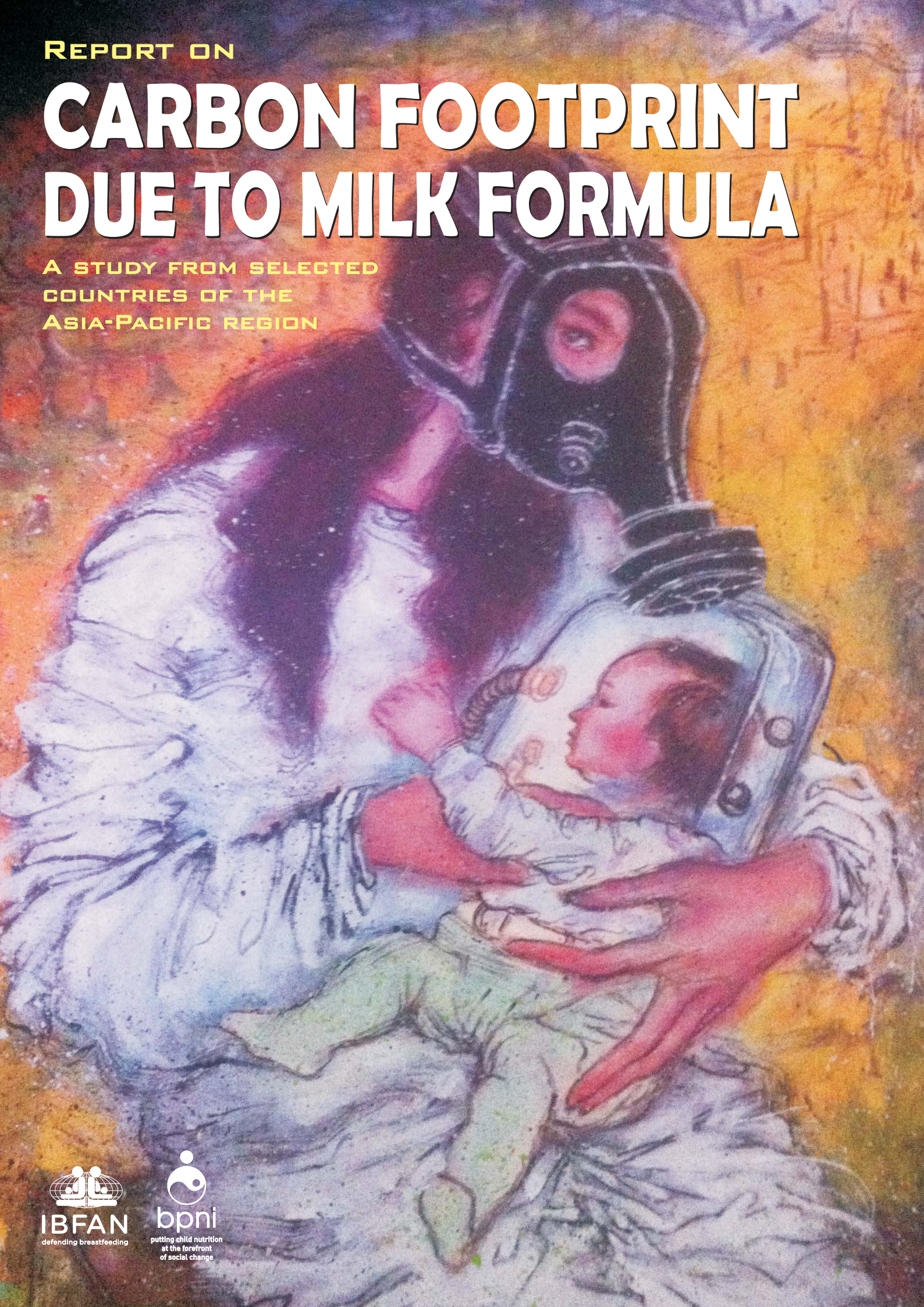
Report on

CARBON FOOTPRINT DUE TO MILK FORMULA

A study from selected countries of the Asia-Pacific region



IBFAN
defending breastfeeding

bpni
putting child nutrition at the forefront of social change

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CARBON FOOTPRINT DUE TO MILK FORMULA

A study from selected countries of the Asia-Pacific region

Report on Carbon Footprints Due to Milk Formula: A study from selected countries of the Asia-Pacific region

Written by: Dr JP Dadhich, Dr Julie Smith, Alessandro Iellamo, Dr Adlina Suleiman

Reviewed by: Libby Salmon

Edited by: Dr. Arun Gupta

Design by: Amit Dahiya (BPNI)

Front cover Photo Credit: Painting by Jonahmar A. Salovosa from Philippines. The master art piece was one of the winners for the UK based Freedom to Create World in 2008

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FOREWORD

In December 2015, governments meeting in Paris finally agreed on doing something about climate change. Negotiations were at a high level, and the links between human health, climate change and the environment hardly rated a mention amidst the detailed accounting for lost profit and reduced emissions. And no one mentioned the world's mothers and babies, or the environmental consequences of how most of the infants and children are now fed. Around two thirds of humans are inappropriately fed processed food in early life. Much of this baby food is manufactured in countries which are hundreds, even thousands of miles away from where it is sold. Much comes from milking another species - a cow - grazed on pastures created from clearing forested land.

If all the immense resource costs of formula feeding were properly accounted for, the baby food industry would be closed down, and mothers paid to breastfeed. Economists call such unattributed resource costs 'externalities'. Industry can ignore such costs, as they are instead passed on to society, or inflicted on the environment. By distorting incentives, externalities result in markets failing to give producers and consumers the right signals to conserve our common resources. In the case of mothers and babies, this means poor feeding practices resulting in higher health care costs for society, as well as for families. Likewise, when environmental consequences of the dairy industry are not fully accounted for in business decisions, costs are imposed on communities - increasingly on humanity as a whole - by greenhouse gas emissions, land degradation, and loss of biodiversity. Methane gas emanating from dairy herds is one of the most potent forms of greenhouse gas, and is a key element of the global greenhouse gas problem. Methane gas results in more damaging effects than other emissions. The greenhouse gas emissions for every kilogram of raw milk are comparable to driving a car 10-20 km, even without accounting for the energy costs of manufacturing the milk powder. Clearing the land for dairy farming creates its own damage to environmental diversity as well as in removing the Earth's innate 'carbon sinks', its forests.

Along with escalating demand for meat and dairy products by more affluent populations particularly in Asia, the booming demand for formula milk forces us to ask some hard questions about sharing the costs of climate change, across countries, within countries, and between the current and future generations. Decisions on climate change are difficult because the solutions may imply lower standards of living and health, in practice often inflicted on the poorest and weakest.

The answers to the problem of climate change are not simple, but at least in 2015 our leaders are now asking some of the right questions. It is no longer, who profits versus who loses from the status quo?, but rather, can humanity afford to continue with the status quo?

However, in the case of infant and young child feeding, those asking the right questions are yet to be heard by the global community. To question the scale and activities of the highly profitable baby food industry is still economic heresy, especially in major food exporting countries such as Australia or New Zealand. Meanwhile the highly sustainable and efficient food system provided by lactating women for children is ignored, devalued and dishonoured by national and global leaders. Ironically, even as climate change contributes to extreme weather events, and greenhouse gas from the milk formula

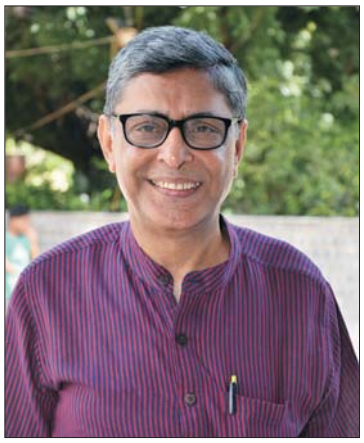
industry contributes to climate change, mothers and their young children face heightened risks of insecurity and starvation due to changing weather patterns and related floods, droughts, fires, storms and other crises. The most vulnerable to the food insecurity, ill health and disease arising from climate change are those also exposed to formula and bottle feeding.

This study will initiate an important conversation. It provides data on how the present formula feeding epidemic 'costs the earth'. Not just the babies. Or the children. Or even the mothers. But what, instead, it costs humanity in the form of greenhouse gas emissions, and dangerous climate change. The study also reveals the deep paralysis of governments who should be taking effective action to protect, promote and support breastfeeding as part of optimal infant and young child feeding.

This is a path breaking report. Concerns since the 1990s about the environmental impacts of the formula milk industry has now been translated into detailed data and analysis using contemporary scientific method. There are difficult decisions ahead, but by truly supporting women to breastfeed, improving IYCF policy is a rare opportunity for nations to meaningfully address the greenhouse gas problem, whilst also benefitting, rather than worsening, human health and social equity. It is time to start talking seriously about how reducing the unnecessary promotion, use and societal costs of formula milk feeding can help tackle the greatest challenge humanity has ever faced, sustaining Mother Earth.

Dr. Julie Smith
Associate Professor and Economist
The Australian National University

PREFACE



This is an ever growing concern that consumption of ultra-processed foods and climate change /environment are majorly linked to causation of several health problems in women and children who are most vulnerable, as well as contribute to non- communicable diseases overload of the world. At the same time latest series of the Lancet in 2016 revealed how breastfeeding if scaled up to universal levels can truly contribute to protection of environment by zero waste, whereas formula feeding which is rapidly growing with the economies leaves behind a huge carbon footprint.

This work was interesting to International Baby Food Action Network (IBFAN) who has championed the cause of protecting women and children from aggressive marketing of baby food companies for more than three decades, when it came across more than 3 years back. We deliberated on the subject in IBFAN's annual One Asia Breastfeeding Partners' Forum in 2011 in Mongolia and 2013 in Lao PDR as well as in the World Breastfeeding Conference in India in 2012. We developed a technical document titled 'Formula for Disaster' in 2014 giving important information about this subject. While working, we realized that there is a lack of concrete data on the contribution of milk formula to Green House Gases emissions. We began research on this issuesin 6 select countries of Asia-Pacific region and the report from these countries is now in your hands. Two of these countries were high income group, 2 were in the upper middle income group and 2 two belonged to lower middle income group according the World Bank criteria.

You would see how China shows rapidly gaining market share of the baby foods as well as the GHG as compared to India and other countries. That's what is critical to look at. Within a period of 4 years China all milk formula grew from 29400 to 56000 tonnes, while India grew from 24480 to 27783 tonnes. In India of total sale of milk formula leads to 111,226 Tonnes of Green House Gases (GHG) while in China corresponding figure is224,9287 tonnes.

Breastfeeding contributes to environmental sustainability, as breastmilk is a renewable food produced and delivered without pollution, unnecessary packaging or waste. In comparison milk formula needs energy to manufacture material for packaging, fuel for transport and resources for daily preparation and use. Breastfeeding, therefore, is the corner stone to the efforts to achieve SDG 13 on the climate change.

BPNI/International Baby Food Action Network (IBFAN) Asia, having worked in 6 countries India, China, Philippines, Malaysia, Australia, and South Korea on this issue would like to take this challenge further with dissemination of the findings and stimulate discussions at country level. It would also be crucial to publish a technical and popular version of this report.

More countries should come forward to take on this work and make policy makers aware of such risk prevention by reducing consumption of formula feeds.

Needless to say, each country, whether developing or developed would be benefitted who invests in scaling up breastfeeding interventions, not just environmentally but economically as well.

Dr. Arun Gupta
Regional Coordinator, IBFAN Asia
Central Coordinator, BPNI

1 INTRODUCTION

Climate change due to rising concentrations of greenhouse gases in the environment affects human health in many ways, including through effects on food production and prices, and changed patterns of disease including increased infectious illness.[1]

Climate change acts as a threat multiplier that interacts both directly and indirectly with variables, such as disease, food production, food security, food safety and poverty.[2] Climate change further exacerbates the enormous existing burden of undernutrition as it affects food and nutrition security and undermines current efforts to reduce hunger and promote nutrition.[3]

Along with the elderly, women and children are highly vulnerable to the health effects of changing weather and disease patterns, and extreme events associated with climate change.[4] An increase in diarrheal[5] and respiratory diseases[6] especially in developing countries, is one consequence that will require greater health investments, particularly in developing countries, while greater food insecurity also demands additional resources to protect nutrition and health.

Optimal breastfeeding not only provides optimal nutrition, it is an effective public health intervention to enhance child survival, nutrition and development.[7,8] Optimal breastfeeding protects children against infectious illnesses through a number of pathways. Formula fed children have much higher risks of infectious illness including gastroenteritis and respiratory infections, including in developed countries where hospitalisation rates are several times higher among children who are not optimally breastfed compared to exclusively breastfed infants.[9] A recent systematic review and meta-analysis has found that risk of all-cause mortality in low and middle income settings was higher in predominantly (RR 1.5), partially (RR 4.8) and non-breastfed (RR 14.4) infants compared to exclusively breastfed infants 0-5 months of age. Children 6-11 and 12-23 months of age who were not breastfed had 1.8- and 2.0-fold higher risk of mortality, respectively, when compared to those who were breastfed.[10] At a time when health systems and health resources are also being drained by the treatment costs of an epidemic of diet related chronic diseases, breastfeeding also provides protection against non-communicable diseases, particularly obesity, diabetes and high systolic blood pressure.[11] Recently published research showed that increased IQ, educational attainment and monthly income in later life were associated with longer breastfeeding duration in infancy and early childhood.[12]

As the world is facing a challenge to deal with the double burden of malnutrition, a study from Brazil found that exclusive breastfeeding for at least six months was protective against overweight in children in the second year of life.[13]

In line with above mentioned facts, this report shows that measures to increase women's opportunities to engage in optimal infant and young child feeding (IYCF), which includes exclusive breastfeeding for six months, and continued breastfeeding to two years and beyond, is an effective and cost efficient response to the urgent global problem of climate change, that also meets wider social and gender equity and economic goals. Breastfeeding, unlike formula feeding, is an environmentally sustainable method of infant feeding. Industrially manufactured milk formula further adds to the climate change burden.[14]

The nutritional role, if any of follow-up or toddler formulas remain debated by regulatory bodies, notwithstanding recent WHO statements regarding the lack of necessity and potential harms. The statement clarifies that as well as being unnecessary, follow-up formula is unsuitable when used as a breastmilk replacement from six months of age onwards. Current formulations increase the risk of higher protein intake and lower intake of essential fatty acids, iron, zinc and B vitamins than those

recommended by WHO for adequate growth and development of infants and young children.[15]

In spite of the great advantages of breastfeeding, use of milk formula is increasing rapidly, particularly in the Asia-Pacific countries, driven by the weak response of governments to regulate aggressive marketing of commercial baby foods, and the failure of labour market policy and workplaces to address the human rights of women.[16,17] Women need conducive environments to practice optimal breastfeeding, which may be provided by implementation of the Global Strategy for Infant and Young Child Feeding (GSIYCF)[18], including protection, promotion and support for breastfeeding. The implementation of the GSIYCF has been assessed in 74 countries in Asia, Africa, Latin America, Arab World, Europe and Oceania using the WBT*i* assessment tool[19], revealing a need for strengthening of policies and programmes on IYCF. Any attempt to reduce use of milk formula and subsequent GHG emissions will only be successful if breastfeeding rates are increased through effective implementation of the GSIYCF in its entirety.

Given the enormous resource demands on governments and communities to mitigate and ameliorate the effects of climate change on human health, it is curious that so little attention is being given to infant and young child feeding, in particular to reversing the current trends of increased formula feeding[20] and reduced optimal breastfeeding[21] both of which add to the existing climate change burden. These trends arise from social, economic and health system factors including increasing maternal employment, aggressive marketing of milk formula for infants and young children in increasingly affluent and time pressed populations, and lack of skilled and effective support for breastfeeding within many health services.

