

VALID

PROJECT

BRIEF



Undernutrition in Bangladesh – how can data be better used to support programme planning and decision making?

A Valid International Project facilitated by the Ministry of Health and Family Welfare in Bangladesh and funded by the Children's Investment Fund Foundation

Project Briefing Paper

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1 Background

Bangladesh has one of the highest rates of undernutrition in the world. Although prevalence has been gradually declining since the 1990s, millions of children and women still suffer from one or more forms of the condition, including wasting, stunting, underweight, vitamin A and iodine deficiencies, and anaemia¹. In 2014, wasting for children under five stood at 14.3% with stunting estimated at 36.1%. Given the country's population size, this translates into approximately 9.9 million stunted and 3.9 million wasted children respectively². Whilst Bangladesh has now signed up to the six **World Health Assembly Targets** to reduce undernutrition by 2025 and has made other recent commitments to the issue at the **Nutrition for Growth Summit** (2013) and at the **Second International Conference on Nutrition ICN2** (2014), recent reports have recognized the need for strong leadership and multisectoral/multi-stakeholder coordination if these targets are to be achieved³. There are plans under discussion to revitalise the **Bangladesh National Nutrition Council (BNNC)** chaired by the Prime Minister and to include multi-sector Ministerial membership which could go some way to strengthening national coordination for nutrition. There is also a new **Nutrition Policy** (awaiting sign-off by Government) that emphasizes the importance of a multisectoral approach, as well as the **7th 5 year plan (FYP)** developed by the General Economics Division (GED) of the Planning Commission, which is nearing finalization and will have a much stronger focus on nutrition than the 6th FYP⁴⁵.

Whilst it is vital to increase commitments at country level, several factors are commonly cited as critical barriers preventing effective leadership and evidence-based decision making for nutrition in many countries. These can include a lack of national and local level knowledge of undernutrition and its causes, as well as a lack of evidence and data on nutrition to inform policy, programming and advocacy⁶. Country decision-makers also face challenges to the effective use and interpretation of the nutrition data and information that does exist⁷.

Recognizing these challenges as part of their 2014 Nutrition Strategy⁸, the Children's Investment Fund Foundation (CIFF) are prioritizing support to strengthen global, regional and country capacity to collect and use data for planning, programming and resource allocation, and to track results/progress. At the beginning

¹ UNICEF. *Child and Maternal Nutrition in Bangladesh*. at <http://www.unicef.org/bangladesh/Child_and_Maternal_Nutrition.pdf>

² Bangladesh Demographic Health Survey. 2014 National Institute of Population Research and Training Ministry of Health and Family Welfare Dhaka, Bangladesh

³ Nutrition Background Paper to inform preparation of the 7th Five Year Plan. Hussain, Talukder and Ahmed. Dhaka, 2015

⁴ In 2012, Bangladesh signed up to World Health Assembly (WHA) Targets, and pledged to align nutrition in the 7th FYP

⁵ It is important to note that this report was drafted during August 2015. **As of April 2016**, when this report went on general release, there was already several positive developments in the nutrition policy environment in Bangladesh including: approval for revitalisation of the BNNC, endorsement of the National Nutrition Policy 2015 and start of formulation of a National Plan of Action on Nutrition.

⁶ Nisbett, N; Wach, E; Haddad, L & Arifeen, S. E. What drives and constrains effective leadership in tackling child undernutrition? Findings from Bangladesh, Ethiopia, India and Kenya. *Food Policy* 2015

⁷ International Food Policy Research Institute. 2014 *Global Nutrition Report* (2014). <http://globalnutritionreport.org/the-report/the-report-2014/>

⁸ See <http://ciff.org/priority-impact-areas/nutrition/>

of 2015, CIFF asked Valid International to work closely with national bodies and stakeholders over six months in Bangladesh (January-July 2015) to help improve understanding around information gaps and needs for nutrition, and to recommend innovative mechanisms to build available nutrition data and to support data application to planning and decision-making.

This report looks at the key elements in the chain of data use for nutrition programme planning and decision-making in Bangladesh. The elements include stakeholders active in nutrition, data/information availability, data use and analysis techniques and visualisation and sharing of data/information.

2 Project Aims and Objectives

To build on what is already being done and on data that already exists to:

- Develop spatial maps of burden of undernutrition and coverage of nutrition-specific and -sensitive interventions
- identify gaps in nutrition data and information needs and recommend ways to fill them
- Develop innovative tools to understand causes of undernutrition

To develop prototype information products that could be used by all stakeholders in Bangladesh to:

- Better understand and analyse the nutrition context at the sub-national level
- Support decision making and planning for nutrition at the national and sub-national levels

3 Approach and Methods

From the start it was recognised that this was a small project operating in a highly networked and highly developed nutrition landscape. Hence, building on what was already being done and on national plans and priorities was central to shaping the objectives and outputs. The aim was also to have a very practical focus and to produce tangible outputs that could potentially be used to support programme planning and decision-making for nutrition in Bangladesh.

Initial stages of the project worked with a broad range of key stakeholders in country to compile and integrate a wide range of secondary data linked to the causal framework of undernutrition (immediate, underlying and basic)⁹. Stakeholder engagement in the project included *ad hoc* support from a steering committee that was facilitated by the MoHFW Additional Secretary and SUN Focal Point and her Adviser and included members from MoF, IPHN, DFID, USAID, FAO, UNICEF and ICCDR,B.

Over 30 sources of secondary data were catalogued, comprising 46 disparate datasets with over 1000 indicators, of which roughly 300 were ultimately used for analysis and/or mapping to identify key data gaps and to begin to understand patterns of undernutrition in relation to other key factors (e.g. food

⁹ In line with the UNICEF (1990) conceptual framework of causes of malnutrition

production). A summary of the data sourced and reviewed can be found in the Data Dictionary created for the project¹⁰.

