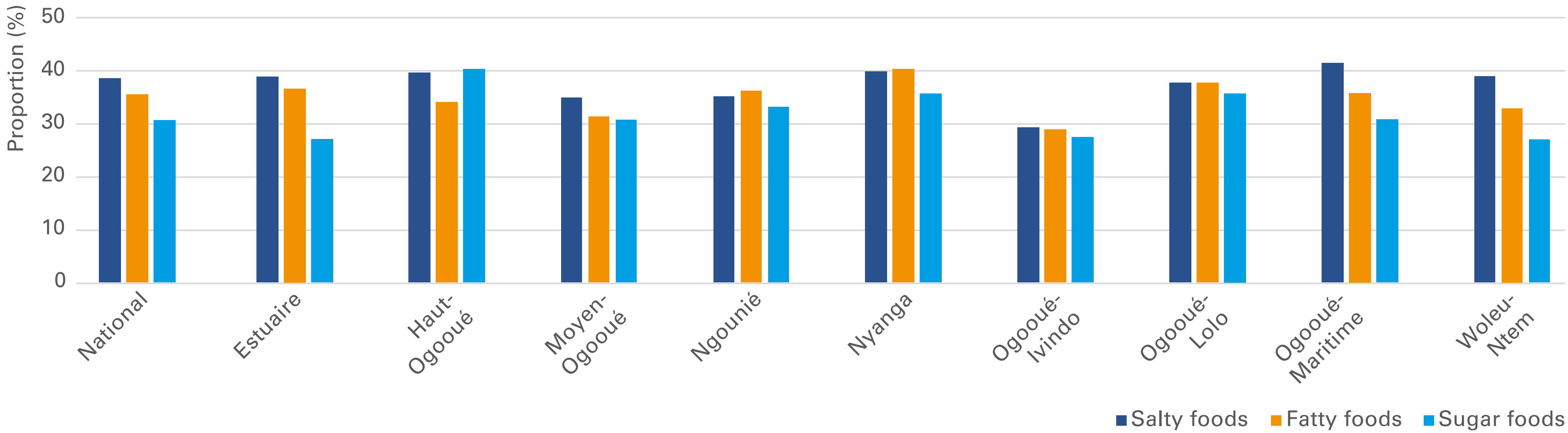


Figure 11: Proportion of adolescents consuming unheathy foods 1 to 3 times a week

The **education system** is a long-term investment in addressing socio-cultural barriers to improving care practices. In WCA, Ghana's national Girls Iron Folate Tablet Supplementation (GIFTS) programme is a promising multisectoral model involving collaboration between health and education. In 2016, a landscape analysis of anemia programing identified, malaria, helminths infections and micronutrient deficiencies the main risk factors for anemia in Ghana. Coinciding with the implementation of the adolescent anemia control program in 2017, the Ministry of Education (MoE) instituted free education at senior high school level which resulted in increased enrollment into secondary school. A dual program platform between schools and health centers, both public and private was also adopted. The school administers weekly iron and folate supplementation (IFAS) by teachers while the community the IFAS tablet is administered monthly, the first through directly observed consumption (DOC) and three more tablets to be taken weekly. This model is proving successful and has a potential for replication but with a few modifications. First, integrate adult women into the community platform. Second, deliver a context specific package that goes beyond IFA to include malaria prophylaxis and treatment for soil transmitted helminths. Third, conduct mass mobilization and nutrition education campaigns to increase awareness and create demand for both micronutrient supplements and the consumption of a diversified diet. Finally, conduct social marketing on micronutrients for population groups that can afford to procure them.

PART V: PROGRAMME DESIGN AND PRIORITIZATION

Opportunities

The analysis presented in this guide shows that despite anemia being an important public health problem in the region, it is possible to implement interventions that break the impact pathways to the disease by leveraging opportunities at global, regional, and national levels. At global level, the World Health Organization has developed a comprehensive framework for action to prevent, diagnose and manage anemia. This renewed global interest in anemia has led to the creation of the global Alliance for Anemia Action. This initiative, if replicated and integrated in existing national platforms such as the SUN secretariat, is a potentially a good opportunity to highlight the current lack of progress on anemia in the national spotlight.

At regional level, the WCA anemia etiology and programme coverage analysis opens opportunities to guide the review and design of anemia reduction programmes. For example, in the context of resource constraints, to achieve national coverage on anemia prevention and control interventions, this WCA programme guide provides options to enhance geographical targeting of programme delivery and national targeting of high-risk populations such as adolescent girls.

WCA model of anemia decision making tree

The decision tree is developed by WCARO as a guide for countries that wish to undertake programme reviews to accelerate anemia programming (Figure 12). It is not intended to be a prescriptive tool. Rather, it is meant to provide guidance to national stakeholders during program review and design to achieve equitable service delivery. The tool has three phases:

- **Phase I** is comprised of, a) a situation analysis based on a review of available data on anemia notably, nationally representative survey data including DHS, MICS, Malaria indicator survey, micronutrient survey, WCARO anemia analysis reports, etc.; and b) the analysis of administrative data from the HMIS system and other nutrition sensitive systems. Available data is used to conduct a granular analysis, for example geospatial mapping of the prevalence and caseloads of anemia, and mapping of the coverage of services. In the absence of recent data, information from neighboring countries with the same context can be extrapolated with some assumptions.
- **Phase II** builds on the findings from phase I and focuses on programme analysis. This entails, a) reviewing the enabling environment for anemia control and prevention; b) updating existing policies with data from phase I, c) revisiting and aligning both the legislative framework, and current national guidelines to align with the new data and evidence. In many countries, nutrition policies exist but need to be strengthened. In some countries, they may need to be revised to better articulate operational plans and programmes of work with clear goals and targets, timelines, and deliverables. In others there is a need to specify roles and responsibilities for those involved or identify the required workforce and their capacity development needs. Finally, there is a need for process and outcome evaluation. Phase II also entails budgetary analysis to assess the feasibility and prioritization within the available budget both from domestic and international sources.

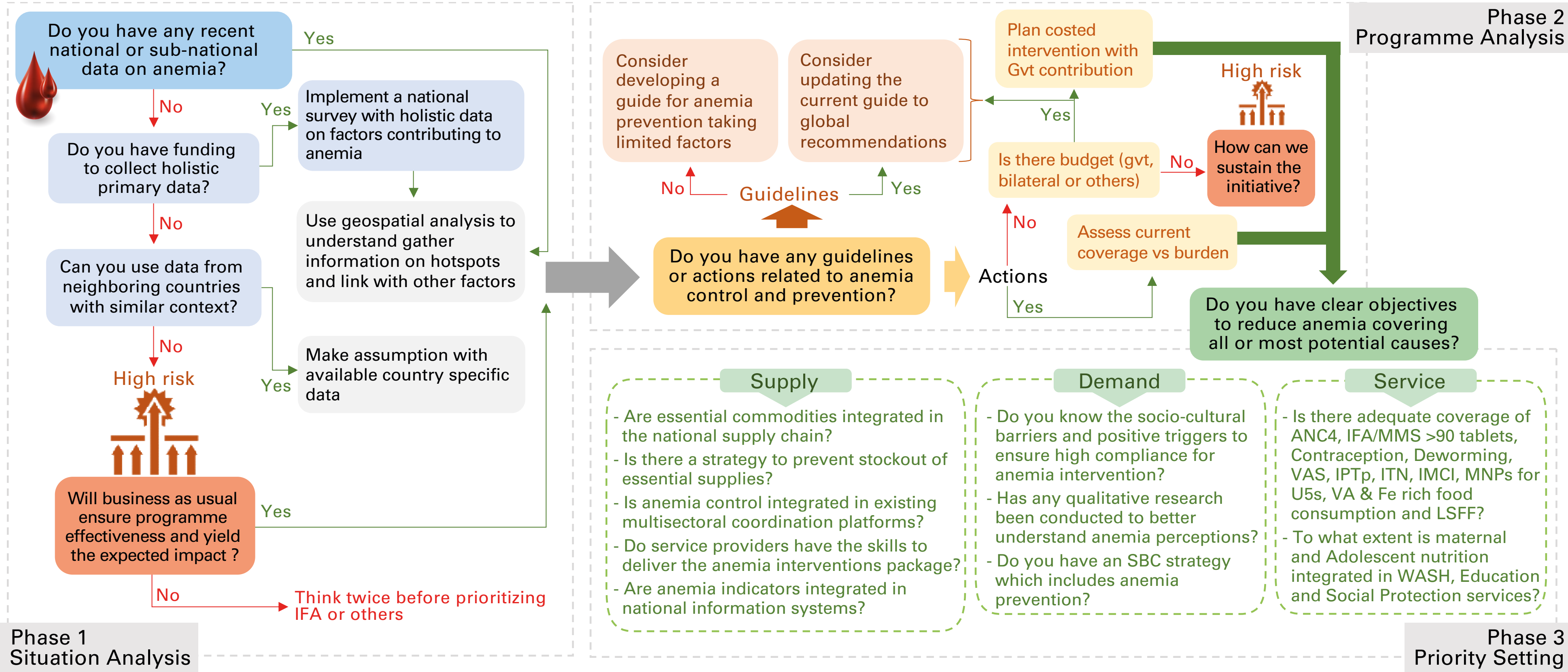


Figure 12: Decision tree for anemia analysis and programing

- **Phase III** focuses on interventions. While the list of interventions is not exhaustive and can vary by context, the proposed priority setting based on the available resources follows a simple criterion of supply and demand, for services. With regards to supply it is important to review and address gaps in a number of areas, including the supply chain of essential commodities, human resources, training and deployment and the availability of anemia indicators in monitoring framework of all contributing systems. The demand analysis entails reviewing and addressing gaps that may include socio-cultural barriers to access services. If not yet available, it could be important to collect qualitative data to complement the quantitative analysis, to inform evidence-based programme design. Service analysis focuses on the coverage of anemia prevention and control service gaps to enable prioritization and achieve equitable coverage guided by either anemia prevalence or caseloads (burden), in high-risk areas.