Marketing studies like those carried out by Euromonitor define milk formulas to include standard milk formula, follow-on milk formula, toddler milk formula and special baby milk formula.[22] Milk formula are a combination of many industrially manufactured ingredients like milk powder, vegetable oil, high fructose corn syrup, sucrose and micronutrients etc.

Standard milk formula is a product based on milk of cows or other animals and/or other ingredients, which have been generally agreed to be suitable for infant feeding, though its inadequacies as an alternative to breastfeeding are well established[23,24]. Also, powdered infant formula is not a sterile product even if it has been manufactured to meet current hygiene standards, *Cronobacter sakazakii* and *Salmonella enterica* being the pathogens of most concern.[25]

Worldwide, industries are now being requested to quantify and reduce their carbon footprints, or emissions of greenhouse gases (GHGs) like Methane (CH_4), Nitrous oxide (N_2O) and Carbon dioxide (CO_2) to the atmosphere. Methane and nitrous oxide are 25 and 298 times more potent as greenhouse gases than carbon dioxide.[26] The relatively high levels of GHG emissions due to the dairy industry are recognised. Studies have documented that dairy products are associated with relatively large greenhouse gas emissions per kg of products.[27,28,29,30]

Calculating the carbon footprint of milk formula is a challenging but achievable task. Despite the rapid growth of the milk formula industry, especially in developing countries, which are most vulnerable to climate change, few studies have examined the GHG emissions from milk formula.

This report aims to calculate how much GHG emissions arise from milk formula sold in selected countries of the Asia-Pacific region based on the available sales data. The report does not include emissions arising from distribution to point of sale or consumption, from packaging and waste disposal and use at the family level including hygienic preparation, boiling water and washing of bottles and teats etc. The globalized trade in formula makes it difficult to calculate the amount of formula manufactured in a country from sales data for that country. In this paper GHG emissions are calculated for the formula sold in a country, and indicate the global GHG consequences of IYCF policies in each study country.

2 METHODS

To illustrate the GHG emission attributable to milk formula, the following methodology was used.

2.1 Selection of countries

Six countries of South Asia and East Asia & Pacific region, categorized by income, as per classification by the World Bank were selected for this study. The six countries were selected to illustrate GHG emissions for lower-middle, upper-middle and high-income countries, as well as large and small populations[31] (Table 1).

Table 1: Study Countries[31]

Income Category	Name of the Country
High Income	Australia; South Korea
Upper Middle Income	China; Malaysia
Lower Middle Income	India; Philippines

2.2 Review of literature

2.1.1 Retrieving industry data on milk formula sale: Published industry data from Euromonitor international for milk formula sales in the study countries was used to calculate volumes of milk formula sold in each country.[22,32,33,34,35,36] This data includes type of formula used in 2012, as well as anticipated growth of milk formula usage in 2017.

2.2.2 Retrieving the composition of milk formula: The composition of milk formula was identified, using guidance from CODEX Alimentarius guidelines on composition of infant formula, follow-up formula and formula for special medical use. Codex standards for follow-up formula include formula for use in young children up to 3 years of age, therefore, composition of toddler formula was retrieved using standards for follow-up formula. Milk formula is a processed food comprising of ingredients like milk powder (mainly cow's milk) as a source of proteins; vegetable oil as a source of fats; high fructose corn syrup or corn syrup or cane sugar or lactose as a source of carbohydrates and some micronutrients. The manufacturing process was identified from the published literature.

2.3 Calculating contribution of each ingredient in the composition of milk formulas

With the available information from the Codex guidelines, the contribution of each major ingredient in the composition of the milk formula i.e. carbohydrates, proteins, and lipids in percentage terms were calculated.

2.4 Identifying GHG emissions due to the individual ingredients of the milk formula

The GHG emissions due to individual ingredients of the milk formula i.e. high fructose corn syrup, cane sugar, lactose, milk powder, whey protein concentrate and vegetable oil etc. were identified from the available literature.

2.5 Calculation of average GHG emissions due to various categories of milk formula

GHG emissions were calculated for different possible combinations of major ingredients i.e. carbohydrates (high fructose corn syrup, cane sugar, lactose, milk powder), proteins (milk powder, whey protein concentrate) and lipids (various vegetable oils). Based on this calculation, an average GHG emission was calculated for the standard milk formula (and the special baby milk formula) and follow-on milk formula (and the toddler milk formula).

2.6 Computation of GHG emission associated with milk formula sales for each individual country

Multiplying the GHG emissions per kg by volume of sales provided the estimated GHG emission

associated with milk formula sales for each individual country. This data includes various estimates for type of formula used in the year 2012 as well as industry forecasts of growth of milk formula usage from 2012 to 2017. GHG emissions were estimated using Microsoft Excel for total as well as sub-categories of milk formula, namely, standard milk formula (0-6 months), follow-on milk formula (7-12 months); toddler milk formula (13-24 months) and special baby milk formula (0-6 months). Estimates of GHG emissions based on the forecast trends in sales of milk formula in each country between 2012 and 2017 were also calculated. For simplicity, manufacturer and retailer stocks were ignored.

2.7 Comparing GHG emissions due to milk formula in study countries with other contributors of GHG emissions

Estimated results for the GHG emissions due to milk formula sale have been compared with GHG emissions due to other significant contributors, using Greenhouse Gas Equivalencies Calculator developed by US Environmental Protection Agency (USEPA)[37].

2.8 Case reports on the status of IYCF policies and programmes in the study countries

Case studies are also provided from selected countries to assess the existing status of implementation of the Global Strategy for Infant and Young Child Feeding (GSIYCF), based on the World Breastfeeding Trends Initiative (WBT*i*) assessment tool. The WBT*i* assessment reports have been produced by IBFAN for 74 countries around the world and provide an assessment of the policy context for optimal infant and young child feeding particularly breastfeeding.[38] This assessment tool includes indicators of the status of policy implementation such as the International Code of Marketing of Breastmilk Substitutes, maternity protection, and hospital practices.

3 RESULTS

This chapter provides information about the composition of milk formula, manufacturing process for milk formula, identifying GHG emissions due to various ingredients of milk formula through a review of literature and estimation of GHG emissions due to various categories of milk formula in six study countries.

3.1 Composition of the milk formula

Codex Alimentarius Commission (CAC) provides standards for various foods including standards for infant formula and follow-up formula which guide the composition of nutrients in these milk formulas, as well as inclusion of additives.[39] Major nutrients identified by CAC as components in infant formula and follow-up formula are carbohydrates, proteins and lipids. Various sources for the major ingredients[40] are:

- carbohydrates (derived from lactose, high fructose corn syrup, cane sugar etc);
- proteins (derived from milk powder, whey protein concentrate etc), and
- lipids (derived mainly from vegetable oils)

3.2 Manufacturing processes for milk formula[41]

The manufacturing process for milk formula involves various methods to combine the ingredients to prescribed standards. The literature search identified manufacturing methods and per kilogram levels of GHG emissions for each of these ingredient as described below.

There are several sub categories of milk formula with somewhat different composition but similar manufacturing processes. Standard Infant formula (standard milk formula) is primarily used as a substitute for breastmilk in infants aged 0-6 months. Other products include "follow-up" formula, promoted as a dietary supplement for older infants. There are also special formulations targeting specific nutritional needs or health issues for formula fed infants, such as soya based milks for lactose intolerant infants.

Box 1: Definitions of various milk formula - Codex Alimentarius Commission (CAC)[42,43]

Infant formula

A breastmilk substitute specially manufactured to satisfy, by itself, the nutritional requirements of infants during the first months of life up to the introduction of appropriate.

Formula for special medical purposes

Formula intended for infants in liquid or powdered form intended for use, where necessary, as a substitute for human milk or infant formula in meeting the special nutritional requirements arising from the disorder, disease or medical condition for whose dietary management the product has been formulated."

Follow-up formula

A food intended for use as a liquid part of the weaning diet for the infant from the 6th month on and for young children.In the standards for follow-up formula Codex STAN 156-1987, Codex defines young children as "persons from the age of more than 12 months up to the age of three years (36 months)". Manufacturers promote these products for age group 1-3 years[44].

Milk formula is supplied either as a spray dried powder which is reconstituted as required, or in liquid form, typically packed in cans or "ready to use" sterile feeding bottles.

Powdered milk formula for infants and young children is manufactured at different plants in various countries but the processes are very similar worldwide.[45]

Powdered infant formula is manufactured using one of two following processes[46]:

1. **Dry blending:** In this process, dehydrated ingredients in the powder form are mixed in the blending equipment to get a uniform blend of required nutrients. The blended product thus achieved is passed through a sifter to get rid of oversized particles and

stored. From here, the powdered product goes to the packaging line to fill up the cans. Filled up cans are flushed with inert gas, sealed, labeled and packed in the cartons.

2. **Wet mixing- Spray-drying:** In this process, ingredients are blended together, homogenized, pasteurized and then spray dried to produce a powdered product. Heat sensitive micro nutrients (e.g., vitamins, amino acids and fatty acids) are added to the product after pasteurization. The rest of the process of sifting, storing and packaging remains the same as in the dry blending process.
3. Sometimes, a combination of these processes is used in which a base powder (consisting mainly of protein and fat components) is first produced using the wet mixing and spray drying process and then the base powder is dry blended with the carbohydrate, mineral and vitamin ingredients.

3.3 Evaluating GHG generated by milk formula products

Milk proteins like casein and whey protein, sugar, vegetable oils, emulsifiers, mineral salts and micronutrients make up the basic ingredients in the milk formula.[47]

Life cycle assessment (LCA)[48, 49] approach is commonly used for evaluating the environmental effects of a particular activity, service or product. This approach takes into account the environmental impacts during the entire life of a product 'from cradle to gate/grave', i.e. it includes all life cycle stages (and related activities) such as extraction of raw materials, production, and transportation, usage and waste management. The International Organization for Standardization (ISO 14040 and 14044 (ISO 2006a, b) has standardized the LCA approach into four steps:[50]

1. Defining goal and scope, the functional unit (FU), the system boundaries and the allocation criteria.
2. Life cycle inventory, which is concerned with data collection.
3. Life cycle impact assessment, which evaluates the magnitude and significance of the potential environmental impacts of a production system.
4. Interpretation of the study with the analysis of results and drawing conclusions.

The system boundary largely depends on the goal of the study. In this study the system boundary is from farm to end of manufacturing process. More data are needed to extend the analysis from cow to baby's mouth, as GHG costs of travel by consumers to shops, refrigeration, heating of ready to feed, boiling of water for powdered milk to make it safe etc

The reference unit that denotes the useful output of the production system is known as the functional unit, and it has a defined quantity and quality. The functional unit can be based on a defined quantity, such as 1 kg of product. Alternatively it may be based on an attribute of a product or process, such as 1 kg of fat and protein corrected milk (FPCM).[28]

In this study, the functional unit used is 1 kg of product.

3.4 Identifying GHG emissions due to ingredients of milk formula for infants and young children

Estimating GHG emissions due to milk formula is a challenge as the product is a combination of many industrially manufactured products. There is a need to consider GHG emission due to each of the major ingredients. Calculating the GHG associated with each of the individual ingredients is the focus of this section, which first examines GHG emissions due to the manufacturing process for powdered milk, then looks at other ingredients such as oil and sugar.

3.4.1 GHG emissions due to milk powder manufacturing

Dairy milk powder is a major component of milk formula. GHG emission from dairy agricultural production include methane (CH_4), nitrous oxide (N_2O) and carbon dioxide (CO_2).[51]

Greenhouse gas emissions attributable to milk powder are significantly higher than for other dairy products because of the additional processing and energy used during manufacture. As described earlier, to generate milk powder from the liquid milk, pasteurized milk is

concentrated using an evaporator, and then spray-dried. The two processes concentration and drying - are both energy-intensive. The schema for the production of the milk powder from the raw milk is depicted below in figure 1.[52]

Figure 2 depicts a typical life cycle of dairy products: fresh dairy products like consumer milk, yogurt; butter; cheese; whey products like whey protein, lactose products; and milk powder.[53]

Figure 1: Schema for the production of milk powder

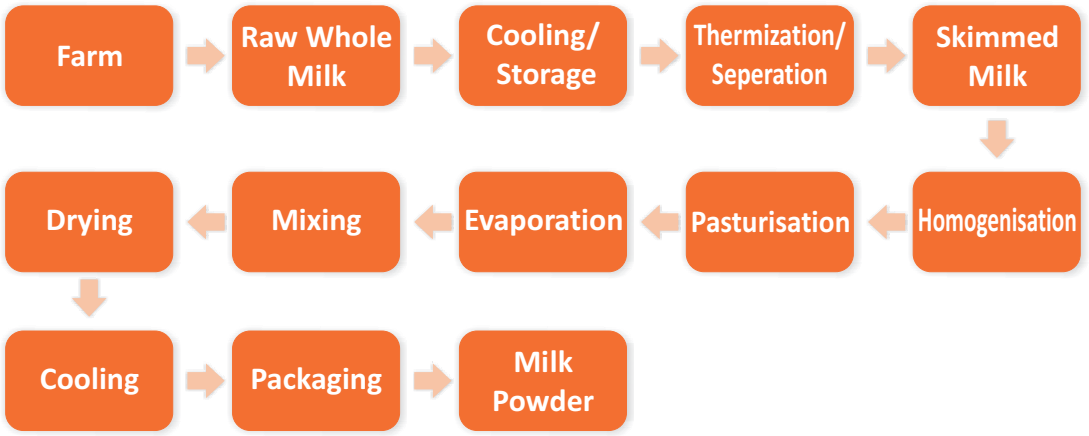
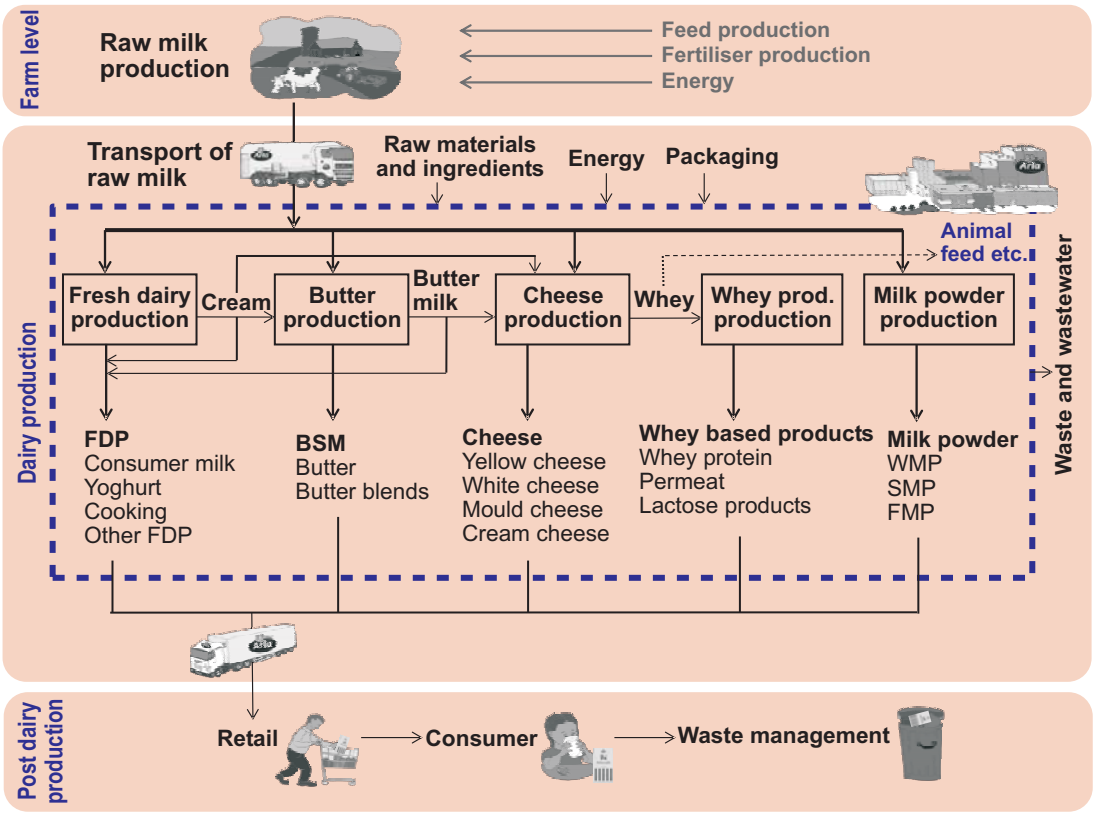