An online stakeholder consultation was implemented to gather opinions on the use of data and information for nutrition planning and operations, on information needs and on the range of barriers to use of nutrition information for planning and decision-making. Forty-two individuals from thirty-four unique organisations responded to the online consultation document. Twenty respondents represented NGO and development partner organisations, while eight came from academic/research backgrounds and 12 from the UN or Government of Bangladesh. Many of the respondents worked across a number of sectors in addition to Nutrition and Food Security, including Health, WASH and Education.

Inverse distance-weighted (IDW) interpolation was used to improve resolution for some indicators for which raw data including geolocations could be obtained. The interpolation was performed using 2011 DHS data on undernutrition, antenatal care, micronutrient fortification, and diarrhoea/deworming treatment, with validation to determine optimal distance power (description of methodology in **Annex 1**). Interpolation was also scoped for dietary diversity and complementary feeding (minimum acceptable diet); however sample sizes were insufficient for this to be practicable using 2011 DHS data.

Valid International also developed a prototype website to demonstrate the functionality of a visualisation platform. Data on interventions as well as indicators on nutrition, health, food security, WASH, and education were mapped to the highest available resolution and layered for visual comparison. Additional layers with administrative boundaries/names, roads, and health centre/school locations were added to improve map utility.

Preliminary project outputs were presented to a broad set of stakeholders in Dhaka on July 22nd 2015. Feedback from stakeholders during this meeting was used to fine-tune project outputs and support development of the project recommendations.

4 Project Findings and Outputs

4.1 Nutrition stakeholders and stakeholder mapping

There are over 200 agencies working in the area of nutrition/nutrition-related operations in Bangladesh, including government agencies, academic and research institutes, development partners, NGOs and the private sector. Multiple government bodies hold responsibilities in the nutrition sector at the national level. Nutrition is being mainstreamed into the regular services of the Directorates General of Health and Family Planning under the Health, Population and Nutrition Sector Development Program 2011-2016¹¹. The National Nutrition Services (NNS) implements the main governmental nutrition interventions, with the remit to provide community-level, comprehensive nutrition services to women and children. NNS replaced

¹⁰ The Data Dictionary may be found as a Google® spreadsheet at the following link: <https://docs.google.com/spreadsheets/d/1MvIJuWTruBEbZraCP3LHoM4g0FOm9Ftn2k0G8lpVmR4/edit?usp=sharing>. The dictionary is intended for comprehensiveness and was created in a short timeframe; consequently there is no feature for easy navigation between indicators which may repeat over multiple datasets and/or years.

¹¹ *WFP Bangladesh Nutrition Strategy 2012-2016*. (2012). at <http://www.wfp.org/sites/default/files/Nutrition Strategy_Final_high_res_5.pdf>

the National Nutrition Programme (NNP) in 2010, bringing nutrition into the existing health service delivery program under the Ministry of Health and Family Welfare (MoHFW)¹². The main action has been in expanding MoHFW community clinics and providing inpatient therapeutic treatment services for those with severe acute malnutrition. After the mainstreaming of nutrition in 2011, the government is exploring the use of a multisectoral approach to address nutrition issues.

There are several resources (described in Table 1) that identify the agencies working in nutrition. These resources also describe the nutrition-specific and -sensitive interventions these agencies are involved in across sectors/clusters (food security, health, education, WASH etc.).

Table 1. Key stakeholder mapping resources

Resource	Information
Inter Cluster 4W	<p>Introduction: A '4W' is a generic name for information on <i>who is doing what where</i>. The 4W is normally administered by UNOCHA with input from clusters during an emergency.</p> <p>In Bangladesh, the 4W¹ is maintained by the Information Management Officer of the Food Security Cluster on behalf of the HCTT (http://www.lcgbangladesh.org/HCTT.php) with input from the other clusters (WASH, Health, Education, Logistics etc.).</p> <p>The 4W will move to the Disaster Management Information Centre (http://www.dmic.org.bd/) whereby the government will take over the administration of it.</p> <p>The 4W is presently held in Excel but there are plans to move it to an online platform where agencies will input their own data</p>

¹² FANTA/FHI 360. *Integrating and Strengthening Maternal and Child Nutrition in Health Service Delivery in Bangladesh: A Report on FANTA Activities from 2010 - 2014*. (2014). at <<http://www.fantaproject.org/sites/default/files/resources/FANTA-Bangladesh-Final-Report-May2014.pdf>>

	<p>Currency: The 4W is updated quarterly; the information in this report comes from the 2014 Q4 data.</p> <p>Benefit: The 4W contains information on all clusters (e.g. health, education, WASH), thus affording a broad perspective on humanitarian interventions.</p> <p>Limitation (for this project):</p> <ul style="list-style-type: none">• The 4W holds information on emergency interventions. The 4W does not contain comprehensive information on the large ongoing nutrition programmes in Bangladesh so the information is not representative of the nutrition interventions in Bangladesh at present.• Not all information on beneficiaries is complete
FANTA III Project	<p>Introduction: In an effort to improve the nutrition status of children in Bangladesh, the Government asked for assistance from the Food and Nutritional Technical Assistance III Project¹ (FANTA) and Helen Keller International (HKI)/Bangladesh with the aim of having multi-sector mapping of the country's nutrition programs. The project was funded by USAID.</p> <p>The mapping afforded a comprehensive overview of nutrition activities in Bangladesh. It also provided a look at the types of projects funded or facilitated by the different nutrition stakeholders that were active in-country.</p> <p>Information was collected from approximately 100 respondents from the government, NGOS, development partners, private sector and research and academic institutes.</p> <p>A final report was published in February 2014</p> <p>Currency: the project finished in 2013 but the information that was collected then identified which projects would continue into 2016.</p> <p>Benefit: Comprehensive resource on the stakeholders and nutrition and other cluster interventions that have been, or are being, undertaken in Bangladesh.</p> <p>Limitations (for this project):</p> <ul style="list-style-type: none">• The mapping report included information only from those organisations that responded to data collection queries or were mentioned in data collection responses.• Data reflect only projects in existence at the time of data collection, making these results time sensitive. Although the project identified which projects would continue until 2016, projects that started after 2013 were not included.• The scope of the exercise did not include collecting data on the number of beneficiaries or verifying that any reported project activities were actually being implemented• Because many projects work in only a few unions within an <i>upazila</i>, a project or intervention reported to be in an <i>upazila</i> could actually be working in only a small fraction of that geographic area with only a small number of beneficiaries.