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CONCLUSION

This guide is the outcome of a comprehensive analysis of the available data in the region. It sets the stage for action at regional and national level to accelerate the attainment of global goals on anemia. To substantially reduce the number and prevalence of anemia among WRA, it is recommended to use a systems approach to deliver a package of interventions that address context specific bottlenecks. In addition to sustaining anemia prevention and control interventions for pregnant and breastfeeding women, non-pregnant women should be primary targets, followed by adolescents. The evidence generated and presented in this guide should be used for advocacy to catalyze dialogue for change with national stakeholders, to facilitate the review of programme design and delivery in order to reach the most vulnerable. The team at regional level is committed to providing technical support to countries undertaking programme reviews in line with this guide.

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ANNEXES

ANNEXE 1

How to interpret a Kernel distribution analysis

The y-axis of a KDE (Kernel Density Estimation) plot represents the density of the data at different values on the x-axis. It's important to note that the y-axis in a KDE plot is not a probability, but rather a density.

Density: The y-axis shows the estimated density of the data, which can be thought of as a smoothed version of a histogram. Higher values on the y-axis indicate regions where the data is more densely packed, while lower values indicate regions where the data is less dense.

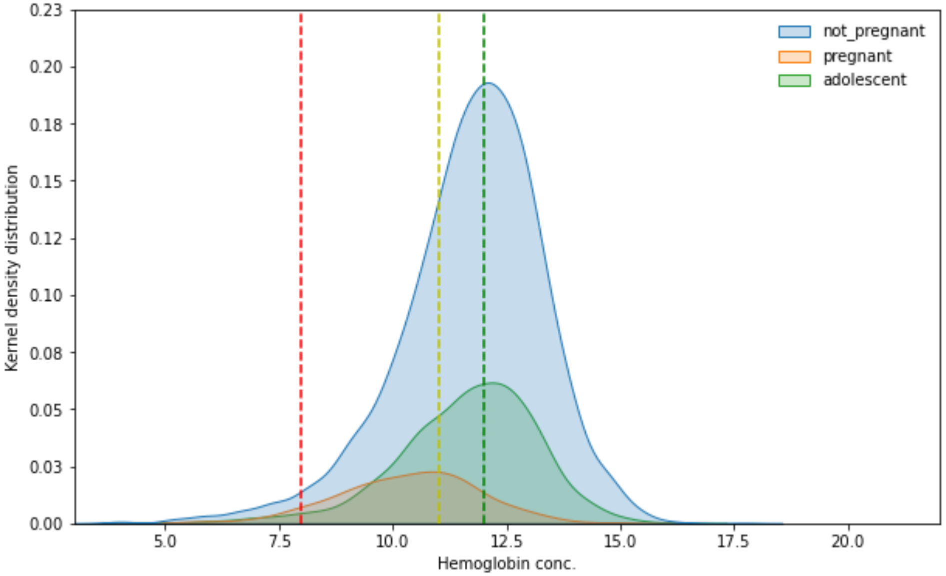
Not Probabilities: The values on the y-axis are not probabilities, and they can be greater than 1.

Area under the Curve: The total area under the KDE curve is equal to 1. This means that if you were to integrate (or sum up) the values of the density function across all possible values on the x-axis, the result would be 1, representing 100% of the probability of the x values. Higher values mean a higher density of observations at that value on the x-axis.

The x-axis represents the variable being examined. The location of the curve shows where the values are concentrated. A taller, narrower curve indicates values clustered close together. A shorter, wider curve indicates values more spread out.

Comparison: In plots where multiple KDEs are shown (like the ones we generated), the relative height at any given x-value can be used to compare the density of data between different groups. For instance, if one curve is higher than another at a particular x-value, it means that the first group has a higher density (or likelihood) of having that x-value compared to the second group

To explain how to interpret the Kernel distribution analysis, we will take the example of Senegal:



Interpretation of the above graph is as follows:

1- Comparing the area under the curve relative to the dashed lines (anemia cut-offs)

Looking at the proportion of the distribution curve that is crossed by the cut-off lines for anemia (e.g. green dashed line), we can see that the line cuts the adolescent and nonpregnant curves almost in half. As the area of a KDE curve indicates the probability, we can roughly say that about 50% of nonpregnant women are anemic, whereas a little over half of adolescents are anemic. For pregnant women, considering a hemoglobin of 11.0 g/dl as a cut-off for anemia, we can roughly say that about 70% of the area of the curve (i.e. pregnant population) falls below the cut-off of 11 and thus about 70% of pregnant women are anemic. The same approach can be used to estimate the proportion of the population that is below the cut-off for moderate and severe forms of anemia.

2- Comparing the height of the plots

Comparing the height of the curves, we can understand that from our sample, the highest number of anemia cases are for non-pregnant women, followed by adolescents, and pregnant women. This is, of course, reflecting the demographic structure in the population and in our sample that follows the order of non-pregnant women (19-45) then adolescents and finally pregnant women.

3- Conclusion

The KDE plots allowed us to have a multidimensional view of the hemoglobin distribution. It allowed us to:

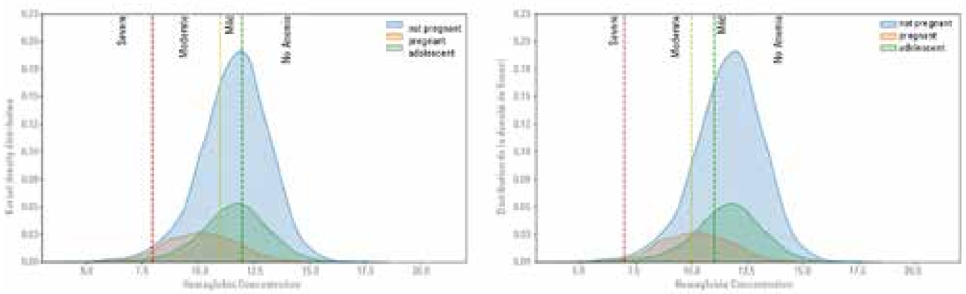
- compare different target groups (adolescent, pregnant, and non-pregnant women) ;
- estimate the probability of anemia within a specific target group (e.g. adolescents) but also compare it between target groups ;
- Identify which target group would yield the highest reduction in the number of anemia given the delivery of an effective set of interventions.

ANNEXE 2

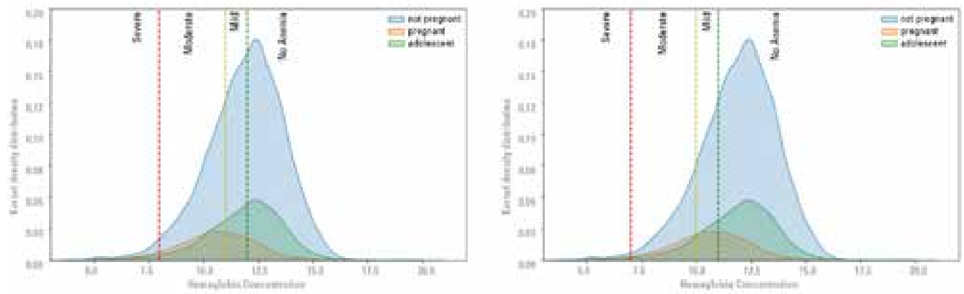
Distribution of anemia according to target groups and countries

- - Severe anemia / non-pregnant (A): 8.0 / pregnant (B): 7.0 g/d l
- - Moderate anemia / non-pregnant (A): 11.0 / pregnant (B): 10.0 g/dl
- - Mild anemia / non-pregnant (A): 12.0 / pregnant (B): 11.0 g/dl

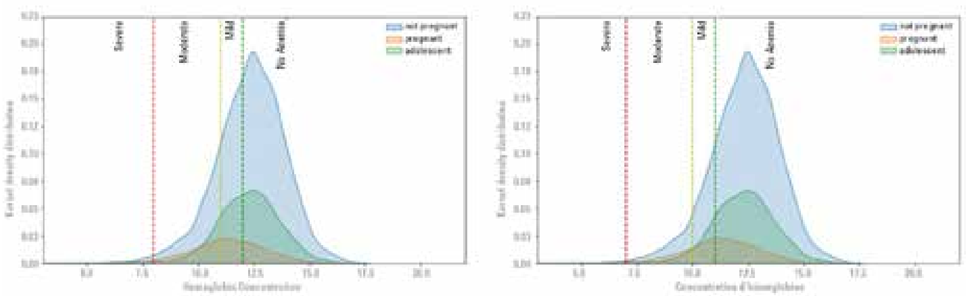
Hemoglobin concentration (g/dl) distribution by pregnancy status, Benin, DHS