Figure 2: The life cycle of dairy products



According to the UN Food and Agriculture Organization (FAO), average global emissions from milk production in the dairy farms, transport of the milk off-farm, and processing are 2.4 CO_2-eq per kg of fat and protein corrected milk (FPCM - with 4.0 % fat and 3.3 % protein) at farm gate. According to global average, from 100 kg raw milk, 20kg (20%) is used for milk powder production, which results in production of 2.2kg of milk powder. This means, for each 1 kg of powdered milk production and processing, 9.09 kg of raw milk is required. Based on the FAO estimate of GHG emission of 2.4 CO_2-eq per kg of fat and protein corrected milk (FPCM) at farm gate, this will lead to GHG emission of 21.8 CO_2-eq per kg of milk powder (9.09 x 2.4CO_2-eq per kg).[28] Table 2 depicts the sources of GHG emissions in dairy farms using the life cycle

Table 2: Sources of GHG emissions using the life cycle approach for milk production, processing and transport[28]

Agricultural processes	Animal processes	Transport	Processing of raw milk into commodities	Others
• Processes for producing grass, feed crops • Crop residues by-products and concentrates	• Enteric fermentation by ruminants (CH4) • Direct and indirect emissions from manure storage (CH4 and N2O)	• Milk • Animals	Cooled milk, yoghurt, cheese, butter, and milk powder	• Production of packaging • Refrigeration • Transport to retail points

GHG emissions due to dairy products (additional data)

The FAO report has documented a regional variation in the GHG emissions. The highest emissions are estimated for sub-Saharan Africa at 7.5kg CO_2 eq per kg FPCM at the farm gate, while lowest values have been estimated for the industrialized countries at 1-2 kg CO_2 eq per kg FPCM at the farm gate. Intermediate levels of emissions have been estimated for South Asia, West Asia & Northern Africa and Central & South America at 3 - 5 kg CO_2-eq. per kg FPCM at the farm gate. These differences are due to higher productivity per animal in more intensive farm production systems.

There have been several country level attempts to estimate GHG emissions due to dairy products including milk. These use several different models. Italian experts have reported 'Latte GHG', which is an electronic worksheet dedicated to the Italian dairy production systems.[54] A software tool, Dairy GHG has been reported from the North America, which calculates the carbon footprint of a dairy production system as the net exchange of all GHG in CO_2 equivalent units per unit of energy-corrected milk produced, primary emission sources being enteric fermentation, manure, cropland used in feed production, and the combustion of fuel in machinery used to produce feed and handle manure and secondary emissions being those occurring during the production of resources used on the farm, which can include fuel, electricity, machinery, fertilizer, pesticides, plastic, and purchased replacement animals.[55] From New Zealand, a tool OVERSEER® Nutrient Budgets (Overseer) has been reported which allows farm-specific greenhouse gas (GHG) emissions to be estimated. The GHG or carbon footprints are reported as emissions per unit of product, for example, per kg milk, meat or wool.[56] Researchers from Denmark have developed the whole-farm model, 'Farm GHG', which is designed to quantify the flows of carbon (C) and nitrogen (N) on European conventional and organic dairy farms.[57]

A study from south Germany dairy farms on carbon footprint of milk using Life Cycle Assessments has estimated a carbon footprint of 1.99 kg CO_2 eq/kg of fat and protein corrected milk (FPCM).[58] A report about the Australian dairy products has revealed that the average Australian milk production carbon footprint at the farm gate for 1 kg FPCM was 1.11 kgCO_2eq. The major contributors to GHG emission were enteric fermentation (57%), manure (18%), purchased feed concentrate (8%), energy (8%), and fertilizer (9%).[59] Similarly, a study from the University of Arkansas 'cradle to grave' life cycle analysis of milk revealed that for one kg of milk consumed in the United States per year, 2.05 kg of GHG are emitted over the entire supply chain to produce, process and distribute the milk.[60]

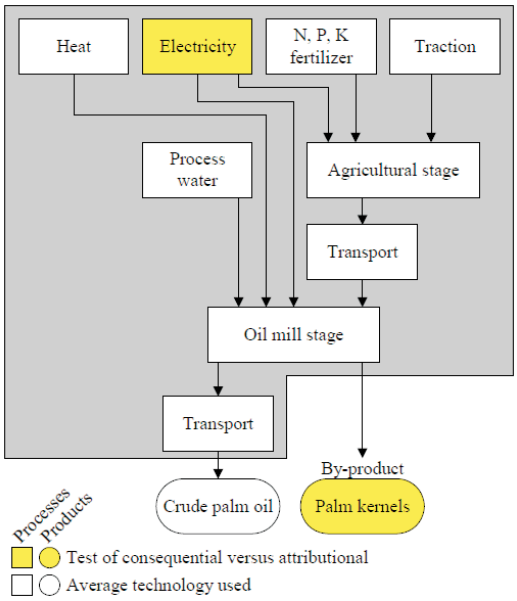
The carbon footprint of powdered milk is much higher as reported in studies. Using an integrated 'cradle-to-gate' model (field to processing plant) in line with the LCA approach, the carbon footprint (CF) of Canadian dairy products including milk powder, has been estimated at 10.1 kg of CO_2e/kg.[61] This high level compared to dairy milk production indicates the high GHG generated by milk formula for infants and young children, on account of the necessary processing of milk into a product in powder form. A three-year (2010-2013) study of GHG emissions on 415 British dairy farms estimated the carbon footprint as 1,232 g of CO_2e/litre.[62]

3.4.2 GHG emissions due to vegetable oil

Vegetable oils are lipid-rich extracts derived from diverse sources including seeds, nuts, fruits, and legumes. The process to derive vegetable oil includes milling, sorting and cleaning; removing husks and crushing and extraction from the source. In addition, for many oils, a refining step is necessary. The energy intensities to produce soybean, rapeseed, and sunflower oils are in the same order or magnitude as they have similar extraction processes. Traditional palm oil and kernel oil extraction have lower overall energy consumption.[63] The process used for production of palm oil is depicted in Figure 3.[64]

A study to evaluate the environmental impacts of a number of major vegetable oils from different geographical regions of the world estimated a carbon footprint of refined oils as 760 kg eq CO_2 per ton for sunflower oil, 2024 kg eq CO_2 per ton for palm oil, 2024 kg CO_2 eq per ton for soybean oil and 4717 kg CO_2 eq per ton for peanut oil.[65]

Figure 3: Product System for Crude Palm Oil



3.4.3 GHG emissions due to the production of sugar (high fructose corn syrup, corn syrup, cane sugar, lactose, etc)

Table sugar, or sucrose is saccharose obtained commercially from beets and sugarcane. One of the first steps in sugar production is the extraction of sugary juices from the plant material. Sugarcane is crushed and the juice separated from the bagasse. The juice goes through a clarification process and then through evaporators to concentrate the clear juice into sugar liquor. Crystallizers then transform the sugar liquor into crystals that are separated with a centrifuge and dried to become raw sugar. Raw sugar can be used as is, but it is more commonly transported to sugar refineries to produce refined sugars.[63]

- **GHG emissions due to the production of high fructose corn syrup**

Corn is processed according to two different methods: dry and wet. The dry process starts with dry kernels that are milled into a meal and used primarily for the fermentation industry, including ethanol and beverages. Wet corn milling includes de-germination, washing, grinding and screening, centrifuging and saccharification/conversion to the sweetener.

GHG emissions for glucose and fructose syrups derived from starch (isoglucose or HFCS as it is most commonly known in the USA) were 780 g (0.78 kg) CO2eq/kg isoglucose when German winter wheat was used as raw material whereas for the US corn-based variant, values ranged from 640 g (0.64 kg) CO2eq/kg (dry milling process) to 1100 g (1.1 kg) CO2eq/kg isoglucose (wet milling process).[66]

Consistent with the above, a study from Europe on production of glucose from cornstarch following the Life Cycle Assessment (LCA) principles assessed Greenhouse Gas emission for the system cradle-to-factory gate. Depending on the approach for allocation, the GHG emissions were from 0.7 to 1.1 kg CO_2 eq./kg glucose ds.[67]

- **GHG emissions due to the production of sugarcane sugar**

A study has estimated the carbon footprint of sugar produced from sugarcane in Thailand as 0.55 kg CO_2e kg^{-1} sugar.[68] GHG emissions for provisions of cane sugar to EU in kg CO_2 eq t^{-1} refined cane sugar ranged between 642-760

depending on the GHG emitted during transport.[66]

- **GHG emissions due to the production of lactose**

Lactose is a simple sugar found in milk and is a major component of whey, derived from the processing of milk. As lactose is only 30% as sweet as sugar, it is used as a sugar supplement, as well as in food and confectionery. Lactose is also widely used as a sugar supplement in milk formulas for infants and young children, as bovine milk has much lower lactose content than needed for children's nutritional requirements. Lactose is a disaccharide carbohydrate, which is only produced as part of the milk of mammals, or as a storage carbohydrate in the seeds of a few plants by the condensation of glucose and galactose.[69]

A study, which looked into the carbon footprints of dairy products in Sweden and New Zealand has estimated carbon footprints of 1.0 kg CO2eq per kg for the Lactose and 17.4 kg CO2eq per kg for the Whey Protein Concentrate.[53] These values include emissions from dairy farming, processing, packaging and transport.

3.5 Estimation of GHG emissions per kilogram of milk formula sold

To estimate the GHG emissions arising per kilogram of milk formula sold, the composition and the possible source of major ingredients of the products were considered to calculate the proportion of each ingredient in the product. Table 3 provides information about the composition and proportion of major ingredients of milk formula.

3.5.1 *Codex Alimentarius* provides global standards for standard infant formula and infant formulas for special medical purposes marketed for infants 0-6 months of age, and for follow-up formula marketed for older children to 36 months. *Codex Alimentarius* prescribes levels for energy in kcal per 100 ml for formula ready for consumption. It also prescribes carbohydrates, proteins and lipids per 100 kcal of energy. The guidelines are largely flexible about the source of the nutrients and source for major ingredients in the formula.

- As per the Codex standards, 100 ml of prepared standard infant formula (standard milk formula) should provide 60-70 kcal of energy.
- As per the Codex standards, the formula should also provide carbohydrates 9.0-14.0 g/100 kcal; proteins 1.8-3.0 g/100 kcal; and lipids 4.4 -6.0 g/kcal.
- Since 60-70 kcal is provided by 100 ml of prepared standard infant formula (standard milk formula), to achieve 100 kcal of energy 142-166 ml of prepared formula will be required. For ease of calculation, we assume that an average of 150 ml of prepared formula will be required to achieve the required 100 kcal energy requirements.
- The recommended quantity of standard infant formula powder for preparing 150 ml of liquid ready for consumption milk is 22.5g (4.5 g for 30 ml). Manufacturers recommend using one scoop of powdered formula for preparing 30 ml

Table 3: Composition of milk formula and estimated proportion of major ingredients in milk formula (based on Codex Alimentarius standards)

Composition/ Ingredient of infant formula	Levels in standard infant formula	Levels in follow-up formula	Possible source of ingredient
Calories	60-70 kcal/100ml	60-85 kcal/ 100 ml	——
Carbohydrate	9.0-14.0 g/150 ml (Appr 60%)	15. 0 g/150 ml (Appr. 67%)	High Fructose Corn Syrup, Cane Sugar, Lactose
Protein	1.8-3.0 g/150 ml (Appr. 13%)	1.8-3.4 g/150 ml (Appr. 15%)	Milk powder, Whey Protein Concentrate
Lipid	4.4-6.0 g/150 ml (Appr. 27%)	1.8 -3.6 g/150 ml (Appr. 17%)	Vegetable oil

of liquid ready for consumption[70] However, the size of the scoop supplied by various manufacturers varies from 4.0 grammes to 5.0 grammes.[71] This report has taken an average figure of 4.5 grammes for scoop size for calculation of powdered infant formula required for preparing liquid ready for consumption.

- Using above mentioned amounts, proportion of each major nutrient is calculated.

3.5.2 According to the Codex standards, the energy content and nutrient composition of Formula for Special Medical Purposes intended for infants is based on the requirements for standard infant formula except for the compositional provisions which must be modified to meet the special nutritional requirements arising from the disease(s), disorder(s) or medical condition(s) for whose dietary management the product is specifically formulated, labeled and presented.

3.5.3 According to the Codex standards, for the follow-up formula, the minimum levels of energy should be 60 kcal/100 ml; and protein contents 3.0 gm/100 kcal; fat content 3 gm/100 kcal and carbohydrates should be enough to achieve desired energy levels and similar levels of energy and ingredients are required for the toddler formula.

Using above mentioned amounts, proportion of each major nutrient is calculated by using the method described above for standard infant formula.

3.6. Estimated GHG emissions due to milk formula ingredients

- Standard Infant formula (standard milk formula) contains multiple ingredients, the major constituents being carbohydrates (60%), proteins (13%) and lipids (27%), as summarised in Table 3.
- The source of major nutrients in formula are, for carbohydrates, high fructose corn syrup, cane sugar and lactose; for proteins, milk powder and whey protein concentrate, and for lipids, vegetable oils.
- The GHG emissions due to ingredients for each nutrient have been identified from published research and based on the estimated standard proportion of the nutrients, the likely ingredients of formula, and the reported GHG in kg CO2eq per kg of the ingredient product, the contribution of each ingredient to 1 kg of standard infant formula (standard milk formula) is estimated. Results are set out in Table 4 below.
- The follow-up formula (follow-on milk formula) contains multiple ingredients, the major constituents being carbohydrates (67%),

Table 4: Estimation of GHG emissions due to individual ingredients in the standard infant formula (standard milk formula)

Nutrients	Standard Proportion	Ingredients	Reported GHG emission (kg CO2eq per kg of final product)		Estimated contribution to GHG emission (kg CO2 eq) per kg of standard infant formula
			GHG	Reference	
Carbohydrates	60%	High fructose corn syrup	0.78 - 1.1	TsiropoulosI, et al (2013)	0.66 (upper limit)
		Cane sugar	0.64 -0.76	Ingo Klenk et al (2012)	0.45 (upper limit)
		Lactose	1.0	Anna Flysjö (2012)	0.6
Proteins	13%	Milk powder	21.8 (estimated)	FAO (2010)	2.83
		Whey protein concentrate	17.4	Anna Flysjö (2012)	2.26
Fats	27%	Vegetable oil	Palm oil 2.02	Muñoz I (2014)	0.54
			Soybean oil 2.02	Muñoz I (2014)	0.54
			Sunflower oil 0.76	Muñoz I (2014)	0.20
			Peanut oil 4.7	Muñoz I (2014)	1.26

Table 5: Estimation of GHG emissions due to individual ingredients in the follow-up formula (follow-on milk formula) in a kilogram of milk formula

Nutrients	Standard Proportion	Ingredients	Reported GHG emission (kg CO2eq per kg of final product)		Estimated contribution to GHG emission (kg CO2 eq) per kg of follow up formula
			GHG	Reference	
Carbohydrates	67%	High fructose corn syrup	0.7 - 1.1	TsiropoulosI, et al (2013)	0.73 (upper limit)
		Cane sugar	0.64 -0.76	Ingo Klenk et al (2012)	0.50 (upper limit)
		Lactose	1.0	Anna Flysjö (2012)	0.67
Proteins	15%	Milk powder	21.8 (estimated)	FAO (2010)	3.27
		Whey protein concentrate	17.4	Anna Flysjö (2012)	2.61
Fats	17%	Vegetable oil	Palm oil 2.02	Muñoz I (2014)	0.34
			Soybean oil 2.02	Muñoz I (2014)	0.34
			Sunflower oil 0.76	Muñoz I (2014)	0.12
			Peanut oil 4.7	Muñoz I (2014)	0.79

proteins (15%) and lipids (17%), as depicted in Table 3.