LINK Initiative

Introduction: The LINK initiative funded by HKI is a new project which is mapping Interaction and USAID-funded projects. These projects account for ~50% of what was in the FANTA III project. There is hope that this project might be extended to non-Interaction and USAID-funded projects.

Currency: New/ongoing

Benefit: Current information on many large scale projects.

Limitation (for this project): Not all stakeholders are currently being mapped

4.2 Availability of Data and Nutrition Information: findings from an online consultation

Bangladesh is a 'nutrition information-rich' country. There are multiple national cyclical surveys that gather data on indicators of nutritional status and on nutrition-specific and -sensitive interventions and practices. These include (but are not limited to) the Multiple Indicator Cluster Surveys (MICS)¹³, the Demographic and Health Surveys (DHS)¹⁴, and the Food Security and Nutrition Surveillance Project (FSNSP)¹⁵. In addition, many implementers are collecting and analysing data at a local level to plan and monitor their own programmes. One output of this project was a consultation that gathered information on the use of data and information in planning and operations by stakeholders in Bangladesh.

The most frequently cited sources of data and information used in operations (as identified during the consultation) were the FSNSP (used by 84% of respondents), the DHS reports (used by 82% of respondents), the Household Income and Expenditure Surveys or HIES (used by 73% of respondents), and the MICS (used by 66% of respondents). Whilst the latter three are essential for evaluation of national trends, they are only produced every three to five years, and are not always available in a timely fashion. They are therefore less useful for programme decision-making.

The FSNSP conducts surveys three times per year (which helps account for seasonal variations), so data is timelier, but results produced are only representative to division level, or to FSNSP's six surveillance zones, across the whole of Bangladesh.

These different sampling approaches make it difficult to compare surveys. The MICS data is the only one of the large datasets that is representative below divisional level and all of these surveys have gaps in some of the key indicators (such as coverage of complementary feeding interventions) required by programme decision-makers. The challenges of data being too old to be relevant for planning and decision-making, gaps in data and poor resolution of data were common themes in the stakeholder consultation.

¹³ MICS are implemented by the United Nations Children's Fund (UNICEF) <http://mics.unicef.org>

¹⁴ DHS surveys are implemented by ICF International, with funding from USAID. <http://dhsprogram.com>

¹⁵ FSNSP has been run jointly by the James P. Grant School of Public Health of BRAC University, Helen Keller International (HKI), the Bangladesh Bureau of Statistics (BBS) and the National Nutrition Services (Ministry of Health and Family Welfare), funded by the European Union. <http://203.76.121.106>

Annex 2 illustrates the range of indicators available and their spatial resolution from secondary data across a core indicator set deemed essential for understanding undernutrition in Bangladesh. In **Annex 2** we also document what has been mapped at this stage in the demonstration web portal (see Section 4.4 below).

Gaps in the resolution of nutrition information was the biggest barrier identified, with >65% of respondents highlighting this as a critical or important challenge to their work. This supports recent findings by reports such as the Global Nutrition Report (GNR) 2014¹⁶ that highlights both coverage data and disaggregated data as key constraining data gaps that could stall scale up of nutrition-specific and -sensitive interventions.

Gaps in information available on indicators measuring the nutritional status of populations and coverage of interventions were also highlighted by over 60% of respondents as important or critical barriers. Again this supports recent findings. The GNR identified several key nutrition status and intervention coverage indicators for which data gaps could be holding back action - many of these (e.g. low birth weight, anaemia, food consumption and coverage of MAM and SAM programmes) were highlighted by respondents to this survey as critical information needs in Bangladesh.

The age (and timely release) of information was identified by >50% of respondents as a critical or important challenge to their work – this is a barrier to responsive action by stakeholders to changing circumstances and could prevent civil society and other organizations from holding implementers accountable for the effectiveness of interventions.

These challenges are illustrated by the nutrition information needs of stakeholders detailed during the online consultation. Broadly, the identified needs fell into four categories:

1. Some level of ‘real-time’ monitoring of nutrition indicators, perhaps using a ‘dashboard’ format. Currently the nutrition indicators that are supposed to be available through the HMIS are not easily accessed
2. More disaggregation and higher spatial resolution of data, either by area (e.g. IYCF and MAM/SAM prevalence data that is representative at lower administrative levels) or by demographic/age groups (e.g. for adolescent girls)
3. Filling data gaps e.g. on food choices and diet assessment, barriers to behaviour change and prevalence of low birth weight and standardizing indicators e.g. different surveys use different methods to assess food security
4. Data on causes of undernutrition and on effectiveness of interventions to address it

4.3 Filling indicator resolution gaps

A combination of interpolated data with high-resolution population data¹⁷ was used to provide information on absolute burden for some indicators; this can be analysed alongside prevalence information for more

¹⁶ International Food Policy Research Institute. Global Nutrition Report. Actions and accountability to accelerate the world's progress on nutrition. Washington DC; 2014.

¹⁷ Data used for this analysis includes:

informed area/programme prioritisation and planning. This more resolved data could allow improved targeting of interventions for prioritization and planning and is shown in maps presented on the web-platform discussed and presented below. **Annex 2** describes the range of indicators for which interpolation was possible during this project, including undernutrition, antenatal care, micronutrient fortification, and diarrhoea/deworming treatment. Interpolation of DHS data was performed using inverse distance-weighting, with cross-validation to determine optimal distance power (description of methodology in **Annex 1**). Interpolation was also scoped for dietary diversity and complementary feeding (minimum acceptable diet); however sample sizes were insufficient for this to be practicable using 2011 DHS data.