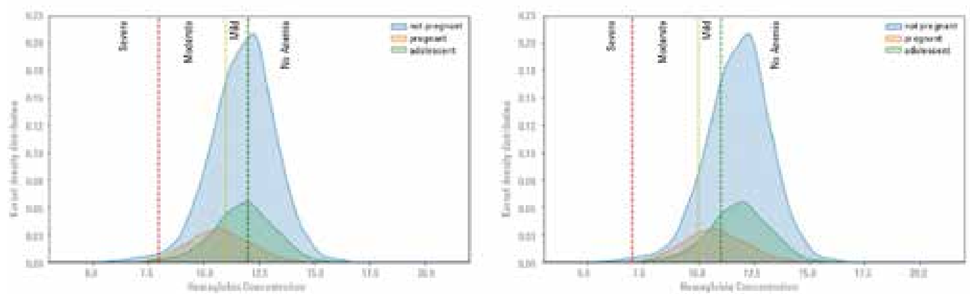
Hemoglobin concentration (g/dl) distribution by pregnancy status, Burkina Faso, DHS



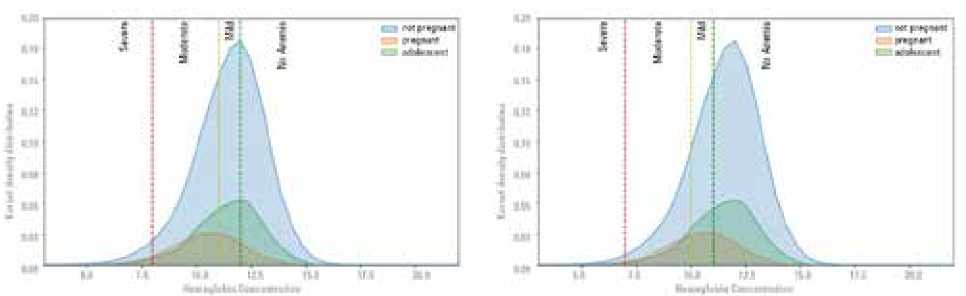
Hemoglobin concentration (g/dl) distribution by pregnancy status, Cameroon, DHS



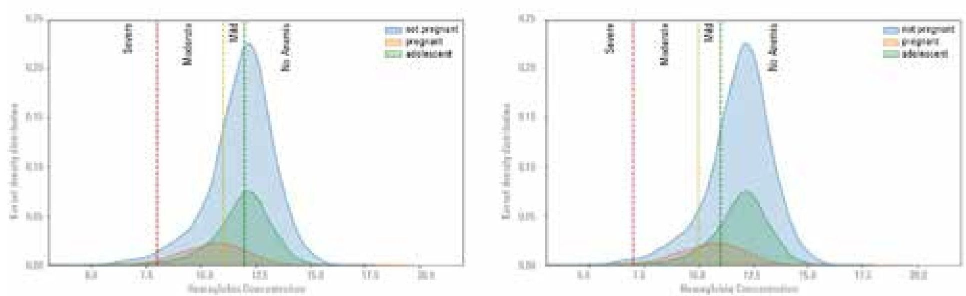
Hemoglobin concentration (g/dl) distribution by pregnancy status, Congo, DHS



Hemoglobin concentration (g/dl) distribution by pregnancy status, Gabon, DHS



Hemoglobin concentration (g/dl) distribution by pregnancy status, Gambia, DHS



ANNEXE 2: Distribution of anemia according to target groups and countries

- - Severe anemia / non-pregnant (A): 8.0 / pregnant (B): 7.0 g/d l
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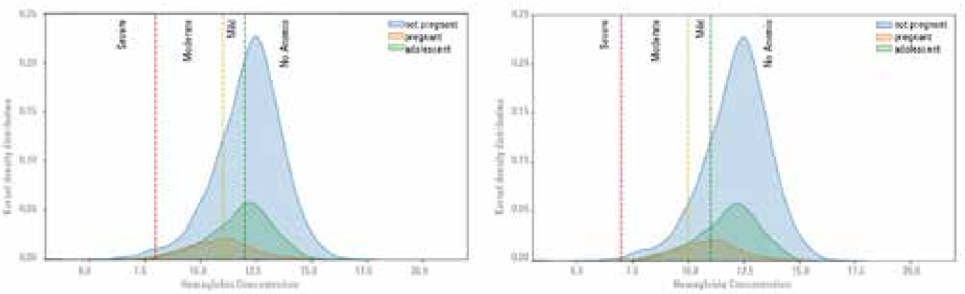
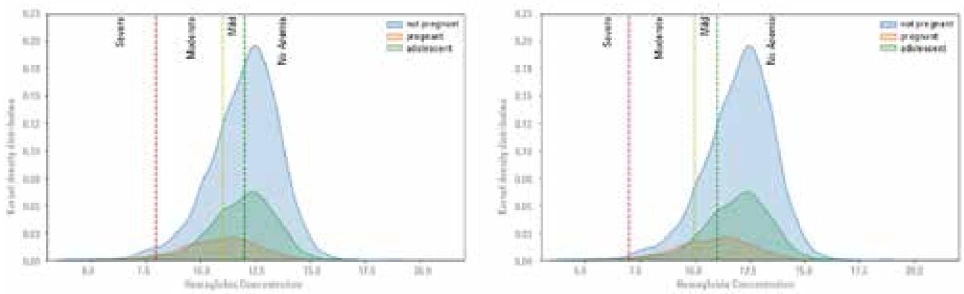
- - Mild anemia / non-pregnant (A): 12.0 / pregnant (B): 11.0 g/dl

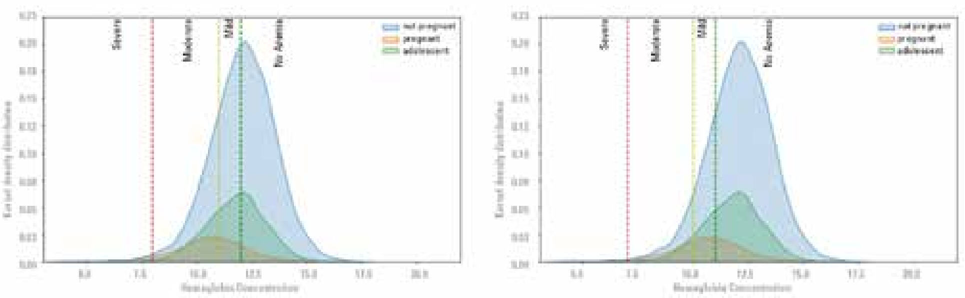
Hemoglobin concentration (g/dl) distribution by pregnancy status, Ghana, DHS



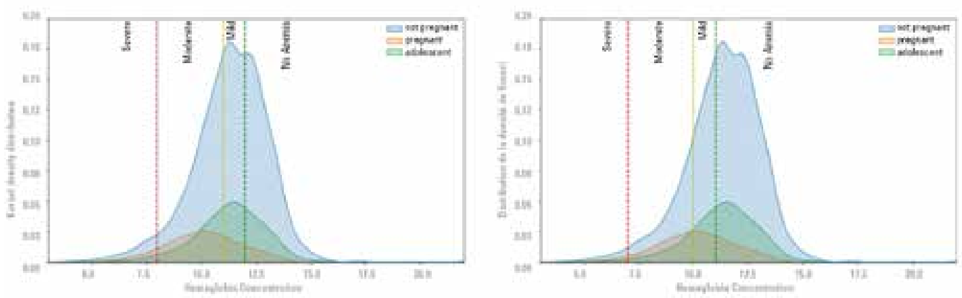
Hemoglobin concentration (g/dl) distribution by pregnancy status, Guinea, DHS



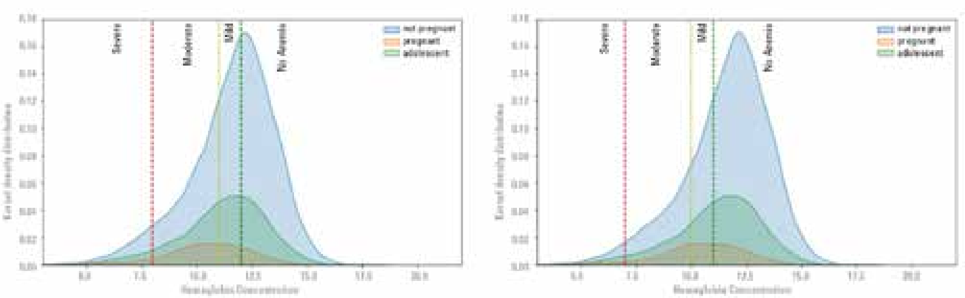
Hemoglobin concentration (g/dl) distribution by pregnancy status, Liberia, DHS



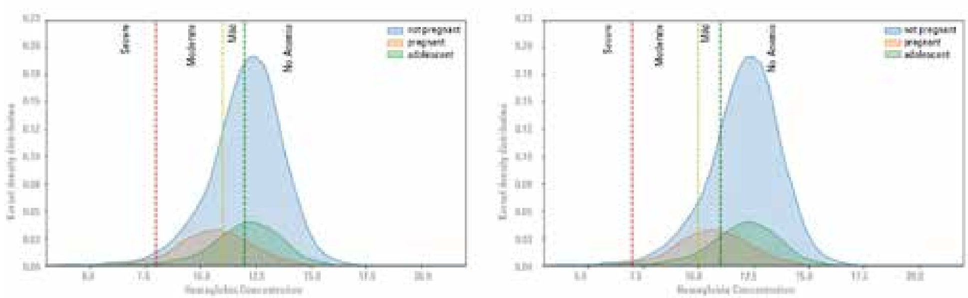
Hemoglobin concentration (g/dl) distribution by pregnancy status, Mali, DHS