- The source of major nutrients remains same as in the standard milk formula for carbohydrates, high fructose corn syrup, cane sugar, lactose; for proteins, milk powder, and whey protein concentrate, and for lipids, vegetable oils.
- The GHG emissions due to ingredients for each nutrient for follow-up formula have been identified from published literature and based on the estimated standard proportion of the nutrients, the likely ingredients of formula, and the reported GHG in kg CO2eq per kg of the ingredient product, the contribution of each ingredient to 1 kg of Follow-up formula (follow-on milk formula) is estimated. Results are set out in Table 5 above.

3.7 Possible combinations of ingredients in milk formula

There are various possible combinations of individual ingredients in the milk formula. The GHG emissions in kg CO_2 eq per kg of the product for various possible compositions of the milk formulas, are estimated. For the standard infant formula (standard milk formula) and formula for special medical use (special baby milk formula) the calculation of GHG for different combinations is given in the Table 6 while the Table 7 contains calculation of GHG emissions for the follow-up and toddler milk formula.

3.8 Average GHG emissions kg CO_2 eq per kg of the standard milk formula and the special baby milk formula products

The calculation above shows that the GHG emission is 2.91-4.69kg CO_2 eq per kg of the standard infant formula and the special baby milk formula product, depending on the ingredients used in the formula. The average GHG emission for these products therefore can be stated as 3.95 kg CO_2 eq per kg.

3.9 Average GHG emissions kg CO_2 eq per kg of the follow-on milk formula and toddler milk formula products

For the Follow-on and Toddler's milk formula, the GHG emission is 2.5-4.79 kg CO_2 eq per kg of the product, depending on the ingredients used in the formula. The average GHG emission for

Table 6: GHG emission for possible combinations of ingredients for standard infant formula and formula for special medical use# (kgCO2 eq per kg of the product)*

S.No.	Possible combinations of ingredients			Total GHG
	Carbohydrates/Sugar	Protein	Fats	
1.	High fructose corn syrup (0.66)	Milk powder (2.83)	Palm/soybean oil (0.54)	4.03
2	High fructose corn syrup (0.66)	Milk powder (2.83)	Sunflower oil (0.20)	3.69
3	High fructose corn syrup (0.66)	Milk powder (2.83)	Peanut oil (1.26)	4.75
4	Lactose (0.6)	Milk powder (2.83)	Palm/soybean oil (0.54)	3.97
5	Lactose (0.6)	Milk powder (2.83)	Sunflower oil (0.20)	3.63
6	Lactose (0.6)	Milk powder (2.83)	Peanut oil (1.26)	4.69
7	Cane sugar (0.45)	Milk powder (2.83)	Palm/soybean oil (0.54)	3.82
8	Cane sugar (0.45)	Milk powder (2.83)	Sunflower oil (0.20)	3.48
9	Cane sugar (0.45)	Milk powder (2.83)	Peanut oil (1.26)	4.54
10	Cane sugar (0.45)	Whey protein concentrate (2.26)	Sunflower oil (0.20)	2.91
	Average			**3.95**

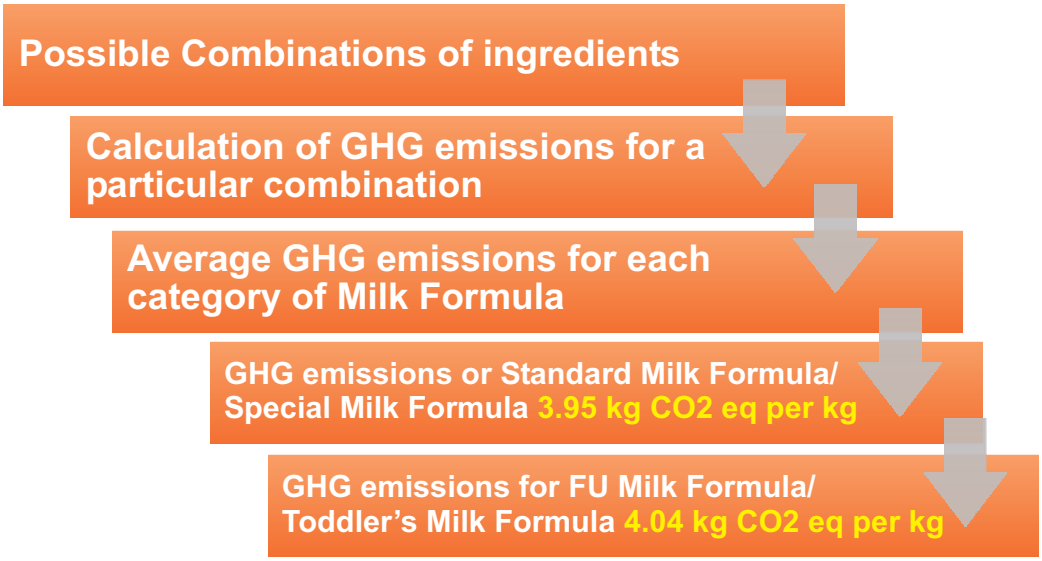
* Standard milk formula # Special baby milk formula
(Figure in brackets taken from table 4)

Table 7: GHG emission for possible combinations of ingredients in follow-up formula (kgCO2 eq per kg of the product)*

S.No.	Possible combinations of ingredients			Total GHG
	Carbohydrates/Sugar	Protein	Fats	
1.	High fructose corn syrup (0.73)	Milk powder (3.27)	Palm/soybean oil (0.34)	4.34
2	High fructose corn syrup (0.73)	Milk powder (3.27)	Sunflower oil (0.12)	2.50
3	High fructose corn syrup (0.73)	Milk powder (3.27)	Peanut oil (0.79)	4.79
4	Lactose (0.67)	Milk powder (3.27)	Palm/soybean oil (0.34)	4.28
5	Lactose (0.67)	Milk powder (3.27)	Sunflower oil (0.12)	4.06
6	Lactose (0.67)	Milk powder (3.27)	Peanut oil (0.79)	4.73
7	Cane sugar (0.50)	Milk powder (3.27)	Palm/soybean oil (0.34)	4.11
8	Cane sugar ((0.50)	Milk powder (3.27)	Sunflower oil (0.12)	3.89
9	Cane sugar (0.50)	Milk powder (3.27)	Peanut oil (0.79)	4.56
10	Cane sugar (0.50)	Whey protein concentrate (2.61)	Sunflower oil (0.12)	3.23
	Average			**4.04**

* Follow on milk formula (Figure in brackets taken from table 5)

Figure 4: GHG Emissions (kg CO2 eq) per kg of Milk Formula



these products therefore can be stated as 4.04 kg CO_2 eq per kg of the product.

3.10 Estimate of GHG emissions due to milk formula in six study countries

Using the available published data for the sales volumes of milk formula used in the study countries, the GHG emissions attributable to milk formula for 2012 were calculated. Multiplying these sales volumes by the average GHG emission of 3.95kg and 4.04 CO_2 eq per kg of standard infant formula and the special baby milk formula and follow-on and toddler's milk formula milk products respectively produced the emission amount for GHG due to milk formulas sold in an individual country. (See Table 8). Estimates are also included for the forecast growth of milk formula usage for the period to 2017. (See Table 9). Per capita sale of the milk formula and consequent GHG emissions are calculated using available data on sale of milk formula; and data on child population 0-3 years in the study countries from the World Bank data-bank.[73] (Table 10)

Table 8: Volume of milk formula sales (Tonnes), and attributable GHG emissions (Tonnes CO2 eq) for milk formula in 6 countries, 2012 [22,32,33,34,35,36]

		Australia	China	India	Malaysia	Philippines	S. Korea	Total
Milk Formula Volumes (Tonnes)	Milk Formula - Total	7,960.0	560,000	27,783	54,200	50,900	19,607.3	720,450
	Standard Milk Formula	3311.8	144,500	10,843	8,800	13,600	8,258.7	189,313
	Follow-on Milk Formula	2473.9	168,100	14,103	9,300	12,000	5,283.5	211,260
	Toddler Milk Formula	858.1	246,200	2,383.4	35,800	24,100	4,408.4	313,749
	Special Baby Milk Formula	1316.2	1,200	453.4	300	1,200	1,656.7	6,126
GHG Emissions kg CO2 eq. per kg of products	GHG emissions due to Standard Infant and Special baby milk formula	3.95	3.95	3.95	3.95	3.95	3.95	3.95
	GHG emissions due to Follow-Up and Toddler milk formula	4.04	4.04	4.04	4.04	4.04	4.04	4.04
Total GHG Emissions due to Milk Formula (Tonnes CO2 eq.)	Milk Formula - Total	31,741.8	2,249,287	111,226.6	218,149	204,304	78,321.1	2,893,029
	Standard Milk Formula	13,081.6	570,775	42,829.8	34,760	53,720	32,621.8	747,788
	Follow-on Milk Formula	9,994.5	679,124	56,976.9	37,572	48,480	21,345.3	853,492
	Toddler Milk Formula	3,466.7	994,648	9,628.9	144,632	97,364	17,809.9	1,267,549
	Special Baby Milk Formula	5,198.9	4,740	1,790.9	1,185	4,740	6,543.9	24,198

Table 9: Volume of milk formula sales (tonnes), and attributable GHG emissions (tonnes CO2 eq) for milk formula in 6 countries (forecast for 2017) [22,32,33,34,35,36]

		Australia	China	India	Malaysia	Philippines	S. Korea	Total
Milk Formula Volumes (Tonnes)	Milk Formula - Total	8,617.10	1,049,800	30,666.30	73,500	55,800	18,130.20	12,36,513.60
	Standard Milk Formula	3,575.90	241,800	11,908.60	10,800	14,700	7,303.10	2,90,087.60
	Follow-on Milk Formula	2,695.80	296,000	15,563.10	11,100	12,700	4,820.60	3,42,879.50
	Toddler Milk Formula	940	507,800	2,646.30	51,300	27,000	4,156.90	5,93,843.20
	Special Baby Milk Formula	1,405.40	4,200	548.3	300	1400	1,849.70	9,703.40
GHG Emissions kg CO2 eq. per kg of products	GHG emissions (kg CO2 eq.) per kg of Standard Infant milk formula	3.95	3.95	3.95	3.95	3.95	3.95	3.95
	GHG emissions (kg CO2 eq.) per kg of Follow-on milk formula	4.04	4.04	4.04	4.04	4.04	4.04	4.04
Total GHG Emissions due to Milk Formula (Tonnes CO2 eq.)	Milk Formula - Total	34,364.767	4,219,052	122,770.731	295,941	223,983	72,422.66	4,968,534.16
	Standard Milk Formula	14,124.805	955,110	47,038.97	42,660	58,065	28,847.24	1,145,846.02
	Follow-on Milk Formula	10,891.032	1,195,840	62,874.924	44,844	51,308	19,475.22	1,385,233.18
	Toddler Milk Formula	3,797.6	2,051,512	10,691.052	207,252	109,080	16,793.87	2,399,126.53
	Special Baby Milk Formula	5551.33	16,590	2,165.785	1,185	5,530	7,306.31	38,328.43

ANALYSIS OF THE RESULTS 4

Estimates of GHG emissions due to milk formula sales in the study countries could be analysed with comparison of milk formula sale and corresponding GHG emissions among the countries; an intra country comparison; analysis according to the product category of the milk formula; analysis according to the forecast volume of milk formula sales and attributable GHG emissions; and GHG emissions due to milk formula and comparing with other equivalent activities.

4.1 Comparison of milk formula sale and corresponding GHG emissions among the countries

- A total of 720,450 tonnes of milk formula were sold each year in the six study countries, China contributed 77.7%, Malaysia 7.2%, Philippines 7.02%, India 3.85%, South Korea 2.72% and Australia 1.1% to the sale. The contribution to the GHG emissions was in the same proportions. (See table 8)
- The GHG emissions are also highest in China among the study countries with an annual emission of 2.24 million tonnes from sale of all kinds of milk formula. GHG emissions in China are approximately 10 times more in comparison to Malaysia; 21 times more than Philippines; 20 times more than India, 28 times more than South Korea and 70 times more than Australia. (See table 8 and Fig. 5)
- The average per capita (children 0-3 years old) sales of milk formula and consequent GHG emissions in the six study countries is 5.39 kgs and 21.66 kg CO_2 eq respectively. Maximum contribution in terms of per capita (children 0-3 years old) GHG emissions comes from South Korea (56.12 kg CO_2 eq), followed by Australia (34.51 kg CO_2 eq), Malaysia (13.05 kg CO_2 eq), China (4.66 kg CO_2 eq), Philippines (3.11 kg CO_2 eq) and India (1.46 kg CO_2 eq). Details about the per capita GHG emissions are given in Table 10.

4.2 Country-wise analysis

Following is the analysis of the milk formula sales and corresponding contribution to GHG emissions in each study country in 2012 (see table 11):

- **Australia:** In Australia, standard milk formula is the single largest category

Figure 5: Contribution to GHG emissions in the study countries (2012)

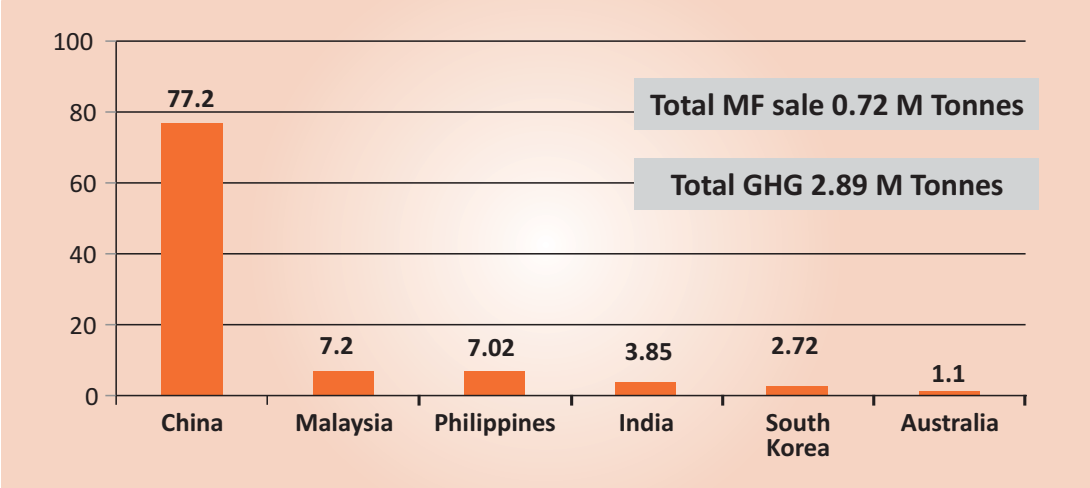


Table 10: Per Capita (child 0-3 years) GHG emissions due to milk formula sales in each country

	Australia	China	India	Malaysia	Philippines	S. Korea	Total
Number of children age 0 - 3 years[72]	919,812	48,232,015	76,185,706	1,671,825	6,560,304	1,395,682	133,569,662
Total milk formula Sale (Tonnes)	7,960.0	560,000	27,783	54,200	50,900	19,607.3	720,450
Per capita milk formula sale (kg)	8.65	11.61	0.36	32.42	7.74	14.05	5.39
Total GHG emissions due to milk formula (Tonnes CO2 eq.)	31,741.8	2,249,287	111,226.6	218,149	204,304	78,321.1	2,893,029
Per capita GHG emissions (kg CO2 eq) due to milk formula	34.51	4.66	1.46	13.05	3.11	56.12	21.66

comprising of 41.6% of total milk formula sales. This is followed by follow-on milk formula 31%, special milk formula 16.5% and toddler milk formula 10.7%. Contribution to the GHG emission are in similar proportions.