4.4 A Prototype Web Platform: sharing data and visualizing nutrition information

A key output of the project was the development of a prototype web platform that enabled users to access detailed maps of burden of undernutrition as well as data on other key indicators and interventions. Where data was available, interpolation allowed for sub-national mapping down to 10 km². Access to raw datasets and the visualisation of information are both highlighted as being critical issues in relation to programme planning and decision-making for nutrition in Bangladesh. At present there is no one-stop-shop to access nutrition-sensitive data or metadata for Bangladesh. Stakeholders identified that data not being available to them was a critical or important barrier to their operations and proposed that data should be freely shared and downloadable.

During the online stakeholder consultation, a number of example visualisation products were shown to stakeholders. Many of these products were identified as being 'required' or 'desired'. Seventy percent of stakeholders stated in the online consultation that an interactive web-based platform to assess data and maps and analyse information would be required or desired for their operations. Stakeholders felt that interactive maps would benefit both internal and external audiences, with the consolidation of datasets and indicators affording a multi-sectoral picture while avoiding duplication of interventions.

A demonstration platform has been developed during this project that presents a basic level of the functionality possible for a visualisation platform of this type¹⁸ (Figure 1).

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- Geodata Institute, University of Southampton. AsiaPop Bangladesh [dataset]. September 2013. Available under Creative Commons Attribution 4.0 International Licence (<http://creativecommons.org/licenses/by/4.0/>). Available at: <http://www.worldpop.org.uk/data/summary/?contselect=Asia&countselect=Bangladesh&typeselect=Population>
 - National Institute of Population and Training, Mitra and Associates, Dhaka, Bangladesh and MEASURE DHS, ICF International. Bangladesh Demographic and Health Survey 2011 [dataset]. Available at: <http://dhsprogram.com/what-we-do/survey/survey-display-349.cfm>

¹⁸ See: <http://validmeasures.org/bangladesh/>

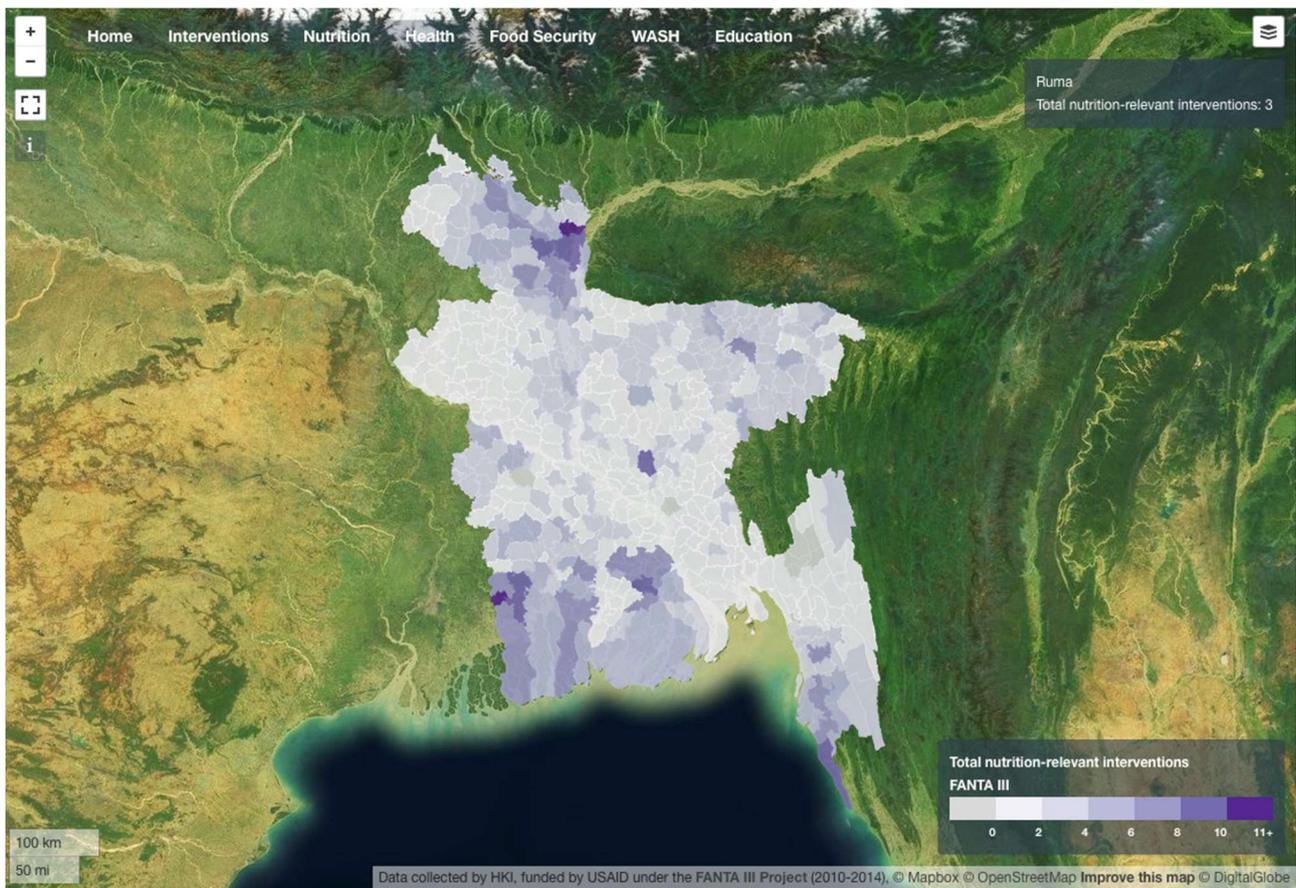


Figure 1. Screenshot of data visualisation platform

Data on interventions as well as indicators on nutrition, health, food security, WASH, and education have been mapped to the highest available resolution and may be layered for visual comparison. The data were visualised both as prevalence and as absolute “population burden,” with a combination of interpolated data (see above) and high-resolution population data¹⁹ derived from remote sensing data being used to provide information on absolute burden for some indicators (Figure 2). Additional layers with administrative boundaries/names, roads, and health centre/school locations were also added to improve map utility. A “tooltip” in the top right-hand corner gives the numerical figure for the chosen indicator when hovering over districts. Additional future features could include district “dashboards” giving a comprehensive view of the nutrition landscape for each individual district, as well as allowing for easier data entry and interactivity in updating maps.