Hemoglobin concentration (g/dl) distribution by pregnancy status, Mauritania, DHS



Hemoglobin concentration (g/dl) distribution by pregnancy status, Niger, DHS



ANNEXE 2: Distribution of anemia according to target groups and countries

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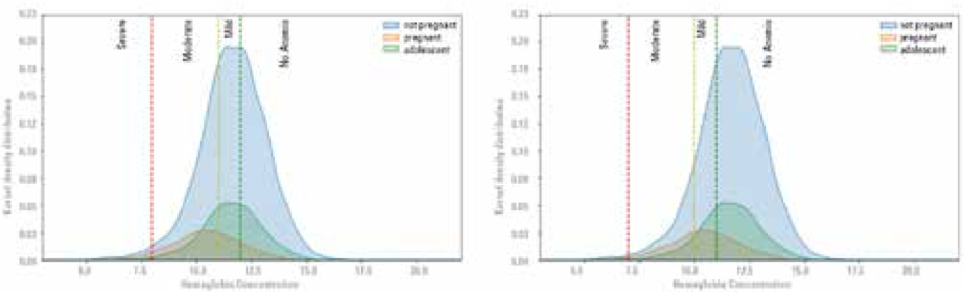
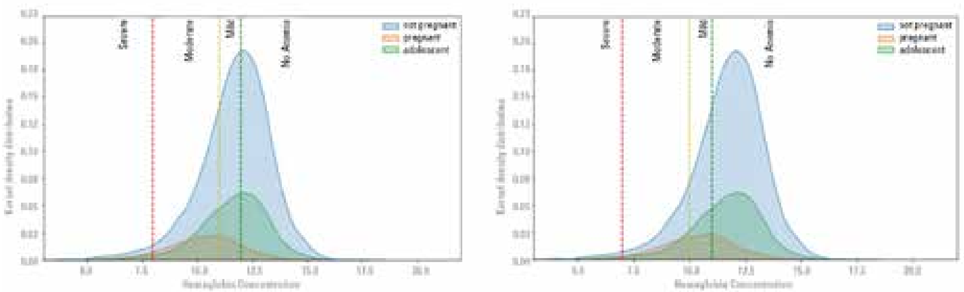
- - Mild anemia / non-pregnant (A): 12.0 / pregnant (B): 11.0 g/dl

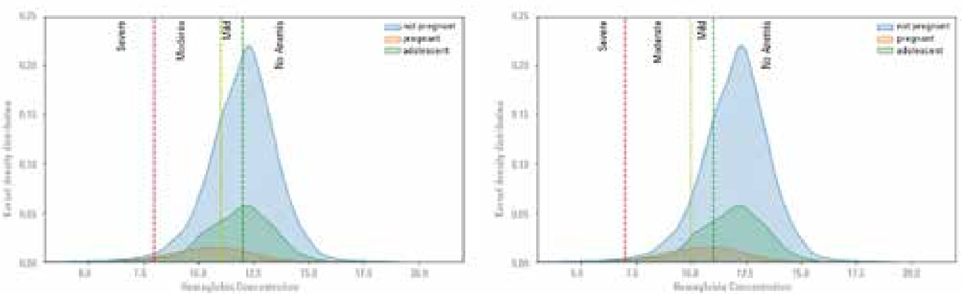
Hemoglobin concentration (g/dl) distribution by pregnancy status, Nigeria, DHS



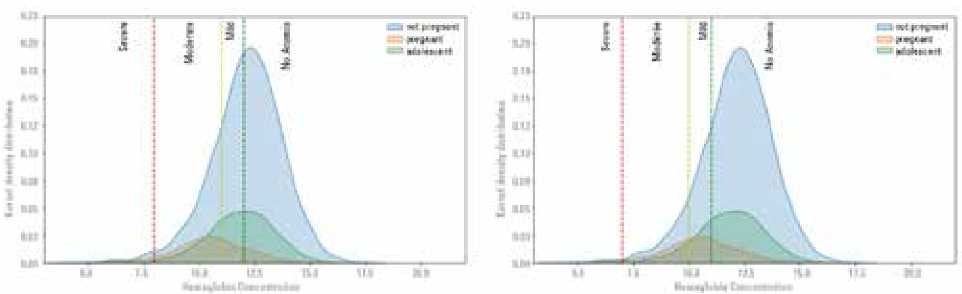
Hemoglobin concentration (g/dl) distribution by pregnancy status, Senegal, DHS



Hemoglobin concentration (g/dl) distribution by pregnancy status, Sierra Leone, DHS



Hemoglobin concentration (g/dl) distribution by pregnancy status, Togo, DHS



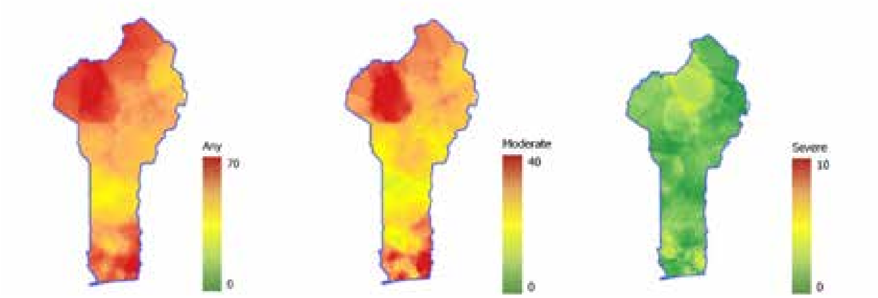
ANNEXE 3

Severity of anemia distribution by countries (prevalence vs caseload)

1. Prevalence

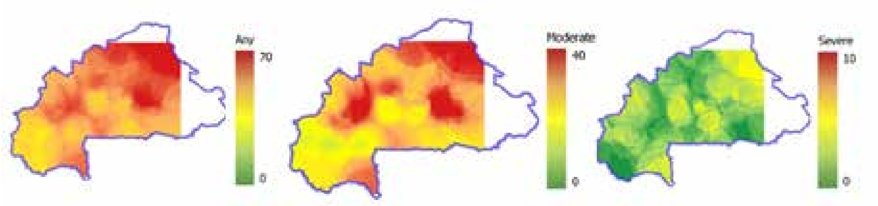
Benin

Any anemia   Moderate anemia   Severe anemia



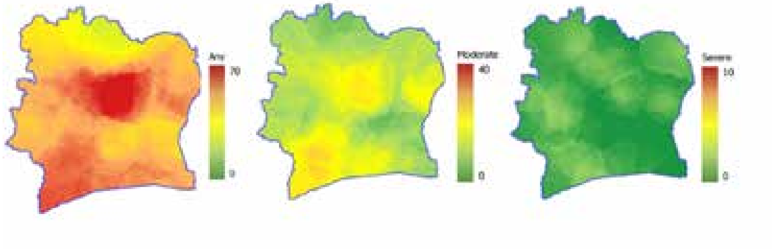
Burkina Faso

Any anemia   Moderate anemia   Severe anemia



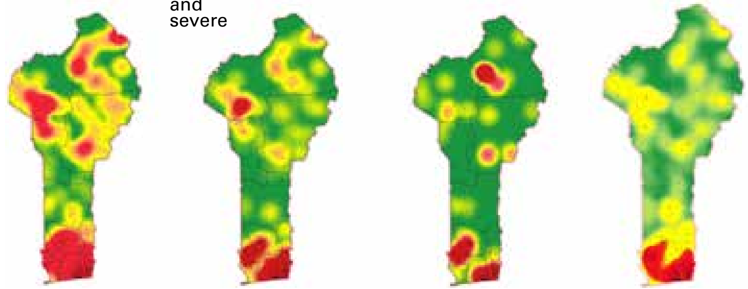
Cote d'Ivoire

Any anemia   Moderate anemia   Severe anemia

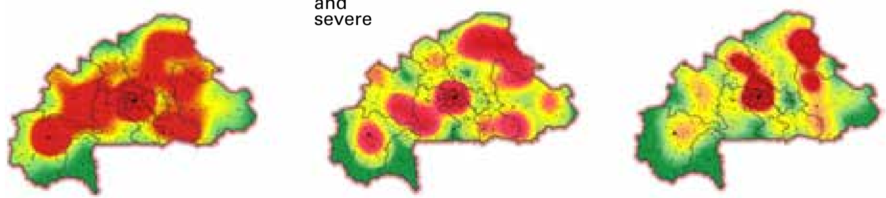


2. Caseloads

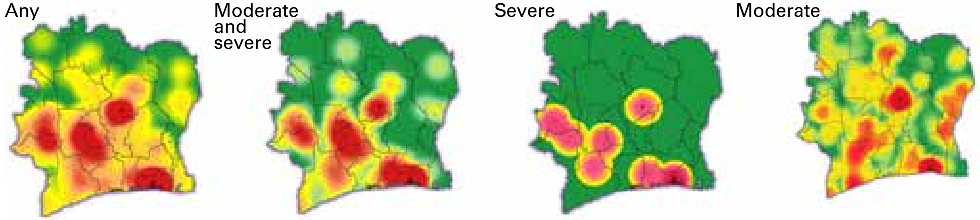
Any   Moderate and severe   Severe   Moderate



Any   Moderate and severe   Severe



Any   Moderate and severe   Severe   Moderate

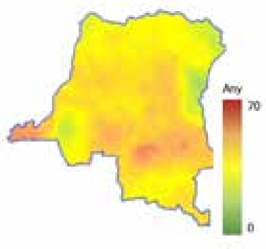


ANNEXE 3: Severity of anemia distribution by countries (prevalence vs caseload)