- **China:** In China, the toddler milk formula is the single largest contributor to GHG for infant and young child feeding products, comprising of 43.9% of total milk formula sales. Follow-on milk formula contributes 30% to the total sale of milk formula followed by the standard milk formula 25.8% and special milk formula 0.2%.
- **India:** In India, the follow-on milk formula is the largest category with contribution of 50% to the total sale of milk formula and GHG emissions. This is followed by the standard infant formula 39%, toddler milk formula 8.5% and special milk formula 1.6%.
- **Malaysia:** Toddler milk formula constitutes 66% of total milk formula sales in Malaysia and follow-on formula, standard infant formula and special milk formula comprising 17.1%, 16.2% and 0.55% of the total sales of milk formula.
- **Philippines:** Toddler milk formula is the single largest selling milk formula category in
- Philippines comprising 47.4% of total sales of milk formula with standard milk formula 26.7%, follow-on milk formula 23.6% and special formula 2.3% following the suit.
- **South Korea:** In South Korea, the standard milk formula leads the band-wagon with contribution of 42.1% with follow-on formula, toddler milk formula and special formula contributing 26.9%, 22.48% and 8.4% respectively to the total sale of milk formula and consequent GHG emissions.

4.3 Analysis according to the product category of the milk formula

1. Total GHG emission from milk formula sold in all six study countries is 2.89 million tonnes, of which 1.26 million tonnes is contributed by toddler milk formula, 0.85 tonnes by follow-on milk formula, 0.74 million tonnes by standard milk formula and 24,198 tonnes by special milk formula (See Figure 6).
2. Toddler milk formula is the largest contributor in the generation of GHG in China, Malaysia and Philippines, while in Australia and South Korea standard infant formula is the leading cause of GHG emissions. In India, the major contributor is the follow-on milk formula followed by the standard milk formula (See Table 11).

4.4 Forecast volume of milk formula sales (kg), and attributable GHG emissions (see table 9)

- An increase in volume of sales of milk formula was forecast in all countries over a period of 5 years between 2012-2017, except in South Korea where it will decrease. This will lead to a consequent increase in the overall GHG emissions.
- The projected overall increase in GHG emission due to milk formula is greatest in

Figure 6: GHG emission for each milk formula category in all six study countries

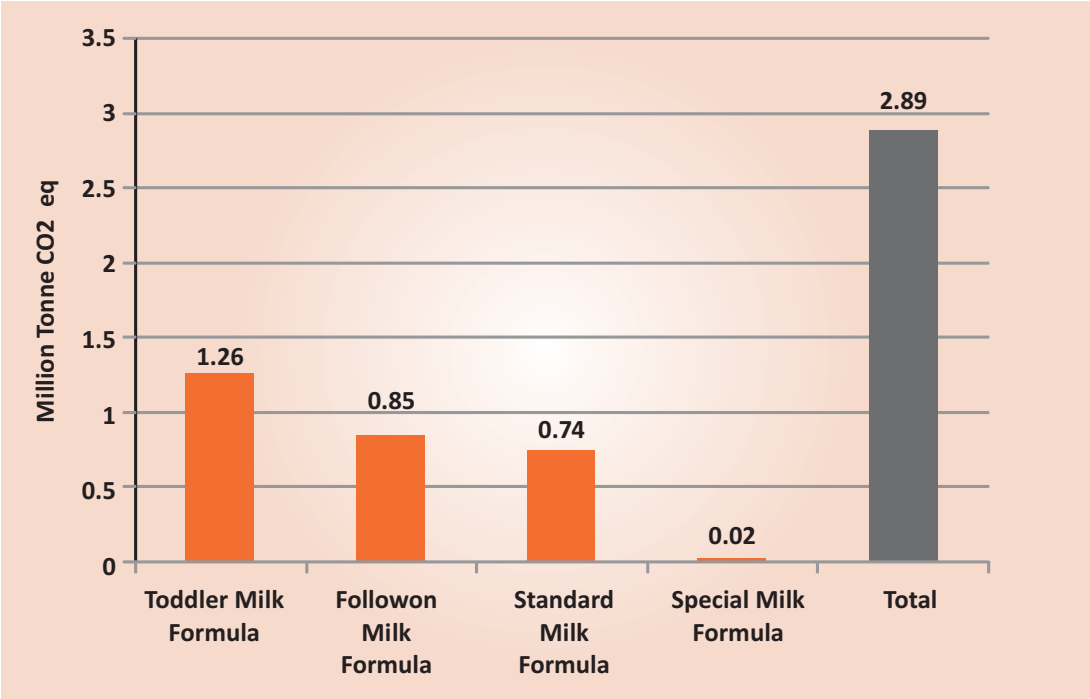


Table 11: Percentage contribution of different milk formula categories to GHG emissions from milk formula sold in each country

Country	Standard Milk Formula	Follow on Milk Formula	Toddler Milk Formula	Special Milk Formula
Australia	41.6	31.0	10.7	16.5
China	25.8	30.0	43.9	0.2
India	39.0	50.0	8.5	1.6
Malaysia	16.2	17.1	66.0	0.55
Philippines	26.7	23.6	47.4	2.3
S. Korea	42.1	26.9	22.4	8.4

* Leading category in each country is highlighted

China (87.46%), followed by Malaysia (35.60%), India (10.37%), Philippines (9.84%), Australia (8.25%) while South Korea will record a decrease in the sale (7.53%).

- In all the six study countries, follow-up and toddler formula together will remain the leading contributors to the GHG emissions in 2017 as per the sales projections.

Table 12 analyses the projected increase of milk formula in individual countries in percentage terms and also identifies the category of leading milk formula in each country. It is interesting to note that in 4 study countries out of 6, either follow-on or toddler formula is projected to lead the maximum increase in the sale in 2017. In Australia, the standard infant formula is projected to lead maximum increase in sales among all milk formulas.

Table 12: Forecast increase of the total volume of milk formula sales (tonnes) in percentage terms in 6 countries [22,32,33,34,35,36]

Countries	2012 (tonnes)	2017 (tonnes)	Predicted percentage increase in total sale of milk formula	Category of milk formula predicted with maximum increase
Australia	7,960.0	8,617.1	8.25%	Standard
China	560,000.0	1,049,800.0	87.46%	Toddler's
India	27,783.0	30,666.0	10.37%	Follow-on
Malaysia	54,200.0	73,500.0	35.60%	Toddler's
Philippines	50,900.0	55,800.0	9.62%	Toddler's
South Korea	19,607.3	18,130.2	- 7.53%	Special Baby Milk Formula

Table 13 depicts projected combined increase in the individual formula category in percentage terms in 6 study countries with a similar increase in the contribution of GHG emissions. The projected increase in the total sale of milk formula is 71.6%. Among the categories of milk formula, maximum increase in sale is projected for the toddler formula (89.2%); followed by follow-on formula (62.3%), formula for special medical uses (58.3%) and Standard milk formula (53.23%).

4.5 GHG emissions due to milk formula and equivalent activities

The United States Environmental Protection Agency has developed a Greenhouse Gas equivalencies calculator,[37] which translates abstract measurements of GHG emissions into concrete terms, which helps the user to understand the GHG emissions in a more practical way. GHG emission due to milk formula use in the study countries has been compared to equivalent activities for GHG emissions using the above-mentioned calculator. Table 14 compares the GHG emission due to milk formula with GHG emissions from miles driven by an average passenger vehicle and amount of waste sent to the landfill; CO_2 emission from amount of gasoline consumed and amount of coal burnt; and carbon sequestered by tree seedling grown for 10 years and acres of US forests in one year. The total estimated GHG emissions of 2.89 million tonnes CO_2 eq. due to milk formula in the six study countries equals the annual greenhouse gas emissions from 6888.1 million miles driven by an average passenger vehicle or 1.03 million tonnes of waste sent to the landfill; CO_2 emissions from 325.5 million gallons of gasoline consumed or 3107.4 million pounds of coal burned; Carbon sequestered by 74.1 million tree seedlings grown for 10 years or 2.37 million acres of U.S. forests in one year.

Table 13: Projected percentage increase in the milk formula sales and consequent contribution to the GHG emissions (2012-2017) [22,32,33,34,35,36]

Milk Formula	2012		2017		Projected increase
	Sale (tonnes)	GHG emission (tonnes CO2 eq)	Sale (tonnes)	GHG emission (tonnes CO2 eq)	
Total	720,450.3	2,893,029.6	1,236,513.6	4,968,534.1	71.6%
Standard Milk Formula	189,313.5	747,788.3	29,0087.6	1,145,846.0	53.2%
Follow-on milk formula	211,260.6	853,492.8	342,879.5	1,385,233.1	62.3%
Toddler milk formula	313,749.9	1,267,549.5	593,843.2	2,399,126.5	89.2%
Special baby milk formula	6,126.3	24,198.8	9,703.4	38,328.4	58.3%

Table 14: Equivalent activities for GHG emission due to milk formula in the US [37]

Total GHG emissions due to milk formula (Tonnes CO2 eq.) 2.8 million tonnes	
Equivalent to annual greenhouse gas emissions from any of these	6888.1 Million Miles driven by an average passenger vehicle
	1.03 MillionTons of waste sent to the landfill
Equivalent to annual CO2 emissions from any of these	325.5 Million gallons of gasoline consumed
	3107.4 Million Pounds of coal burned
Equivalent to annual Carbon sequestered by any one of these	74.1 Million tree seedlings grown for 10 years
	2.37 Million acres of U.S. forests in one year

CONCLUSIONS 5

Breastfeeding is a feeding method which generates no carbon footprints of its own as a well nourished woman utilising her body fat stores needs no extra food.[73] Breastfeeding does not burden the earth with waste requiring disposal. On the other hand, the alternative used in place of breastfeeding, the industrially manufactured milk formula adds to GHG emissions at every step of production, transport and use. It also generates waste, which needs disposal, further adding to climate change.

The study and analysis of GHG emissions due to milk formula sold in six countries in Asia and Pacific region is relevant to ongoing global efforts to address climate change and curb carbon footprints. The study has revealed that milk formula is emerging as an important source of GHG emissions. Projections show an ever-increasing sale of these products with consequent increase in the GHG emissions. More worrisome is the increased use of unnecessary follow-on and toddler milk formulas in all study countries.

To reverse the trend of increasing use of milk formula and to reduce consequent GHG emissions, there is a need to invest in implementation of *Global Strategy for Infant and Young Child Feeding* in its entirety with special attention on protection, promotion and support for breastfeeding. It includes strengthening of policies and programmes on implementation of the International Code of Marketing of Breastmilk Substitutes, maternity protection, hospital practices, information, community level counseling support and support during the difficult situations such as HIV, emergencies and disasters etc. Case studies from four study countries, three of which are based on the World Breastfeeding Trends Initiative (WBT*i*) assessments have documented several gaps in policies and programmes on IYCF. This is leading to suboptimal breastfeeding and an increased demand for milk formula. There is a need for the governments, UN agencies and others to give adequate emphasis on the policies and programmes on IYCF not only for enhancing maternal and child health and nutrition but also as a measure to address the prevalent situation of climate change as highlighted in the sustainable development goal 13.[74]

Future direction: This study has been done only in six countries of the Asia Pacific region and limited only upto the sale point. There is a need to have an estimation of GHG emission due to milk formula for all countries and for all stages of the milk formula consumption including manufacturing and post-manufactuing activities like transport to retailers, preparation of formula at home etc.

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ANNEXURE-1

CASE STUDIES

For four of the study countries (from each of the three country groups) namely, India, Australia, Malaysia and Philippines, brief case studies assessing breastfeeding policies, programmes and practices are provided in this section

Philippines: Case study on the status of infant and young child feeding policies, programmes and practices[1]

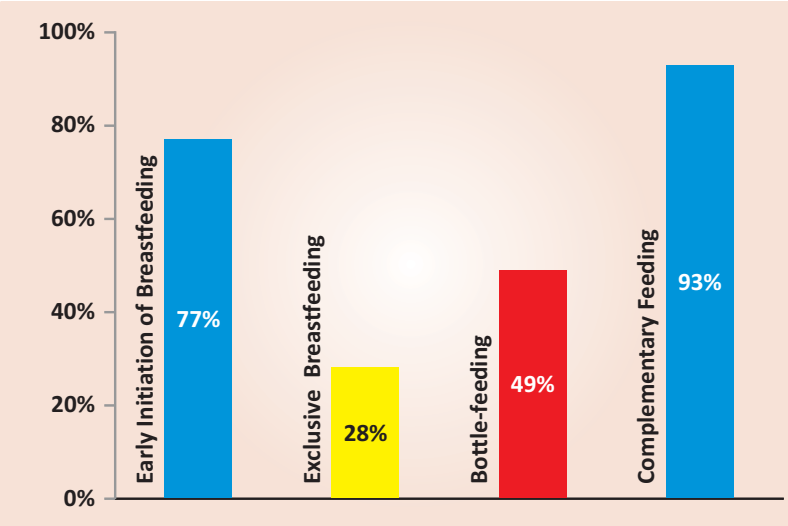
Compiled by Alessandro Iellamo with contribution from Ma. Ines Fernandez

Infant and Young Child Feeding Practices

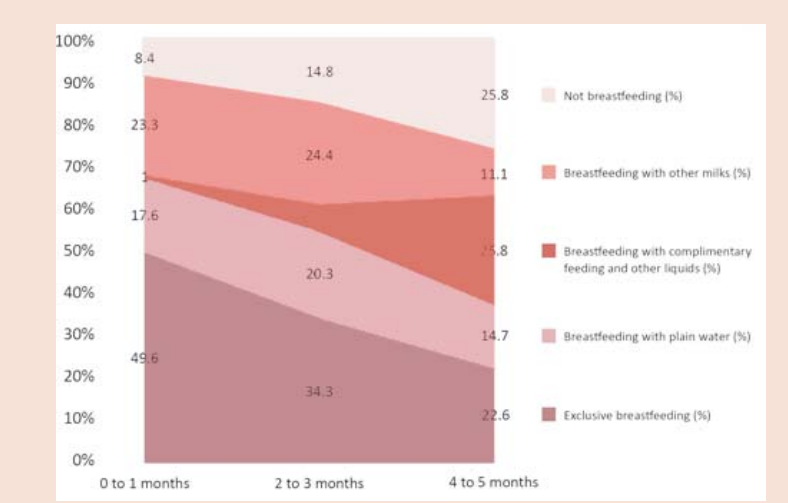
The World Breastfeeding Trends Initiative (WBT*i*) assessment report 2015[2] has revealed that breastfeeding is initiated within one hour in 77% births in Philippines; exclusive breastfeeding rate in infants < 6 months is 28%; complementary feeding is introduced at appropriate time in 93% infants and median duration of breastfeeding is 8 months. Bottle feeding rate in infants at 49% is very high. The WBT*i* report has used data from the National Nutrition Survey, 2013. (See Graph 1)

The IYCF Plan of Action (2011-2016) has set a target of 90% mothers initiating the breastfeeding within one hour of birth by the end of 2016.