¹⁹ Derived from the open source database Geodata Institute, University of Southampton. AsiaPop Bangladesh [dataset]. September 2013. Available under Creative Commons Attribution 4.0 International Licence (<http://creativecommons.org/licenses/by/4.0/>). Available at: <http://www.worldpop.org.uk/data/summary/?contselect=Asia&countselect=Bangladesh&typeselect=Population>

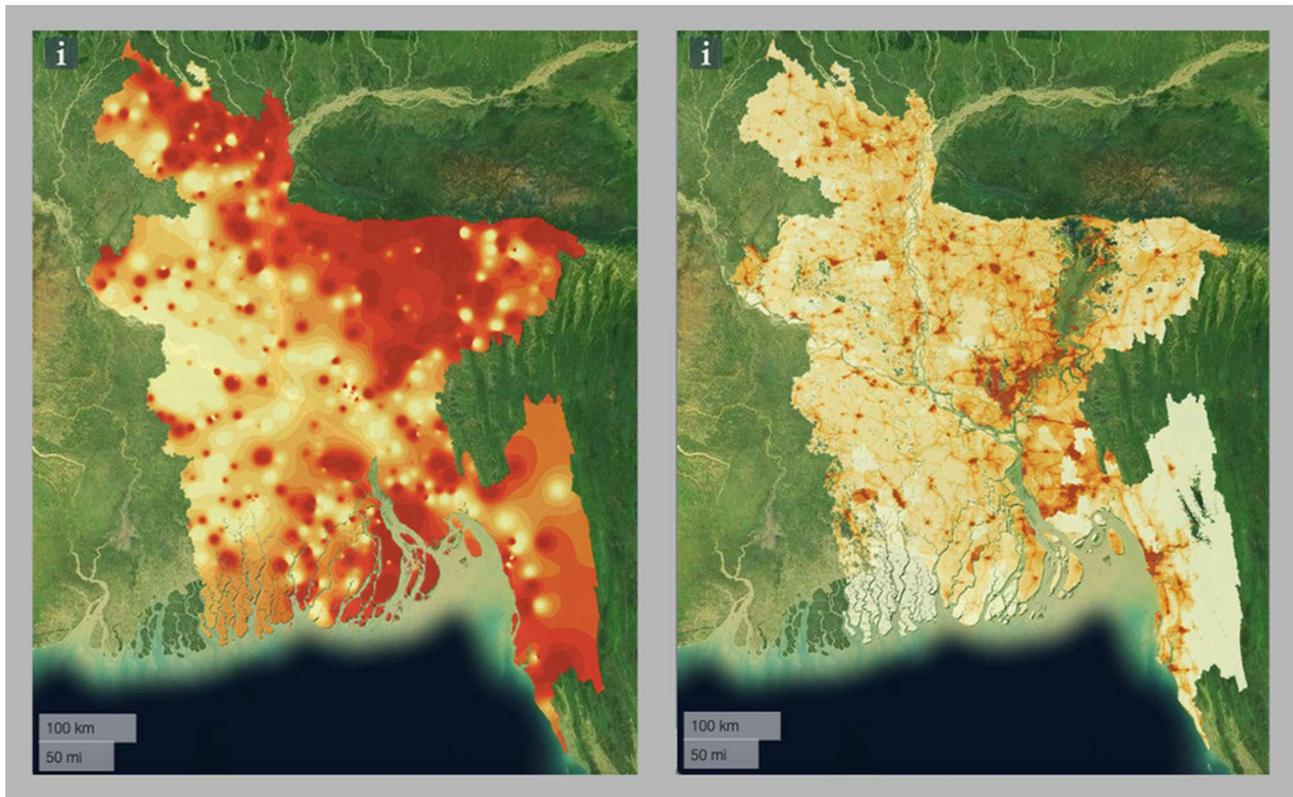


Figure 2. Interpolation of data on stunting prevalence (left), and those data combined with high-resolution population information for a visualisation of absolute stunting burden (right)²⁰

The aim is that these maps will support key stakeholders from the upazila to national levels to make informed decisions for nutrition programme design, management and resourcing. By offering a platform to visualise and interrogate data on malnutrition prevalence and absolute burden, causal factors, and nutrition interventions, stakeholders can guide decision-making, for example by better targeting efforts to minimize overlap and maximize effectiveness.

5 Conclusions and Recommendations

Bangladesh has made great progress over the last decade with strengthened commitments and actions for nutrition. But if nutrition goals are to be achieved, multiple sectors, stakeholders and line ministries will need access to better, more coordinated data to support evidence-based planning and progress tracking. There are several initiatives underway to support this, including **the National Information Platform for**

²⁰ Data used for these figures include:

- Geodata Institute, University of Southampton. AsiaPop Bangladesh [dataset]. September 2013. Available under Creative Commons Attribution 4.0 International Licence (<http://creativecommons.org/licenses/by/4.0/>). Available at: <http://www.worldpop.org.uk/data/summary/?contselect=Asia&countselect=Bangladesh&typeselect=Population>
- National Institute of Population and Training, Mitra and Associates, Dhaka, Bangladesh and MEASURE DHS, ICF International. Bangladesh Demographic and Health Survey 2011 [dataset]. Available at: <http://dhsprogram.com/what-we-do/survey/survey-display-349.cfm>

Nutrition (NIPN) project and the **‘Common Results Framework’ for nutrition**. The former is an EU/DfID/SUN project that is just getting underway²¹ and the latter is under development by multiple sectors (although led by IPHN/MoHFW), and intended to be the mechanism by which multiple sectors will monitor nutrition impacts against the new 7th five-year plan. There was general agreement and recognition by all stakeholders involved in this project that Bangladesh would benefit from a much more joined-up approach to compilation of nutrition-specific/sensitive data, as well as strengthened analysis, interpretation and presentation for use by decision-makers in planning and advocacy. Needs include establishing ownership and leadership for nutrition as well as strengthening analytical capacity within national institutions.