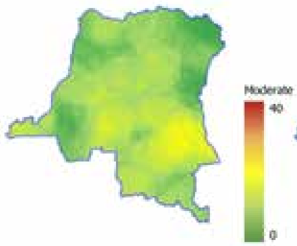
1. Prevalence

DRC

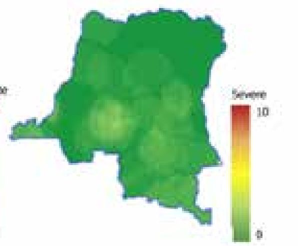
Any anemia



Moderate anemia

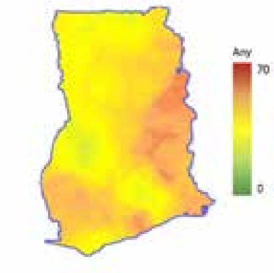


Severe anemia

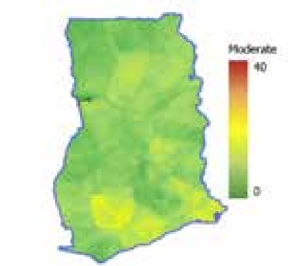


Ghana

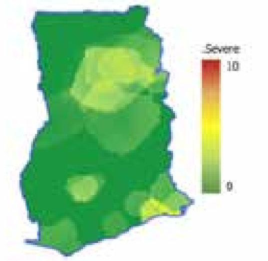
Any anemia



Moderate anemia

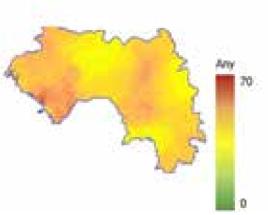


Severe anemia

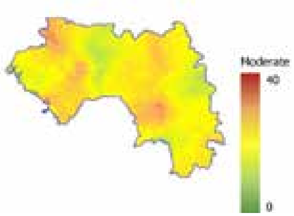


Guinea

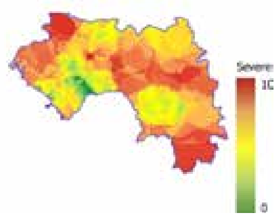
Any anemia



Moderate anemia

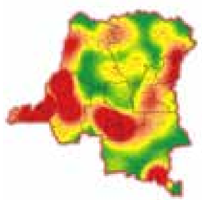


Severe anemia

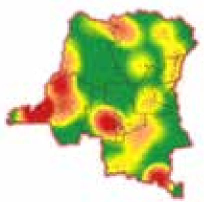


2. Caseloads

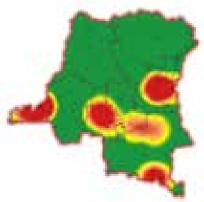
Any



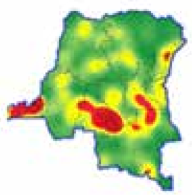
Moderate and severe



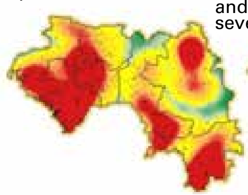
Severe



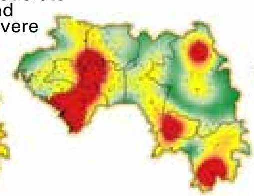
Moderate



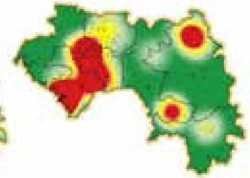
Any



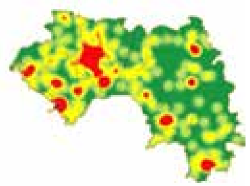
Moderate and severe



Severe



Moderate

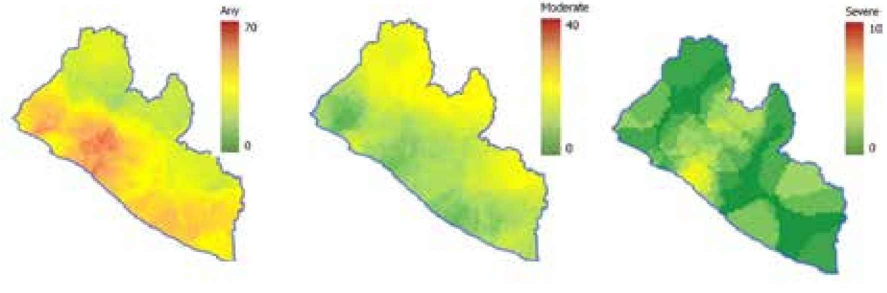


ANNEXE 3: Severity of anemia distribution by countries (prevalence vs caseload)

1. Prevalence

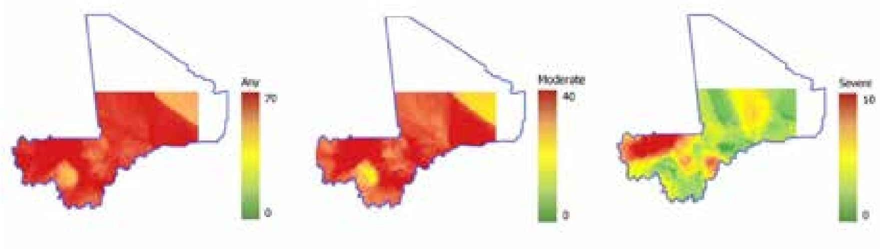
Liberia

Any anemia | Moderate anemia | Severe anemia



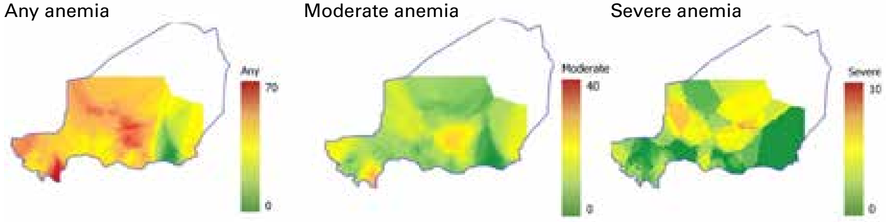
Mali

Any anemia | Moderate anemia | Severe anemia



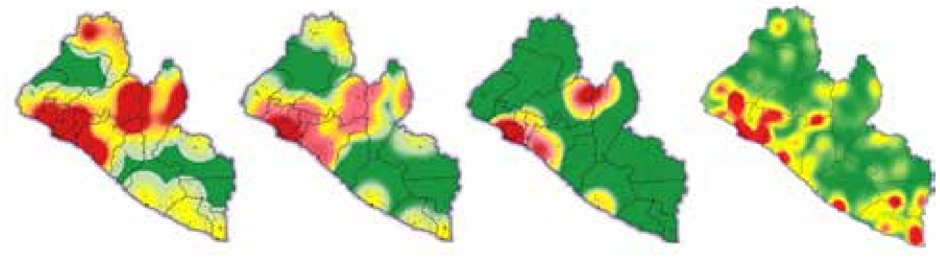
Niger

Any anemia | Moderate anemia | Severe anemia

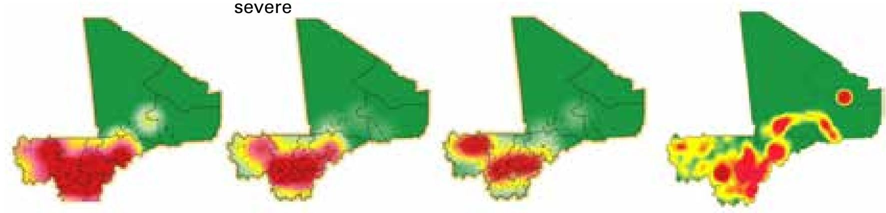


2. Caseloads

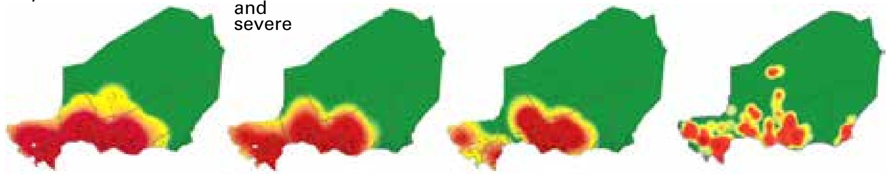
Any | Moderate and severe | Severe | Moderate



Any | Moderate and severe | Severe | Moderate



Any | Moderate and severe | Severe | Moderate

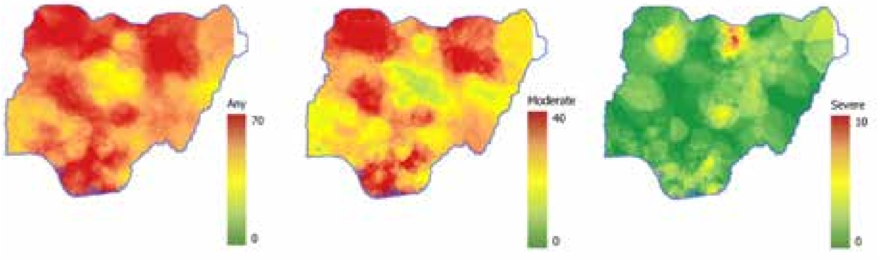


ANNEXE 3: Severity of anemia distribution by countries (prevalence vs caseload)