During the first month of life, only half of all infants in the Philippines are exclusively breastfed. Of those who remain, 8.4% are not breastfed, 18% receive breast milk and water, 22% receive breast milk and other milk, and 2% receive breast milk and solid or semi-solid foods. The situation worsens in the succeeding months (Graph 2).



Graph 1: IYCF practices in Philippines (WBT*i* report, 2015)



Source: Philippines National Demographic and Health Survey, 2008

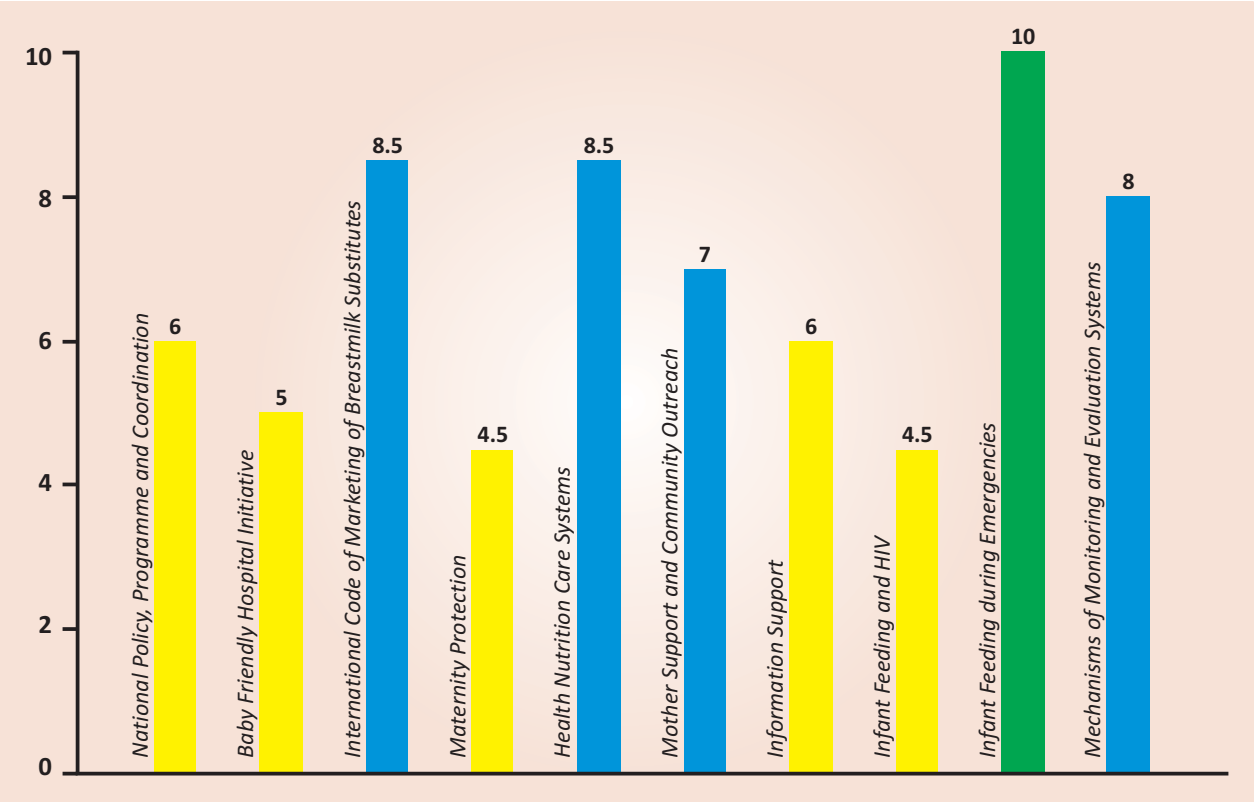
Graph 2: Breastfeeding practices in the Philippines, 2008

Status of the IYCF Policies and Programmes

According to the World Breastfeeding Trends Initiative (WBT*i*) assessment report 2015 (See Graph 3), Philippines has achieved good policies and implemented programmes in infant feeding during emergencies. But the country requires more efforts to adopt national policy on IYCF, BFHI, maternity protection, information support and infant feeding and HIV. Following text provides more information about the policies and programmes on IYCF in Philippines.

Philippines approved its first National Policy on Infant and Young Child Feeding in 2005. The Department of Health is the lead agency for programme and policy development. It helped create management structures at the national, sub national and local government levels. Programme coordinators are in place at each level, and funding is allocated yearly from the Government budget to support specific IYCF (breastfeeding) activities.

The IYCF National Plan of Action (2005-2010) was developed to support the implementation of the IYCF National Policy. In 2011, it was reviewed,



Graph 3: Policies and Programmes on IYCF in Philippines (WBT*i* report 2015)

revised and relaunched as the IYCF National Plan of Action (201-12016).

Legislation supporting the protection, promotion and support of breastfeeding include: (1) the Philippine Code of Marketing of Breastmilk Substitutes, (Executive Order 51, 1986); (2) the Rooming-In and Breast-feeding Act (Republic Act 7600, 1992), which implements the 1991 BFHI global standards; and (3) the Expanded Breastfeeding Promotion Act (Republic Act 10028, 2010), which establishes standards for workplaces, health facilities (with the establishment of milk banks) and public places.

In the Philippines, Republic Act 7600 (1992) called for the implementation of the *Ten Steps for Successful Breastfeeding* and the global BFHI standards. According to a recently published article, between 2003 and 2004, 79% (1427/1798) of all the health facilities with maternity services were certified as Mother-Baby In 2004, Government of Philippines, through an administrative order, allowed milk companies to get involved in the education, communication and production of IEC materials on breastfeeding promotion. Friendly. Due to a high turnover of personnel and limited funds, however, the MBFHI programme declined. Thus, hospitals that were initially certified were not sustaining the BFHI standards.

The Department of Health reported that as of August 2013, 426 of 1798 (24%) hospitals had received a Certificate of Commitment, and 26 national, regional and private hospitals were accredited as Mother-Baby Friendly Hospitals.[3]

The Philippines was among the first countries to pass national legislation (Executive Order 51) on the International Code of Marketing of Breast-milk Substitutes in 1986.In a recent review, UNICEF recognized the 1986 Philippine Code of Marketing of Breast-milk Substitutes as fully translating all provisions of the International Code. In 2004, the Department of Health initiated the revision of the implementing rules and regulations of the legislation. Later on, breastfeeding protection gained a momentum and a strong IRRi- implementing rules and

regulation of the Milk Code 2006 was issued.

In 2009, after the Philippines submitted its country report, the CRC Committee concluded that maternity leave in the Philippines is insufficient to support the efforts of increasing exclusive breastfeeding rates in the country.[4]

While Republic Act 10028 is the first law to provide for paid breastfeeding breaks and breastfeeding stations in the workplace, not all workplaces are implementing the law. The Department of Health cited the lack of implementing guidelines as one reason.

On the other hand, as of September 2012, the Department of Health reported a total of 378 breastfeeding/ lactation stations were set up in workplaces (e.g. factories, offices) and public places (e.g. malls, commercial centres, airports), and 34 were accredited as Mother-Baby Friendly.

The Philippines has an established community-based health infrastructure with services offered by Barangay Health Workers (BHWs) and Barangay Nutrition Scholars (BNS), both with a minimal incentive scheme, and breastfeeding counsellors, generally without a formal incentive scheme.

In line with that, the initial Philippines model was then transformed into a national campaign led by the Department of Health and its partners. As of 2013, the Department of Health reported that 5849 out of 42 000 (14%) barangays had established community support groups, with the training of peer counsellors.[3]

The existing policies in the Philippines are aligned with the recommendations of the Emergency Nutrition Network. The IRR of Executive Order 51 (May 2006) prohibits the donation of covered products, and Administrative Order 2007-0017 (July 2007) states: "Infant formula, breast-milk substitutes, feeding bottles, artificial nipples and teats shall not be items for donation."

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Australia - Case study on the status of infant and young child feeding policies, programmes and practices

Compiled by: Dr. Julie Smith with assistance from Naomi Hull

Breastfeeding Practices in Australia

Overall, only around one in ten Australian children are fed according to national dietary guidelines, and about one in twenty meet WHO optimal breastfeeding recommendations, though there are small improvements in initiation, exclusivity and duration in the past decade.

There was little change in breastfeeding initiation and duration in Australia between 1995 and 2004-05, but the gap between the most disadvantaged and least disadvantaged families widened considerably.[1] While breastfeeding initiation in Australia is currently high, exclusivity is very low, and duration of both exclusive and any breastfeeding is short. In 2004-05, breastfeeding initiation was 87.8%, and the proportions of infants breastfeeding at 6 and 12 months were 50.4% and 23.3%, respectively.[2] Breastfeeding initiation increased slightly between 2004-05 and 2010-11; virtually all children (92-96%) in Australia now initiate breastfeeding. Still, however, only around 15-18% of children are exclusively breastfed to at least 6 months;[1,2] one in three receive non-human milk or formula before one month of age.[3] Median duration of breastfeeding is less than 7-9 months, though 60% of babies still breastfeed at 6 months of age. A recent study found that continuation at 12 months increased from 26% to 30% after introduction of paid maternity leave in 2011.[4] Around 18% continue to breastfeed beyond 12 months, and 7% still breastfed at 19-24 months.

Australia's National Policies, Programmes and Coordination on Breastfeeding[5,6,7,8,9]

A national breastfeeding strategy and national infant and young child feeding strategy has been officially adopted by all Australian governments, but national infant and young child feeding guidelines diverge from WHO optimally IYCF recommendations in not promoting continued breastfeeding to 2 years. WHO growth charts have been adopted as the standard for Australian children aged 02 years. The Australian National Breastfeeding Strategy 2010-2015 (ANBS)[10] was adopted by Australia's Commonwealth and State governments in 2009. Governance of ANBS implementation is not strong, lacking a broad National Breastfeeding Committee, or National Coordinator, and with little public consultation, engagement or reporting. No specific funding has been allocated for implementation of the ANBS.

Infant Feeding and HIV

Australian guidelines are that, at present, breastfeeding is contraindicated when a mother is known to be HIV positive (specialist advice is needed for each individual case).

The National Health and Medical Research Council (NHMRC)[11] guidelines on HIV and breastfeeding are also supported by the BFHI in Australia. Confidential testing for HIV is available prenatally and ante-natally and appropriate counselling is provided if needed.

Infant Feeding During Emergencies

No national policy on protecting appropriate infant and young child feeding during emergencies exists.

NHMRC guidelines for health professionals state that where infants are being formula fed, supplies of infant formula, sterile water and feeding containers are required, and identify that there are important health and ethical issues associated with distribution of infant formula in disaster situations; hence preparation of any disaster plan should include discussion of these issues. With regard to breastfeeding mothers, the guidelines state "For the mothers of infants who are breastfed it is important to ensure that the mother has adequate nutritional support, including supplies of clean water to enable her to

continue breastfeeding." There is no implementation of this policy through training, or procedural guidelines among emergency services, though one state government department of health website ("Get Ready Queensland") has pantry lists for formula fed and breastfed infants. The Save the Children Australia report card on protecting children in emergencies highlights that emergency planning needs to consider the needs of pregnant women and breast feeding mothers.[12]

Education and Training for Health Professionals: Health and Nutrition Care Systems (in support of breastfeeding & IYCF)

The Australian Government committed $0.8 million over 4 years from 2007-08 to support training and educational opportunities for breastfeeding counsellors and health professionals. Australian government funding was allocated to address an identified lack of consistency in provision of breastfeeding training between jurisdictions and between categories of health practitioners, and to update information and resources on breastfeeding for health professionals who inform and support expectant women, their partners and families. Access to lactation consultants is limited, being unavailable through the public health system, Medicare.

Support Out of Hospital: Mother Support and Community Outreach, and Information Support

Several recent initiatives integrated with other health and nutrition policy frameworks for women and children and targeting priority groups partly address identified needs for mother support and information on breastfeeding in the community. Funding was provided for a national breastfeeding helpline operated by qualified ABA volunteer breastfeeding counsellors.

Mother-to-mother feeding support for breastfeeding in Australia has been available via Australian Breastfeeding Association (ABA) since 1964.[13] In 2007, the Best Start Inquiry recommended funding ABA to expand its current breastfeeding helpline to become a toll-free national breastfeeding helpline. From 2008, the Commonwealth government provided funding of $250,000 per annum for a 5 year period to ABA for this purpose. The free service is available 24 hours a day and callers receive breastfeeding information and peer to peer support by qualified ABA volunteer counsellors. Independent evaluation found that the National Helpline 'meets a clear need for non-clinical breastfeeding information and support, and makes an effective and efficient contribution to government policy to achieve better outcomes for mothers and babies...[with] a high level of satisfaction among users with the service'.[14]

Support in Hospitals: BFHI (Ten steps to successful breastfeeding)

The BFHI was launched in Australia in 1991. Initially, the UNICEF Committee in Australia oversaw BFHI, and since 1995, the Australian College of Midwives. Australian governments publicly stated a policy in 2012 to encourage all hospitals to implement the Ten Steps and to be BFHI accredited, but currently less than one in four hospitals is BFHI accredited and only around 30% of Australian babies are born in these hospitals. There is little evident progress on recommendations to requiring maternity care facilities to achieve BFHI accreditation as a condition of receiving public funding.

Revisiting the WHO Code: Implementation of the International Code of Marketing of Breastmilk Substitutes

The WHO International Code of Marketing of Breastmilk Substitutes aims to contribute "to the provision of safe and adequate nutrition for infants, by the protection and promotion of breastfeeding, and by ensuring the proper use of breast-milk substitutes, when these are necessary, on the basis of adequate information and through appropriate marketing and distribution".[15]

In voting for the adoption of this Code at the WHA in 1981, Australia made an international commitment to take action to give effect to its aims and principles and accepted responsibility for their implementation as appropriate to social

and legislative frameworks in this country.

To date Australia has only partially implemented the WHO Code, and this implementation is highly fragmented. Though reviews since 2001 have recommended action to address key gaps in WHO Code implementation, these have not been taken. Guidance for health workers on infant feeding on the WHO Code is contained in national dietary guidelines. An industry agreement to restrain marketing of infant formula was supervised by government from 1992 until 2013, when government oversight ended. Mandatory labelling and composition provisions contained in the Australia New Zealand Food Standards Code remain inconsistent with NHMRC Dietary Guidelines on infant age for introducing complementary foods, and regulation of health and nutrition claims including on toddler formulas is weak and out-dated. Key aspects of the WHO Code that to date have not been implemented in Australia include marketing restrictions on retailer activity, bottles, teats, and dummies and breastmilk substitutes other than infant formula (e.g. milk drinks for toddlers, baby foods and non-milk drinks.