Our project highlighted many barriers to stakeholder understanding of the nutrition situation and its drivers at district level and lower and this presents challenges for planning and decision-making. As a result there was great enthusiasm for approaches that could improve use of data at programme and community level and that could better identify and prioritize causes of undernutrition.

“We have started monitoring the CIP (Country Investment Plan) with an emphasis on food security and nutrition, but data is not yet available at sub-national level, so CIP monitoring is not disaggregated and therefore not useful at District or sub-District level. Sub-national data/interpretation of data will help decision making about level and location of investments needed” [MoF, 2015]

There are no initiatives currently that map interventions linked to nutrition²² and present/compile nutrition-specific and -sensitive intervention coverage (as proportion of beneficiaries). There was agreement from the majority of stakeholders (including Government and International Agencies) that there is a real need for this to support joined-up thinking and planning for nutrition. There is also a need for better data cataloguing and improved analysis of nutrition at a sub-national level in order to support a more efficient mechanism of identifying knowledge gaps and prioritizing research needs.

5.1 Recommendations

1. There are several **data gaps identified above that need to be filled** to complete the current nutrition information picture in Bangladesh:
 - a. **Absence of data on specific core nutrition indicators such as coverage of MAM/SAM treatment.**
These could be filled through support for ongoing data collection mechanisms such as the new FSNSP (being developed by the James P Grant School of Public Health) or the next MICS due

²¹ The European Union (EU), together with the UK Department for International Development (DfID) and Scaling Up Nutrition Movement Secretariat (SMS) are exploring support to country governments in strengthening the use of available information to track the effectiveness of nutrition investments and inform their decision-making. The National Information Platform for Nutrition (NIPN) project aims to maximize the use of existing information through systematic organization and analysis of available data. It builds from on-going work in the health sector, applying National Evaluation Platforms. Any work that takes forward the outputs produced under this CIFF funded project would need to work closely with NIPN as it develops to ensure a coordinated and effective approach for data management and use in Bangladesh.

²² The Cluster 4W initiative covers only emergency interventions and the FANTA mapping project is already quite out of date

2015/16. Building on existing surveys would address current reservations from stakeholders about need for additional data collection at national level.

- b. **Resolution gaps for core indicators.** These should be filled in the first instance by working with the secondary data that is available to interpolate indicators down to sub-divisional level (district or upazila). This has already been done during this pilot phase for several indicators (see **Annex 2**). Where interpolation is not possible and finer resolution is considered important to complete the nutrition picture in Bangladesh, primary data collection will be necessary.

- Whilst the demand for the interpolated indicator maps with improved sub-divisional resolution was high, there was also a demand for their validation and expert review. This validation work should happen as soon as possible and will require ‘ground-truthing’ interpolated indicators with primary data collection. This validation could happen through partnerships with ongoing data collection platforms.

2. There was **great interest and high demand for the data visualization web platform**, and once data gaps are filled (see above), this will address one of the key weaknesses identified by stakeholders with this platform. **This platform should be operationalized and distributed as soon as possible**, as a prototype for use now with a note that clearly states it remains under development.

- a. Other weaknesses identified with the platform that need to be addressed include the need for a ‘user guide’ to simply articulate what the platform does with data (and does not do), the kind of questions and uses to which it can be applied and ideas for future developments. A contacts link on the platform should be used to prompt users to send any comments/questions back to Valid – these could feed into and support development of further development of this or other data platform projects.

3. In order **to be sustainable and used, a data visualization web platform at country level (and any updates to it) would need to be sited within the government**, would have to fit into the landscape of other monitoring frameworks and platforms under discussion and would need to be designed around the specific needs of both national and sub-national-level stakeholders. This is in line with findings from the recent EC/DFID mission on establishing the ‘National Information Platform for Nutrition (NIPN) project. There are several Government institutions that could be central to the success of a data platform initiative and where such a platform might be housed would need to be agreed by Government stakeholders:

- a. The GED plays a pivotal role in government-wide accountability. This includes its role in the development and monitoring of the 7th five-year plan that includes an enhanced number and quality of indicators for nutrition and stipulates cross-ministerial collaboration.
- b. The MoHFW, as lead for nutrition within GoB and as the SUN Focal Point (including the IPHN Director²³) will be critical in creating demand for the platform from national and international stakeholders in country.
- c. Securing reliable access to the data required (including permissions for its use) for the continuation of the web platform will require both the involvement of the GED and the Bangladesh Bureau of Statistics (BBS).

²³ The Institute of Public Health Nutrition (IPHN) is the nutrition technical support wing at the MoHFW

4. There is strong demand for a mechanism to **analyze causes of stunting at sub-national level**. Demand is particularly high from ministry-level planners and decision-makers who felt this could greatly support their targeting and efficient resource use for nutrition. However, it was clear during the dissemination meeting that stakeholders in country would a) want to see any novel causal analysis tool compared to more commonly understood methodologies, such as logistic regression and b) need to see indicator gaps in the analysis filled, before they were happy that the tool was reliable. Therefore, we recommend development of an **approach validated using primary data collection in parallel with filling indicator gaps for inclusion in the analysis** before this work is scaled up and disseminated further. Ground-truthing a causal analysis tool that used secondary data analysis could be done, for example, by a case-control study to corroborate results. Some validation may also be possible using secondary data, for example by comparing causal analysis results to logistic regression. However, since regression/factor analysis are predictive tools based on secondary data, a lack of coherence between results would not necessarily indicate superiority of one over the other. We recommend corroboration by means of primary data collection as the priority.