1. Prevalence

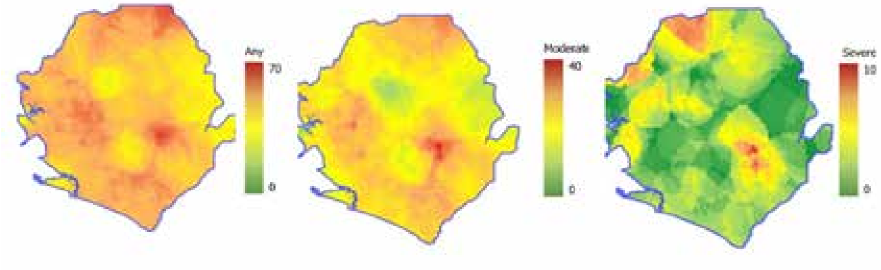
Nigeria

Any anemia | Moderate anemia | Severe anemia



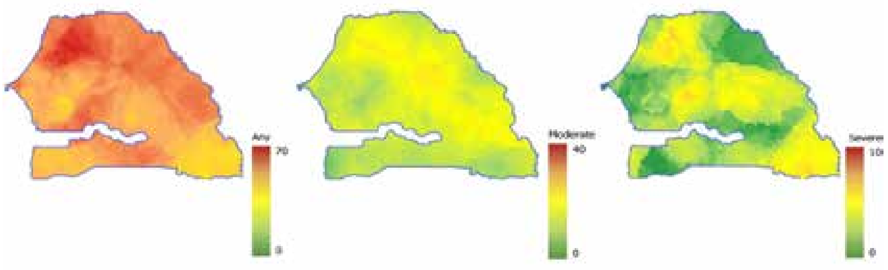
Sierra Leone

Any anemia | Moderate anemia | Severe anemia



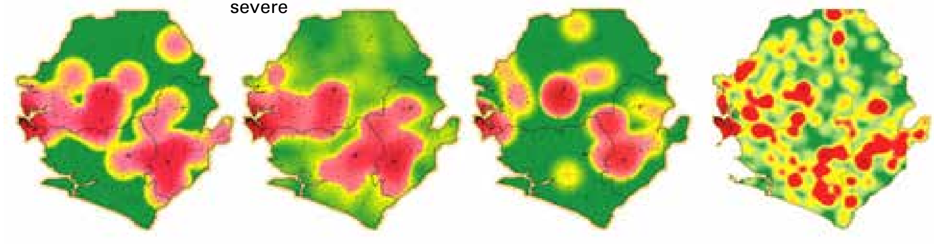
Senegal

Any anemia | Moderate anemia | Severe anemia

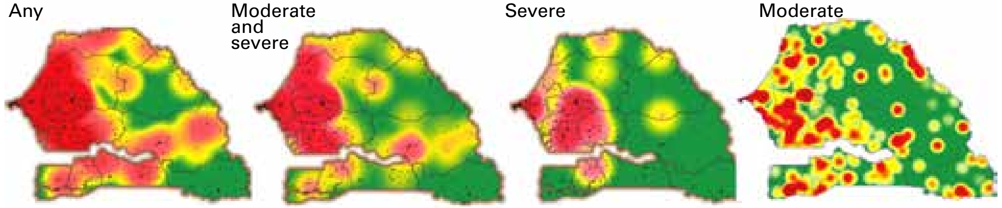


2. Caseloads

Any | Moderate and severe | Severe | Moderate



Any | Moderate and severe | Severe | Moderate

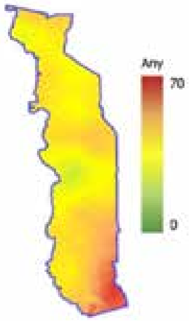


ANNEXE 3: Severity of anemia distribution by countries (prevalence vs caseload)