In 2010, the World Health Assembly (WHA 63.23, May 2010) had resolved "(4) to end inappropriate promotion of food for infants and young children, and to ensure that nutrition and health claims shall not be permitted for foods for infants and young children, except where specifically provided for in relevant Codex Alimentarius standards or national legislation."[16]

Until 2013 Advisory Panel on the Marketing in Australia of Infant Formula (APMAIF) monitored industry compliance with the Marketing in Australia of Infant Formulas (MAIF Agreement).On 8 November 2013, the APMAIF ceased to operate, due to public service cutbacks.[17,18] In late 2015, the industry sought regulatory endorsement of a further MAIF Agreement,[19] though compliance is no longer over sighted by government. The proposed Agreement continues to exclude commercial food products for infants and young children, other than infant formulas, as well as failing to addressing concerns raised about the 1992 MAIF Agreement, such as regarding toddler formulas or marketing to health professionals or health services. The proposal to authorise and Agreement for a further 10 years has been met with strong opposition from NGOs and members of the public.

Breastfeeding friendly environments: Maternity protection

Although Australia has not yet ratified ILO Convention 183 or Recommendation 191, a national paid parental leave (PPL) scheme was introduced in 2011 providing the equivalent of 18 weeks paid maternity leave on the minimum wage for employees or self-employed women, and legislative provisions protect the rights of breastfeeding women, including in relation to treatment in employment, obtaining goods and services, and breastfeeding in public. Employment legislation also provides some maternity protections including 12 months statutory unpaid maternity leave, and requesting flexible employment arrangements. An evaluation study[4] found increased breastfeeding duration resulting from introduction of the PPL scheme, and improved maternal mental health, especially disadvantaged mothers. Breastfeeding at 12 months rose to 30%, from 26% before PPL was introduced. Prior to the scheme, only around 25% of women were entitled to paid maternity leave, mostly professionals or government employees.[20,21]

Laws regulating employment conditions also provide maternity protection including unpaid leave. The Fair Work Act provides for the right to parental leave and related entitlements, and to request flexible working arrangements.[22] Minimum National Employment Standards since the 1970s have included 12 months statutory unpaid maternity leave for many employees. While many public sector employees have workplace or employer based entitlement to paid breaks for feeding/expressing, paid breaks are not part of these minimum standards.[23]

All Australian states and territories have legislative provisions protecting the rights of breastfeeding women, including in relation to employment and breastfeeding in public. In addition to state and territory anti-discrimination laws, amendments to the

Commonwealth Sex Discrimination Act 1984 were passed in 2011 establishing breastfeeding as a separate ground of discrimination.

Statistics: Mechanisms of monitoring and evaluation system

A national infant feeding survey was conducted in 2010 to provide baseline data for ANBS evaluation, though there are no plans for a follow up survey, and progress on a nationally consistent system for monitoring and evaluation depends on funding which has not been committed. Breastfeeding is no longer adequately measured in Australia's National Health Survey, which is conducted every five years.

As part of ANBS implementation, the Australian government committed to establish a basic set of national indicators and definitions for a national system to monitor breastfeeding trends in Australia and work with state and territory towards greater coordination of breastfeeding data collection of which is presently highly diverse and irregular.

Conclusion

Responding to several years of NGO policy advocacy, a national breastfeeding strategy and national infant and young child feeding strategy (the Australian National Breastfeeding Strategy 2010-15) was adopted by all Australian governments in 2010. However, funding has not been committed for implementation of the strategy, including for nationally consistent systems of monitoring and evaluation of breastfeeding. Since 2003, national infant and young child feeding policy (the NHMRC Dietary Guidelines) has promoted exclusive breastfeeding to around 6 months, though not continued breastfeeding to 2 years. WHO growth charts have been adopted, but Australia has not formulated plans for appropriate infant and young child feeding in emergencies; HIV/AIDS remains a contraindication for breastfeeding.

The BFHI has not been widely implemented or accreditation required as a condition of public funding, though since 2012, all Australian governments have officially encouraged accreditation. Some funding has been provided for improved training and education of health workers on breastfeeding, and for mother support and information, but there is no commitment to ongoing national funding for implementation of the ANBS. The WHO Code is only partially and weakly implemented with fragmented regulatory arrangements. Food labelling and packaging standards remain inconsistent with dietary guidelines recommending 6 months exclusive breastfeeding and continued breastfeeding to 12 months and beyond. Maternity protection has recently been improved to ILO minimum standards of paid maternity leave, and legislation prohibits discrimination against breastfeeding women. Employment law also supports requests for flexible work arrangements, and 12 months unpaid maternity leave with job protection is a minimum employment standard.

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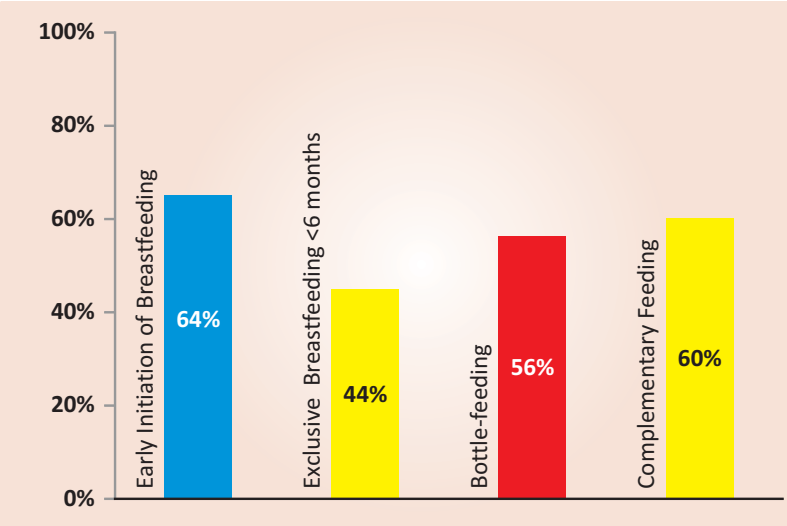
Malaysia: Case study on the status of infant and young child feeding policies, programmes and practices

Compiled by: Professor Dr Hjh. Adlina Suleiman, PJM; Advisor: Puan Siti Norjinah Abdul Moin

Infant and Young Child Feeding Practices

According to the World Breastfeeding Trends Initiative (WBT*i*) Malaysia assessment report 2015 (see graph 1 below), 64% women initiate breastfeeding within one hour of birth; 44% women practice exclusive breastfeeding below six months of age; complementary foods are started in 60% infants at appropriate time and the median duration of breastfeeding is 12 months.



Graph 1: IYCF practices in Malaysia (WBTi report, 2015 available at: http://www.worldbreastfeedingtrends.org/GenerateReports/report/WBTi-Malaysia-2015.pdf)

Infant and Young Child Feeding Policies and Programmes

In the WBTi assessment of policies and programmes in 2015, Malaysia has score 85.5/150. The country has achieved fair amount of success in national policy, programmes and coordination; health and nutrition care systems; and infant feeding and HIV. The country is not doing well in infant feeding during emergencies. In other areas like BFHI, Code implementation, community outreach, information support, monitoring and evaluation systems etc. country needs to do more (see the Graph 2).

Policies and programs on BFHI (hospital practices)[1]

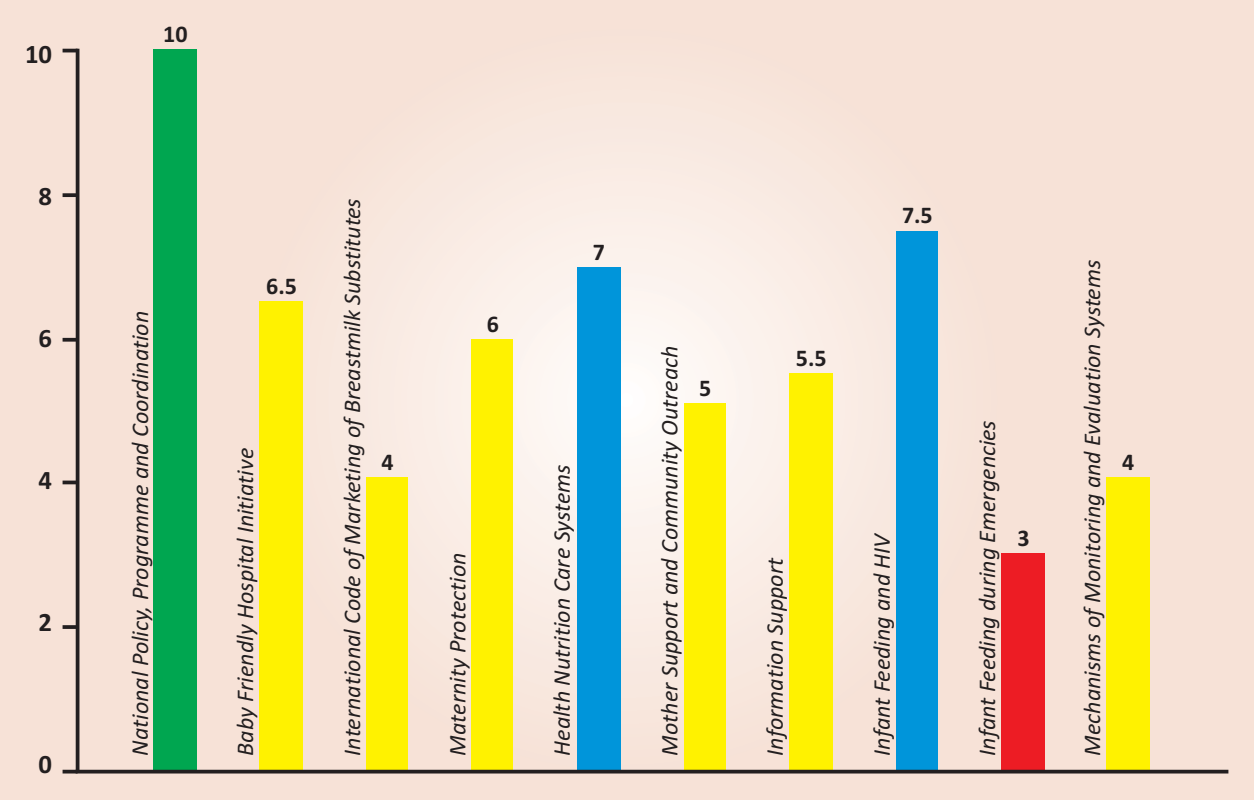
In Malaysia, 147 out of a total of 358 hospitals (41%) - both public and private and maternity facilities offering maternity services have been designated or reassessed as "Baby Friendly" in the last 5 years.

In 2004 Ministry of Health Report, government facilities recorded 354,856 (78.5%) of births compared to 83,275 (18.4%) at private hospitals and home delivery of 13,712 (3%). If this percentage holds true until now, there will be about 75% of mothers having access to the right information on breastfeeding at birth in Malaysia since all government hospitals are Baby-Friendly now.

Though initiation rates have increased in recent years due to stringent implementation of the Ten Steps in BFHI policy, the continuance rate is disappointing. This is partly because the policy is not extended to community clinics where most mothers and their newborns go for follow-up and immunization.

Non-conformance after achieving BFHI recognition is an area of concern. The BFHI Assessment system is questionable since the team that goes around assessing consists of nurses and doctors who are working in the Ministry of Health. They do not assess their own hospitals but of others within the Ministry which brings in the question of bias. This whole routine has become an institutional exercise that in the end does not benefit the breastfeeding mother who breastfeeds while at the hospital but stops soon after she reaches home. Hospitals are not accountable for sustaining breastfeeding, community clinics and health clinics should become `Baby-Friendly'.

There is a need to strengthen the internal monitoring and assessment for hospitals. There should be an independent body (not just



Graph 2: WBT*i* assessment - Malaysia 2015 - IYCF Policy and Programmes

Ministry of Health) to assess the BFHI status, which picks hospitals at random for a follow-up assessment. (eg. 5 from different states for each country) to recheck the status on behalf of WHO-UNICEF. This will ensure integrity and quality of the accreditation and most importantly help the mother who is breastfeeding. Moreover, there is a need to have an accreditation program for the community clinics to become `Baby-Friendly', using the hospital based guidelines but extending it to the community.

International Code of Marketing of Breastmilk Substitutes[2]

The International Code of Marketing of Breastmilk Substitutes in Malaysia is being implemented as a voluntary measure including provisions for a monitoring system. The compliance with the measures is monitored and violations reported to concerned agencies. However, in the absence of legislation, fines cannot be handed to violating companies.

There are three committees set up by the Ministry of Health Malaysia that meet regularly about matters pertaining to this Code:

- Review of Code and Ethics of Marketing Baby Food and Related Products
- Milk and Formula Industry and Ministry of Health Malaysia Relations

The idea of turning the code into law seems remote as the milk industry presses for leniency in the promotion of their products. Endless meetings have met with a deadlock on how to proceed with this matter. The voices of the breastfeeding mothers support groups seem to have fallen onto deaf ears. Because the code is not made into law, milk companies still continue to find their way `around' the regulations.

Private hospitals and maternity centers are not enthusiastic in their efforts to stop the usage of infant formula for newborns nor to stop the distribution of gifts for the newborns that include mother's milk and infant formula.

Non-compliance to the code is increasing. Milk companies are finding ways to break away from the code by using growing up formula milk (GUM) for cross branding. The whole marketing

plan of industry seems to be to `implant' the brand name in mother's psyche.

There is a need for a more effective advocacy effort with the parliamentarians for the code to be enacted as a law, which should also cover the marketing of growing up milk (GUM). Heightened code monitoring and enforcement by hosting a refresher training course and train new people to monitor the implementation of the code is also required.

Maternity Protection[3]

In Malaysia, women covered by the national legislation including private sector employees are allowed leave for 54 days (only for 3 children) but they are not formally allowed any breastfeeding break or reduction of work hours. Legislation obliges private sector employers of women in the country only 8 weeks of paid maternity leave and no formal paid nursing breaks. The national legislation provides for work site accommodation, which consists of space for breastmilk expression and crèche (tax rebate is given to the organization that has a crèche within the premises) for breastfeeding and/or childcare in work places in the formal sector. Women in informal/unorganized and agricultural sector are accorded the same protection as women working in the formal sector. Information about maternity protection laws, regulations or policies is made available to workers. There is a system for monitoring compliance and a way for workers to complain if their entitlements are not provided. Paternity leave is granted for the public and private sector for at least 3 days.

Public and private sectors still faced constraints in setting up crèches at the workplace due to the lack of suitable space and a safe environment for children such as at factories, and the difficulty of getting trained staff or care givers.

There is a need to provide the maternity leave for at least 120 days to all mothers regardless of the number of children. Allowing some flexibility of working hours for mothers to express milk should not impose a strain on the job, as the time required to express their breast milk is minimal. Supportive environment and policies as well as providing facilities at the workplace have been promoted by WHO. The government should provide better incentives for more creches either at or near workplaces and make it a priority in future development plans. The training programmes for the personnel that will manage the day care centres must also be put on the fast track and all should include breastfeeding support. One week paternity leave should be given to new fathers.

Community support to women[4]

In Malaysia, not all women have access to IYCF counseling and support services and community based counseling through mothers support group are not integrated into an overall IYCF health and development policy.