Annex 1: Interpolation Methodology

Spatial interpolation using inverse distance weighting

Spatial interpolation can be described as a process of smoothing data over space to create a surface map. There are various approaches and methods of spatial interpolation; the main differences are determined by the weights applied to the point dataset to estimate values at each of the unknown points of the surface map. For the interpolation of nutrition-related and nutrition-relevant indicators for Bangladesh, spatial interpolation was performed using the inverse distance weighting (IDW) method. As the name implies, IDW uses weights that are inversely proportional to the distance of a point being estimated from the sampling point locations:

$$\hat{v} = \frac{\sum_{i=1}^n \frac{1}{d_i^p} v_i}{\sum_{i=1}^n \frac{1}{d_i^p}} \quad (1)$$

where d_1, \dots, d_n are the distances from each of the n sampling point locations to the point being estimated, p is the power of the distance and v_1, \dots, v_n are the sample values (Isaaks & Srivastava 1989; Diggle & Ribeiro 2007; Diggle 2014).

The power of the distance p is an important aspect of the IDW method for point estimation. The influence of p to the weights applied to the point estimation is such that as p approaches 0, the weights become more similar, thereby giving more weight to the nearest sample values. As p approaches ∞ , the weights become more different from each other, thereby giving more weight to the closest sample. The power of the distance p has been traditionally set at 2 for convenience and ease of calculations. In theory, given a set p , IDW calculations can be performed using manual calculations aided by a spreadsheet and / or a calculator as it requires fewer calculations.

For the spatial interpolation performed, we chose to set p initially at 2 and then performed a cross-validation technique (see next section) to optimise p to a value that minimises the estimation errors at each of the sampling point locations.

Cross-validation to determine optimal distance power

Cross-validation is a technique applied to validate the predictive models. It assesses how accurately the predictive model performs in practice. IDW is one of the simplest model-based interpolation methods available, but ideally would still require a form of cross-validation to determine the optimal value of the distance power p (described in previous section).

We performed a two-fold cross validation (Bivand et al. 2013) in which we randomly split the data points into two sets of equal size, with one set assigned as the validation data for testing the model, and the other set as the training data. The validation data was then interpolated using the IDW method with an initial p of

2 and the resulting predictions were compared with the training data. Comparison was made using the sum of the squared residuals between the predicted values and the observed values to report errors.

Optimisation was then performed by replicating the two-fold cross validation process 100 times using randomly generated values for p . Out of these replicates, the value of p that provided prediction results with the minimum errors was selected as the distance power for the eventual interpolation performed²⁴.

Indicators used in interpolation

Interpolation was performed for:

- Stunting/severe stunting prevalence
- Mean height-for-age z-score
- Wasting/severe wasting prevalence
- Mean weight-for-height z-score
- Proportion of children given iron sprinkles, pills or syrup
- Proportion of children given vitamin A supplementation in the last six months
- Proportion of mothers given vitamin A within two months of giving birth
- Proportion of mothers receiving at least 4 ANC visits from any provider
- Proportion of children with diarrhoea treated with zinc
- Proportion of children with diarrhoea treated with ORS
- Diarrhoea, fever, and ARI period prevalence
- Proportion of children given anti-helminthic within the last six months

We performed preliminary scoping for DHS 2011 data on the Infant and Child Feeding Index (ICFI), Child Dietary Diversity Score (CDDS) and Minimum Acceptable Diet (MAD), to see if resolution could be improved to district level or better by bootstrapping or interpolation. Data on frequency of milk/dairy/formula feeding were insufficient to compile the MAD indicator. ICFI and CDDS indicators could be compiled but had insufficient sample size for bootstrapping or interpolation (mean sample size ranged from 1.7 to 8.3 children per sampling cluster for dietary diversity).

In future work, there is the potential for further interpolation or bootstrapping of household or women's indicators, which have larger sample size than child indicators. Options for child indicators could include combining survey data from different DHS surveys with other geolocated data from national surveys (e.g. FSNP and MICS) and adjusting for year/season.

²⁴ This cross-validation algorithm with value optimization was developed and designed by Mark Myatt and Ernest Guevarra specifically for IDW interpolation optimization.

Annex 2: Spatial Resolution of Core Indicators for Bangladesh and their Visualisation

The following table outlines the indicators identified during the project, their resolution and which have been added to the current version of the data platform²⁵. Note that in initial discussions potential indicators were identified but data was not available to include in the analysis.

Sector	Indicator	Source	Upazila/ Interpolated	District	Division	National	Visualised
Health	Infant mortality rate (IMR)	NIPORT, UNICEF, MICS 2012					
Health	Under 5 mortality rate	NIPORT, UNICEF					
Health	Neonatal mortality rate	NIPORT					
Nutrition	Prevalence of stunting/severe stunting	DHS (Valid's interpolation), WFP (upazila), MICS 2012, FSNSP					<input type="checkbox"/>
Nutrition	Prevalence of underweight	WFP (upazila), MICS 2012, FSNSP					
Nutrition	Prevalence of wasting/severe wasting	DHS (Valid's interpolation), MICS 2012, FSNSP					<input type="checkbox"/>
Nutrition	Mean weight-for-height z-score	DHS (Valid's interpolation)					<input type="checkbox"/>
Nutrition	Mean height-for-age z-score	DHS (Valid's interpolation)					<input type="checkbox"/>
Nutrition	Prevalence of exclusive breastfeeding	MICS 2012 (incomplete data), BIHS (rural only), DHS, FSNSP					<input type="checkbox"/>
Nutrition	Proportion of children < 24 months who were initiated to breastfeeding within 1 hour of birth	MICS 2012, FSNSP					<input type="checkbox"/>
Nutrition	Proportion of children < 24 months who receive age-appropriate breastfeeding	MICS 2012, UNICEF, FSNSP					<input type="checkbox"/>
Nutrition	Prevalence of anemia among children aged 6-59 months	DHS 2011, UNICEF micronutrient survey					<input type="checkbox"/>
Nutrition	Proportion of children aged 6-23 months who receive the minimum number of meals	FSNSP					
Nutrition	Prevalence of children aged 6-23 months receiving a minimum acceptable diet (MAD)	FSNSP					

²⁵ See: <http://validmeasures.org/bangladesh/>

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Nutrition	Prevalence of children aged 6-23 months receiving a minimum dietary diversity	FSNSP						
Nutrition	Proportion of children aged 6-23 months who consume iron-rich foods	FSNSP						
Nutrition	Proportion of children given iron supplementation	DHS (Valid's interpolation)						