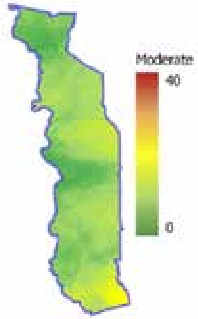
1. Prevalence

Togo

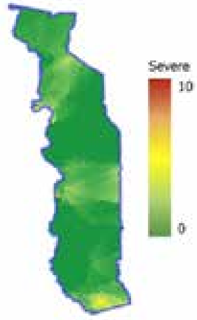
Any anemia



Moderate anemia

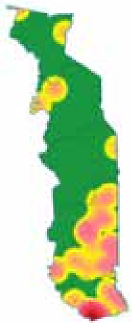


Severe anemia

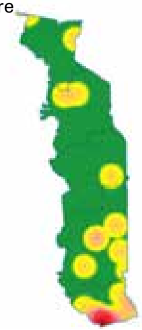


2. Caseloads

Any

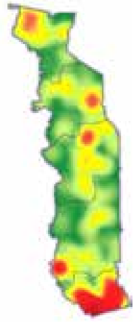


Moderate and severe



Severe

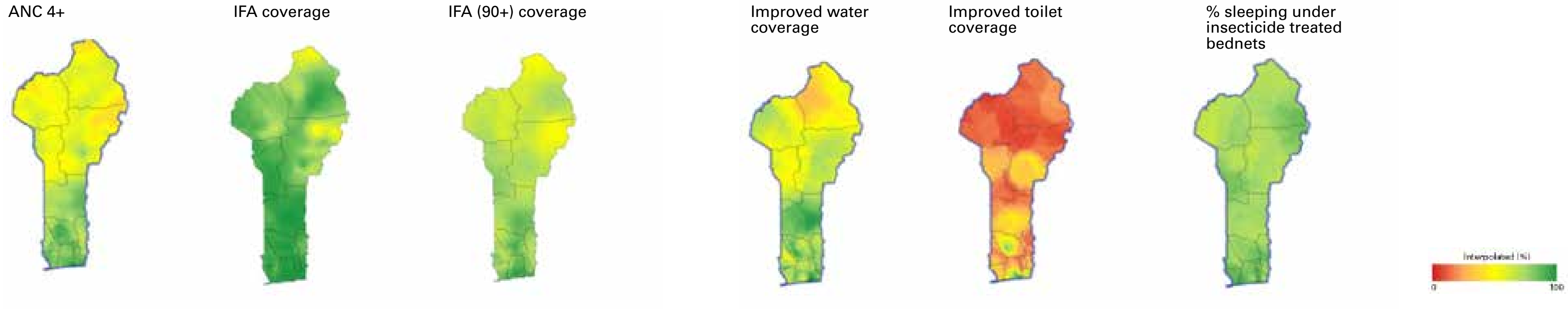
Moderate



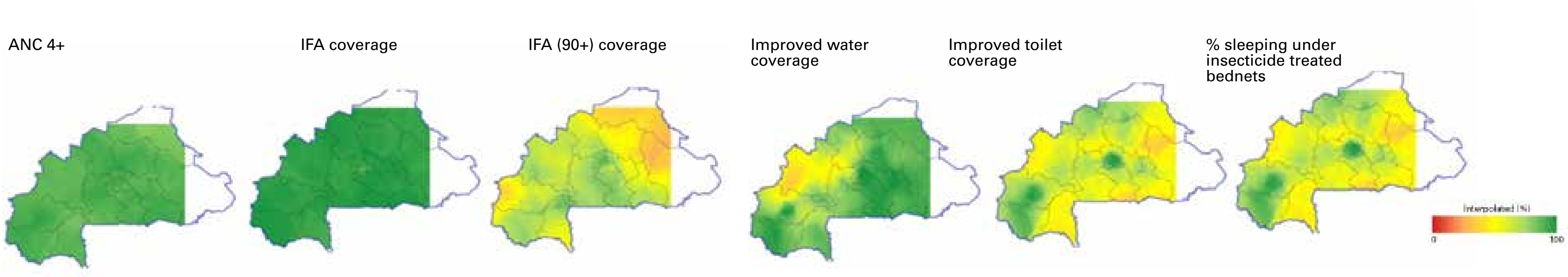
ANNEXE 4

Distribution of key interventions to prevent anemia by countries

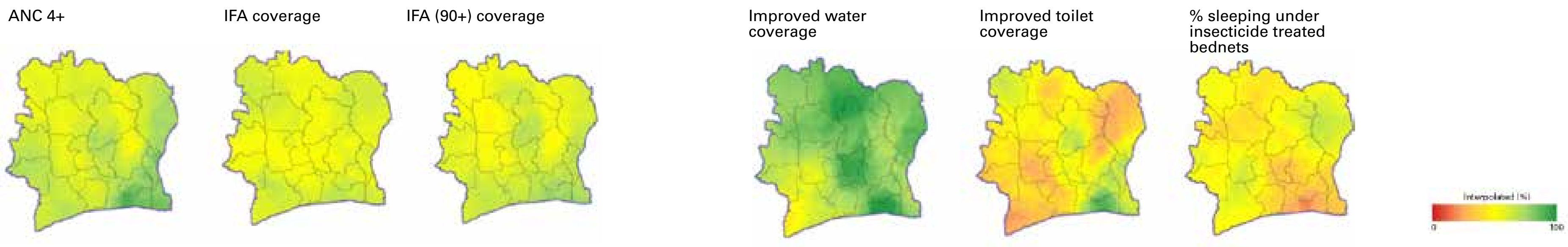
Benin



Burkina Faso

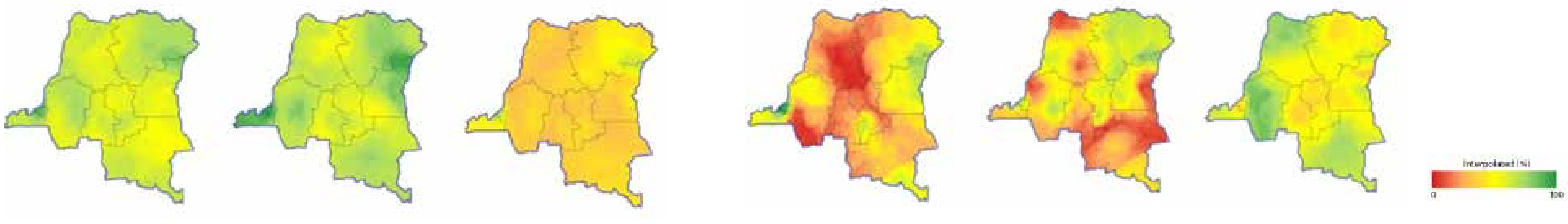


Cote d'Ivoire



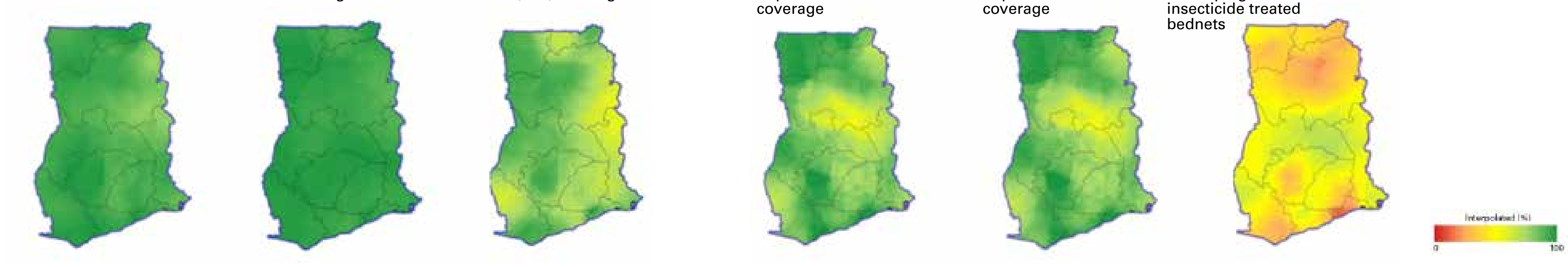
DRC

ANC 4+ | IFA coverage | IFA (90+) coverage | Improved water coverage | Improved toilet coverage | % sleeping under insecticide treated bednets



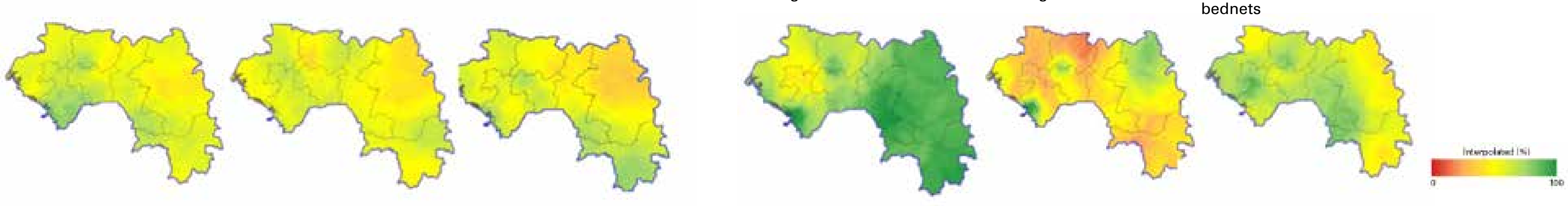
Ghana

ANC 4+ | IFA coverage | IFA (90+) coverage | Improved water coverage | Improved toilet coverage | % sleeping under insecticide treated bednets



Guinea

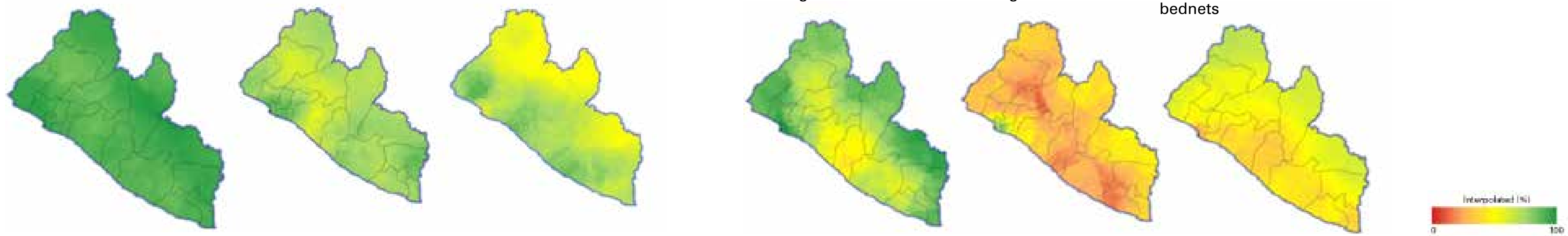
ANC 4+ | IFA coverage | IFA (90+) coverage | Improved water coverage | Improved toilet coverage | % sleeping under insecticide treated bednets



ANNEXE 4: Distribution of key interventions to prevent anemia by countries

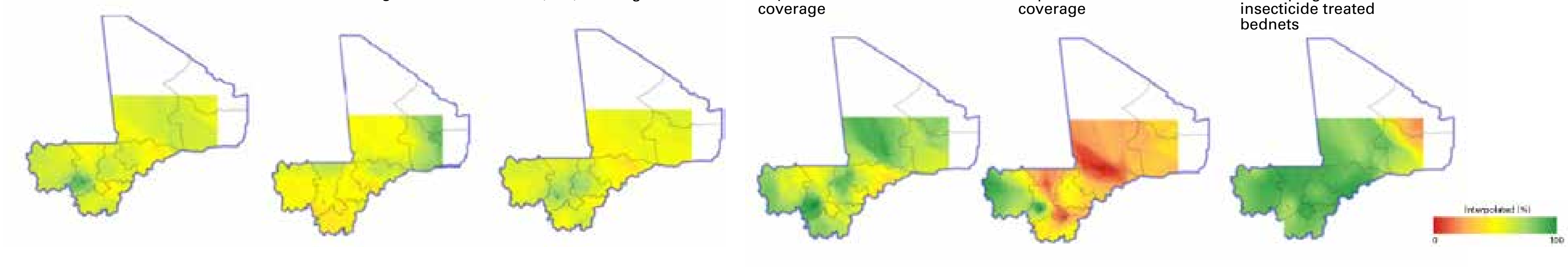
Liberia

ANC 4+ | IFA coverage | IFA (90+) coverage | Improved water coverage | Improved toilet coverage | % sleeping under insecticide treated bednets



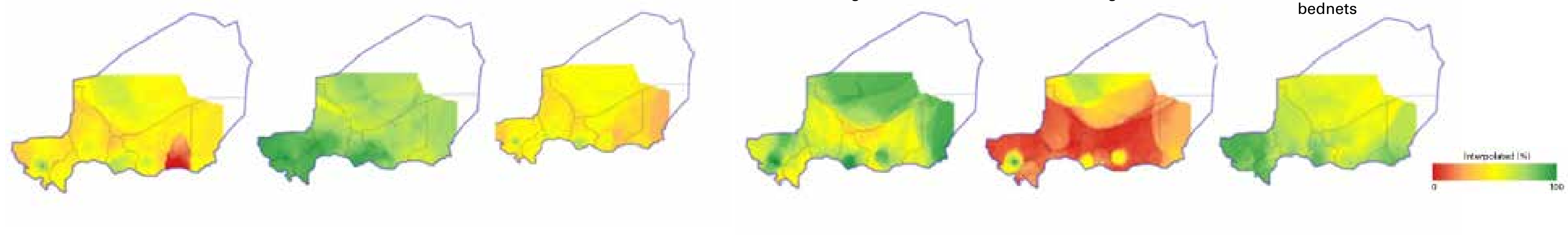
Mali

ANC 4+ | IFA coverage | IFA (90+) coverage | Improved water coverage | Improved toilet coverage | % sleeping under insecticide treated bednets