Sector	Indicator	Source	Upazila/ Interpolated	District	Division	National	Visualised
Nutrition	Proportion of children aged 6-23 months who consume vitamin A-rich foods	FSNSP					
Nutrition	Proportion of children aged 6-59 months receiving vitamin A supplementation	DHS (Valid's interpolation), MICS 2006, UESD, DHS, FSNSP					
Nutrition	Proportion of children 6-59 months old de-wormed	DHS (Valid's interpolation), FSNSP					
Nutrition	Coverage of SAM treatment						
Nutrition	Coverage of MAM treatment/complementary feeding interventions						
Nutrition	Prevalence of low-birthweight	MICS 2012, FSNSP					
Health	Full immunization coverage	MICS 2006					
Health	Prevalence of childhood illness - diarrhoea	DHS (Valid's interpolation), MICS 2012, FSNSP					
Health	Prevalence of childhood illness - ARI	DHS (Valid's interpolation), MICS 2006, FSNSP					
Health	Prevalence of childhood illness - fever	DHS (Valid's interpolation), FSNSP					
Health	Diarrhoea treatment (ORS/Zinc)	DHS 2011 (Valid's interpolation - zinc and ORS separately), MICS 2006, FSNSP - zinc and ORS separately, MICS 2012 full					
Health	Care seeking for diarrhoea, fever, and/or ARI	MICS 2006 (pneumonia), FSNSP (diarrhoea, fever, ARI)					
Health	Maternal mortality ratio	NIPORT BMMS 2010					
Health	Prevalence of anemia among women of reproductive age (15-49 years)	DHS (2011 & 2014), UNICEF Micronutrient survey					
Nutrition	Prevalence of thinness (BMI<18.5) among women of reproductive age (15-49 years)	FSNSP					

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Nutrition	Proportion of women who received a dose of vitamin A during the first two months after the birth of their most recent child	DHS 2011 (Valid's interpolation), MICS 2006, BIHS, FSNSP						<input type="checkbox"/>
Health	Coverage of antenatal care (at least one visit by skilled health professional)	NIPORT, MICS 2012, FSNSP						
Health	Coverage of antenatal care (at least 4 visits by any provider)	DHS 2011 (Valid's interpolation), NIPORT, MICS2012, FSNSP						<input type="checkbox"/>

Sector	Indicator	Source	Upazila/ Interpolated	District	Division	National	Visualised
Nutrition	Coverage of Fe/Folate supplementation during pregnancy	FSNSP					<input type="checkbox"/>
Health	Skilled attendant at delivery	NIPORT, MICS 2012					
Food security	Proportion of mothers/ households that are food secure, mildly food insecure, moderately food insecure or severely food insecure	FSNSP (HFIAS)					<input type="checkbox"/>
Nutrition	Proportion of households using iodised salt	MICS 2012					<input type="checkbox"/>
WASH	Proportion of households with improved drinking-water sources	MICS 2012, FSNSP					<input type="checkbox"/>
WASH	Proportion of households with improved sanitation facilities	Child Equity Atlas (upazila), MICS 2012, NIPORT, FSNSP					<input type="checkbox"/>
WASH	Proportion of households with designated place for handwashing	MICS 2012					
WASH	Households with soap available	MICS 2012, FSNSP					<input type="checkbox"/>
Protection	Child marriage	MICS 2012					<input type="checkbox"/>
Food security	Proportion of households with food deficit/severe food deficit	FSNSP					<input type="checkbox"/>
Nutrition	Mean dietary diversity score - children	FSNSP					<input type="checkbox"/>
Nutrition	Minimum dietary diversity - women and adolescent girls	FSNSP					<input type="checkbox"/>
Nutrition	Mean dietary diversity score - women and adolescent girls	FSNSP					<input type="checkbox"/>
WASH	Safe disposal of child's faeces	MICS 2012, FSNSP					<input type="checkbox"/>
Education	Level of school completion (girls/women)	NIPORT, MICS 2012, UNICEF					<input type="checkbox"/>
Interventions	Presence of nutrition-specific and nutrition-sensitive interventions	FANTA III					<input type="checkbox"/>
FSS/AG	Land use (under crop, non-crop, forest etc.)	BBS via VDSA					
FSS/AG	Food production (cereal & non-cereal, fisheries, livestock)	BBS via VDSA					

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FSS/AG	Food availability (cereal & non-cereal, fisheries, livestock)						
FSS/AG	Food intake (cereal & non-cereal, fisheries, livestock)						
FSS/AG	Cropping intensity						
FSS/AG	Irrigation	BBS via VDSA					
Base	Rainfall	NM has sat data					
Base	Poverty incidence	Poverty WFP HCR					
Base	Poverty inequality (income)						

Sector	Indicator	Source	Upazila/ Interpolated	District	Division	National	Visualised
FSS/AG	Food expenditure	HIES 2010					
FSS/AG	Food price	In HIES and FSNSP, resolution unclear					
FSS/AG	Income/Expenditure share (cereal, non-cereal; food, non-food, education, housing, recreation etc.)	HIES 2010					
Education	Literacy (gender)	Child equity atlas (upazila), also UNICEF, MICS (district)					
Education	Secondary school net attendance ratio	MICS 2012					☐
Base	Land ownership	UESD 2013, MICS 2006, HIES					
Base	Sources of income	HIES 2010					
Base	Disaster (flood, drought, cyclone)	Shocks and risks (GIS data)					
Base	Seasonality						
Base	Coping capability						
Base	Access to electricity	Child Equity Atlas (upazila), MICS 2012, ACAPS JNA, BBS via VDSA					
Base	Access to paved road	GIS analysis from NM					☐
Base	Number of persons per grid cell	WorldPop					☐
Nutrition	Number of stunted children per grid cell	WorldPop/DHS					☐
Nutrition	Number of wasted children per grid cell	WorldPop/DHS					☐