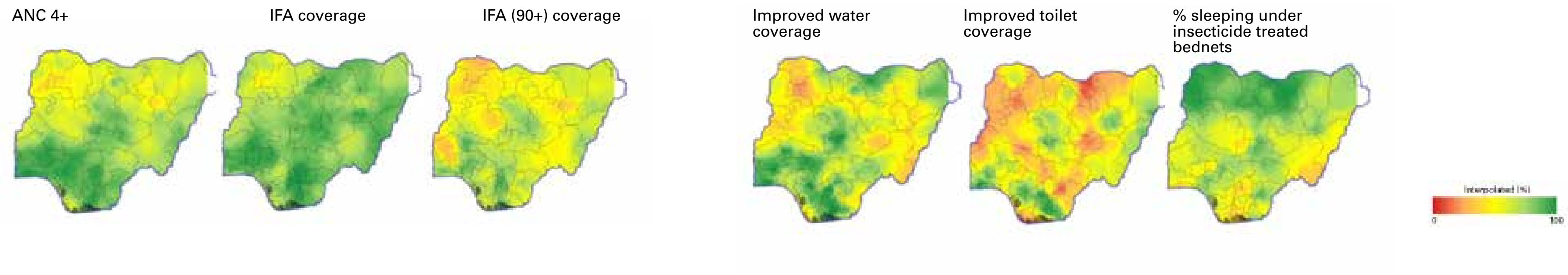


Niger

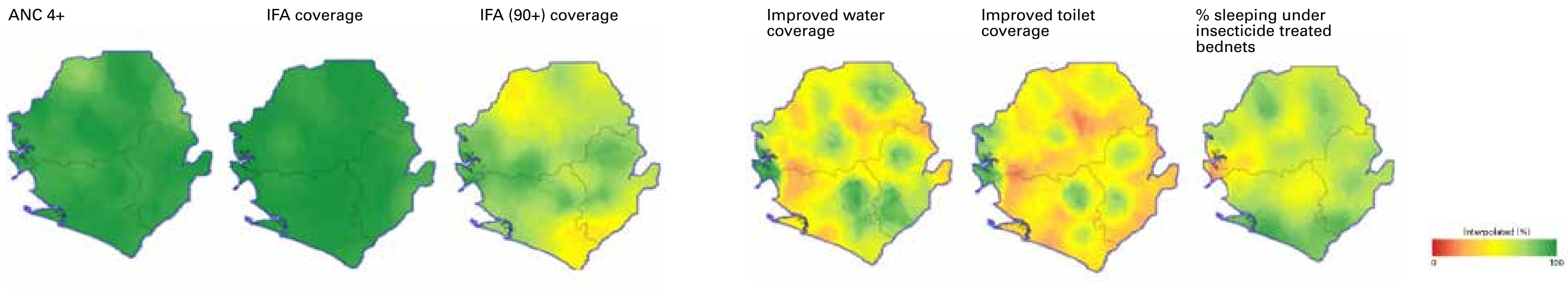
ANC 4+ | IFA coverage | IFA (90+) coverage | Improved water coverage | Improved toilet coverage | % sleeping under insecticide treated bednets



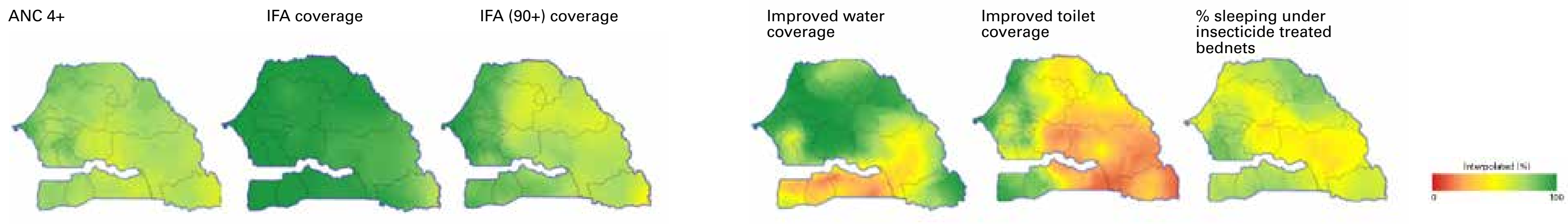
Nigeria



Sierra Leone



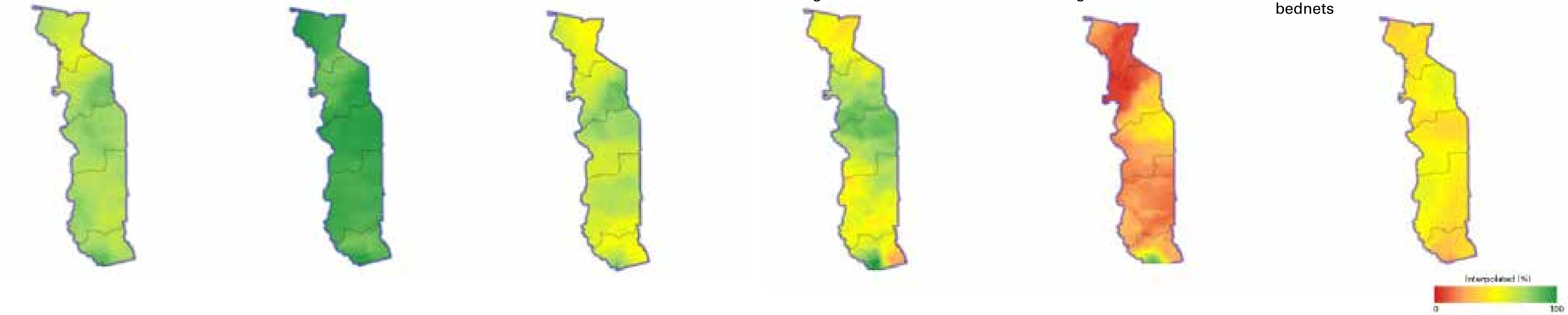
Senegal



ANNEXE 4: Distribution of key interventions to prevent anemia by countries

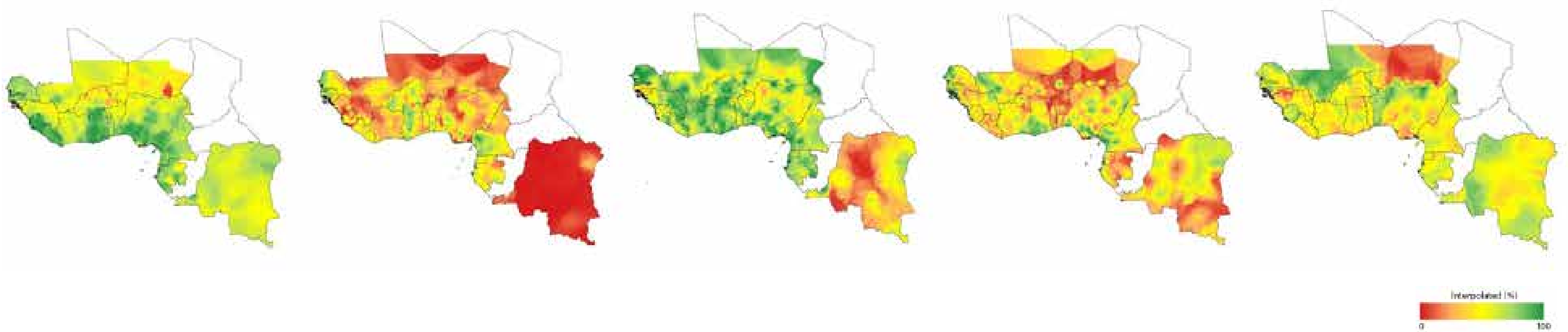
Togo

ANC 4+ | IFA coverage | IFA (90+) coverage | Improved water coverage | Improved toilet coverage | % sleeping under insecticide treated bednets



WCA

ANC 4+ | IFA (90+) coverage | Improved water coverage | Improved toilet coverage | % sleeping under insecticide treated bednets



ANNEXE 5

How the composite score was developed

Methods

Using the latest post-2010 DHS data of 20 West and Central African countries. Data on coverage of interventions that can prevent anemia were extracted. Subnational (cluster-level) estimates of the coverages were calculated using spatial interpolation. Cluster-level coverage estimates were calculated for the following five interventions/ exposures:

1. Proportion of women receiving four or more ANC visits
2. Proportion of women receiving 90+ tablets of iron-containing supplement
3. Proportion sleeping under bed-net
4. Access to improved water
5. Access to improved toilet
6. Proportion using polluting cooking fuel

Principal component analysis (PCA) was then used to construct a single index reflecting coverage of the above six interventions/ coverages. We pooled estimates from 7,711 clusters, from 20 West and Central African countries (Table 1).

Table 1: Countries for which DHS data was pooled, by year

COUNTRY	YEAR
Burkina Faso	2010
Benin	2017/8
DR. Congo	2013/4
Chad	2014/5
Central Africa Republic	1994/5
Cote d'Ivoire	2011/2
Cameroon	2018
Gabon	2012
Ghana	2019MIS
Gambia	2019/20

COUNTRY	YEAR
Guinea	2018
Liberia	2019/20
Mali	2018
Nigeria	2018
Niger	2012
Sierra Leone	2019
Senegal	2019
Togo	2013/14
Mauritania	2019-21

The weights for each principal component are given by the eigenvectors of the correlation matrix, or if the original data were standardized the covariance matrix. The variance (λ) for each principal component is given by the eigenvalue of the corresponding eigenvector. The weights (factor loading) for each of the individual components are presented in Table 2.

Table 2: Principal component analysis factor loadings, based on the combined dataset including all 20 West and Central African countries

VARIABLE	MEAN COVERAGE (%)	WEIGHTS (λ)
ANC 4+	75.4%	0.436
90+tablets	67.9%	0.472
Sleeping under bed-nets	51.7%	-0.133
Improved water	73.9%	0.431
Improved toilet	49.5 %	0.483
Domestic fuel	12.1 %	0.387

We then estimated the anemia prevalence per decile of the composite index of the interventions/coverages (Table 3). Overall, between decile 10 (highest) and decile 1 (lowest), we are able to reduce the anemia prevalence at cluster level by 5.9%.

Table 3: Composite score by decile and anemia prevalence

DECILE	COMPOSITE SCORE (OUT OF 100)	ANY ANEMIA PREVALENCE (%)
1	61.5	52.9
2	67.3	51.3
3	70.8	52.0
4	73.8	50.9
5	76.5	51.4
6	79.3	50.2
7	82.0	49.7
8	84.8	49.0
9	87.8	48.1
10	93.3	47.0

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