Mothers support groups in Malaysia includes:

- *Face book:* Breastfeeding mother to mother support group Malaysia: Provides grass root level counseling for breastfeeding mothers. Volunteers visit and talk to mothers on various matters pertaining to breastfeeding and infant feeding.
- BFHI Training and Research Centre provides a variety of breastfeeding/lactation courses, workshops and teaching aids to support health professionals. Established in 2013 this center has conducted the 40 hour WHO breastfeeding counseling course in Brunei in January 2014 and in Kuala Lumpur from 18 22 December 2014. There was a Breastfeeding Forum in Kuala Lumpur on 23 December 2014. The next 40 hr training course will be in March 2015.
- *Susuibu.com:* Conducts the Malaysian Breastfeeding Peer Counselor Program,. Project is focused on building capacity of breastfeeding counselors in Malaysia in order to sustain exclusive breastfeeding for 6 months, and continued breastfeeding with appropriate complementary foods up to 2 years and beyond. For 2015 this program is organized by susuibu.com and Global Health Media Project.
- Ibu Breastfeeding Support Group/ **www.ibufamily.org**
- *Glenie Mums' Club:* The mother-to-mother support group of Gleneagles Intan Medical Centre in Ampang, Kuala Lumpur. Kangaroo lub/**www.pah.com.my/health/kangaroocl ub**

- The Breastfeeding Support Group of Penang Adventist Hospital, it welcomes all pregnant women and breastfeeding mothers.
- Penang Mother To Mother Peer Support (MMPS) **http://pgmmps.wordpress.com**: MMPS offers support and information to breastfeeding mothers. The group meets every first Saturday of the month at Koala Kids Enrichment Center, YMCA Penang

There are several gaps in providing community-based support to the breastfeeding mothers. Community based volunteers and health workers are not trained in counseling for IYCF. Even at BFHI hospitals, mothers are not fully taught how to attach the baby to the breast since there is inadequate training (few hands on exercises and training program only covers 20 hour course that is inadequate).Postnatal follow up IYCF at community clinics and community level is inadequate.

To improve the situation, all health staff at hospitals and community level and members of mother support groups should be trained with WHO 40 hour's breastfeeding counseling course.

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India: Status and trends of the IYCF practices in the country including use of infant formula based on the latest data/WBTi assessment report

Compiled by: Dr. Shoba Suri

In India, annually about 26 million babies are born. According to the recent Rapid Survey on Children (2013-14),[1] timely initiation of breastfeeding is at 44.6%, and exclusive breastfeeding up to the age of six months has shown a rise and is 64.9%. However, introduction of complementary feeding to children 6-8 months has shown decline and is at 50.5% as compared to the NFHS-3 (2005-06). Unfortunately, infant and young child feeding indicators have not shown a consistent rise. This is a worrying trend. The reasons are manifold; they include aggressive promotion of baby foods by commercial interests, lack of support to women in the family and at work places, inadequate health care support, and weak overall policy and programmes. The sale of baby foods (infant formulas and infant foods) is increasing at a rapid pace in India. A report of Euromonitor International[2] has estimated a market worth 22 billion Rupees in India, and one that is growing each year, (Rupees 12666 to 22693 million from 2008 to 2012), which is a cause of concern.

Status of the IYCF Policies and Programmes

The latest WBT*i* assessment and analysis for India (2015) comes at an interesting juncture. On the one hand, the Government has made significant moves in policy, where child health and nutrition are concerned, such as promulgating the National Food Security Act (NFSA), with its assurance of maternity protection and food security for children, and the ICDS restructuring document, which carries much-needed reforms for the only scheme for children under the age of six years. However, on the other hand, major cuts have been announced in the social sector budgets related to education, health, and nutrition, including a massive cut in the ICDS scheme. Even though it has been over two years to NFSA, rules have yet to be finalized. The experience of those working at the grass-roots also suggest that problems of implementation of existing schemes and programmes for children are grave and likely to be exacerbated by the budget cuts.

Some specific issues related to infant and young child feeding (IYCF), such as the failure to convert the national guidelines into policy remain an overarching handicap, which the WBT*i* tool continues to pick up round after round. Gains have been made in clarifying breastfeeding issues in the situation of HIV/AIDS, but these are offset by stagnation in the context of disaster-management and the most important indicator: monitoring health facilities using the "Baby Friendly Hospital" criteria. Perhaps the matter of utmost concern is the fact that India does not currently monitor its public programmes for IYCF though it is believed that some reforms of the MIS for ICDS are in the pipeline. Though new data has emerged, this has been provided by a "one-off" exercise, and there is no clear direction on how comprehensive nutrition data is to be collected routinely and periodically at one goes rather than through many separate surveys.

While there is scope for improvement in all the indicators, India can make significant gains over the next three years if it addresses indicators 1 (Policy, Programme & Coordination), 2 (Baby Friendly Hospital Initiative), and 9 (Infant Feeding during Emergencies) as a priority. For all three indicators, India is currently in the 'Red' zone according to the WBT*i* colour rating. The fourth in Red is on Maternity Protection needs utmost attention too. All these indicators can be improved by simple and doable means not requiring vast investment but better coordination and conscious governance. There is scientific evidence available to support the actions that need to be taken in these indicators and the tools and training materials are also readily available. Graph 1 given below depicts status of policies and programmes on IYCF in India based on the WBT*i* assessment 2015.

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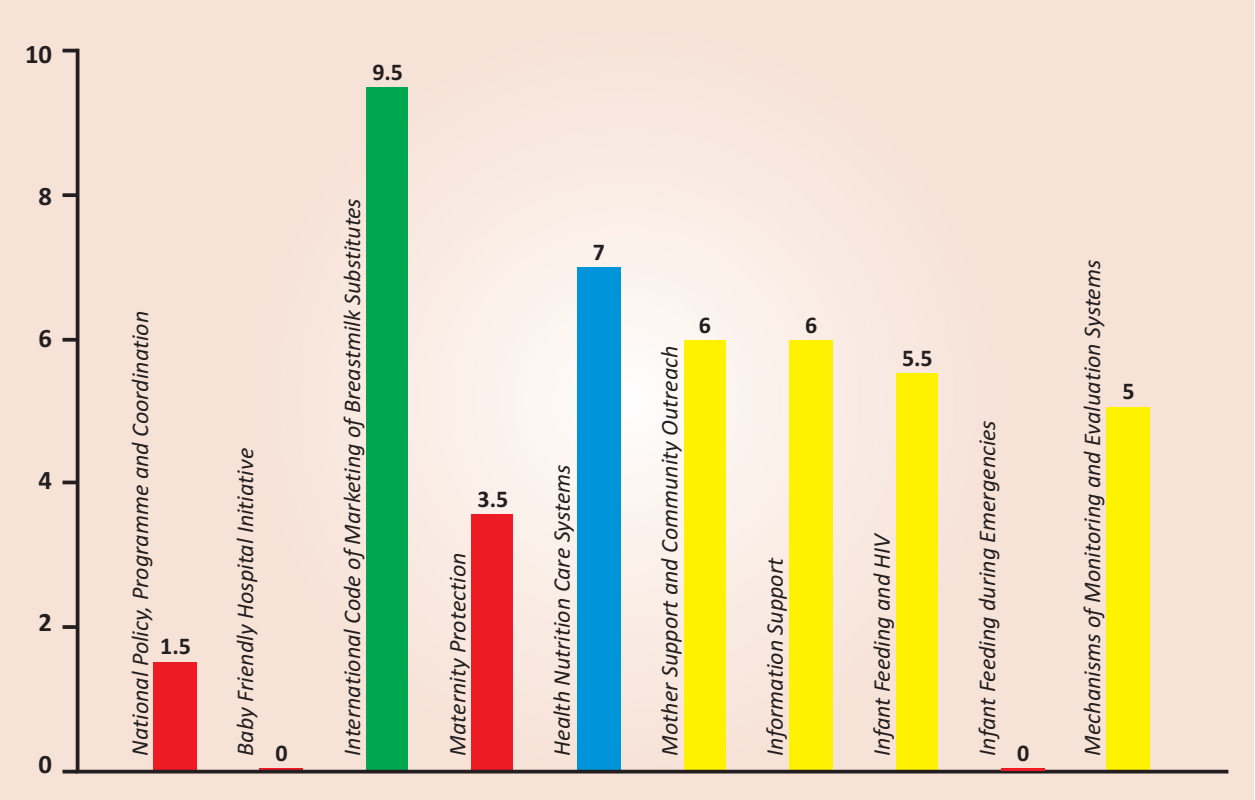

Graph 1: WBT*i* assessment - India 2015 - IYCF Policy and Programmes

ANNEXURE-2

GLOSSARY

ATTRIBUTIONAL LCA (ALCA) provides information about the impacts of the processes used to produce (and consume and dispose of) a product, but does not consider indirect effects arising from changes in the output of a product. ALCA generally provides information on the average unit of product and is useful for consumption-based carbon accounting.

BIODIVERSITY is the degree of variation of life forms within a given ecosystem or an entire planet. Biodiversity is a measure of the health of ecosystems and greater biodiversity implies better health. Biodiversity is in part a function of climate and tropical regions are typically rich, whereas the Polar Regions support fewer species.

CARBON FOOTPRINT is "the total set of greenhouse gas (GHG) emissions caused by an organization, event, product or person." GHG can be emitted through transport, land clearance, and the production and consumption of food, fuels and manufactured goods. The carbon footprint is often expressed in terms of the amount of **carbon dioxide** or CO_2 emitted, or its equivalent comprised of other GHGs such as **methane, (CH_4)**. These gases together contribute to global warming and are expressed in terms of **CO_2 -e** (equivalent). We all need to reduce our carbon footprint and lessen the impact of our ecological footprint.

CLIMATE CHANGE includes global warming and everything that the increasing levels of greenhouse gases will affect. Climate Change is a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years, not an oscillation such as El Niño. Climate change may be limited to a specific region or may occur across the whole Earth.

CO_2-EQUIVALENT EMISSION: is the amount of CO_2emissions that would cause the same time integrated radiative forcing, over a given time horizon, as an emitted amount of a long-lived GHG or a mixture of GHGs. The CO_2 equivalent emission is obtained by multiplying the emission of a GHG by its Global Warming Potential (GWP) for the given time horizon. The CO_2equivalent emission is a standard and useful metric for comparing emissions of different GHGs, but does not imply the same climate change responses (IPCC, 4 AR 2007)

CONSEQUENTIAL LCA (CLCA) provides information about the consequences of changes in the level of output (and consumption and disposal) of a product, including effects both inside and outside the life cycle of the product.

ECOLOGY is the interdependence of living things. It comes from the Greek words which in English mean "house" and "study of". It is the scientific study of the relations that living organisms have with respect to each other and their natural environment in our "house", that is, planet Earth.

ECOLOGICAL FOOTPRINT or environment footprint is a measure of human demand on the earth's resources and the load imposed on nature by a given activity or population. To leave no ecological footprint means that a person or an activity replaces in the environment exactly what is taken out. By assessing the use of non-renewable resources it is possible to estimate how much of the Earth or how many Earths - are needed to sustain a particular level of consumption.

ECO-LABELS: Who decides what is "green" and how do they decide? Eco-labels identify a product that meets specified environmental standards, and should be awarded by an independent third-party organization to products or services that is determined to meet these standards.

ECOSYSTEMS are fragile because they are composed of inter-dependent parts. An example is a coral reef, a hierarchical system that is organized into a graded series of regularly interacting and semi-independent parts, such as coral species. These aggregate into higher orders of complex integrated wholes, such as communities.

ENVIRONMENT: The natural environment is the air we breathe, the water we drink and the soil that we cultivate to grow the food we eat. It includes all living and non-living things that occur naturally on Earth and interact with each other.

FOOD MILES are a way to measure how far food has travelled before it reaches the consumer. It is a

way of looking at the environmental impact of foods and their ingredients and includes transport of foods from 'farm to fork' and also taking waste foods to the landfill.

GLOBAL WARMING POTENTIAL (GWP): is defined by the Intergovernmental Panel on Climate Change(IPCC), as an indicator that reflects the relative effect of a GHG in terms of climate change considering a fixed time period, such as 100years, compared to the same mass of carbon dioxide.

GLOBAL WARMING refers to the continuing rise in the average temperature of Earth's atmosphere and oceans, their surface temperatures. Global warming is caused by increased concentrations of greenhouse gases in the atmosphere, resulting from human activities (anthropogenic) such as deforestation and burning of fossil fuels. A large proportion of the energy from the sun is thus prevented from being reflected back into space, leading to a rise in temperatures and contributing to global warming.

GREEN HOUSE GAS (GHG) is a gas in the atmosphere that absorbs and emits radiation within the thermal infra-red range. This process is the fundamental cause of the greenhouse effect. The primary greenhouse gases in the Earth 'satmosphere are water vapour, carbon dioxide, methane, nitrous-oxide, and ozone. For graphics see: http://en.wikipedia.org/wiki/File:The_green_house_effect.svg

GREEN HOUSE GAS MITIGATION is one way to reduce carbon footprints through the development of alternative projects, such as solar or wind energy or reforestation. It can be argued that breastfeeding provides some mitigation of green house gas emissions, thus contributing to reducing carbon footprint.

LIFE CYCLE ASSESSMENT (LCA) is a technique to assess environmental impacts associated with all the stages of a product's life from-cradle-to-grave (from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling). LCA is also known as life cycle analysis, ecobalance and cradle-to-grave analysis and in Sweden as life span assessment. LCA can help avoid a narrow outlook on environmental impacts. There could be Attributional and Consequential approaches to LCA.

METHANE (CH_4) is a relatively potent greenhouse gas. It has a high global warming potential compared to carbon dioxide, because it is more efficient at trapping heat. The comparative impact of methane on climate change is over 20 times greater than carbon dioxide over a 100-year period. Methane is emitted by human activities such as agriculture and raising livestock. Methane has a net lifetime of about 10 years, and its lifetime in the atmosphere is much shorter than carbon dioxide. It is primarily removed by reaction with hydroxyl radicals in the atmosphere, producing carbon dioxide and water. Methane also affects the degradation of the ozone layer.

SUSTAINABLE DEVELOPMENT is defined in the 1987 report of the Brundt land Commission: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Despite some perceptions that associate sustainable development mainly with the natural environment, it focuses on ways of meeting people's social and economic needs within natural resource limits so that human development can be both sustainable and sustained. This means the continuing the advance of poverty eradication, human rights and equity while also realizing more sustainable patterns of consumption and production, stabilizing climatic forces, and sustainably managing our common natural resource base. (quoted from UNICEF- A Post-2105 World Fit for Children: Sustainable Development starts and ends with safe, healthy and well-educated children, May 2013).

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AUTHORS

Dr. JP Dadhich, MD (Paediatrics) is the National Coordinator of the Breastfeeding Promotion Network of India (BPNI), South Asia sub regional representative for IBFAN Asia and South Asia regional focal point coordinator for World Alliance for Breastfeeding Action (WABA). He has contributed chapters in text books on various subjects including Newborn care, Pediatric care, Infant and young child nutrition etc. He has reviewed research articles and published research papers in pediatric, neonatology and Nutrition journals. He has also contributed in editing of Journals, Policy documents, Position statements, Training modules, Conference reports etc. on breastfeeding, infant and young child feeding, newborn health, child survival, etc.

DR JULIE P. SMITH, BEc(Hons)/BA (Asian Studies), PhD (Economics), ANU Dr Julie Smith is an Associate Professor and economist at the Australian National University (ANU), and holds an Australian Research Council Future Fellowship for her research on the economic valuation of breastfeeding, and the regulation of markets in mothers' milk. Her publications in public health, paediatrics, public health nutrition, feminist and labour economics journals include studies on the economic value of breastfeeding, health costs of formula feeding, time use studies of breastfeeding, and on breastfeeding, work and childcare She led a research study for WHO on commercial baby food marketing in 2015, and has advised on the economics of breastfeeding for the US Surgeon General's 2011 Call to Action on Breastfeeding, for the Australian Parliament's Best Start Inquiry on Breastfeeding, and for the WHO/UNICEF Western Pacific 2007 Regional Consultation on Breastfeeding. She served as a board director for the Australian Breastfeeding Association from 2002 to 2011.

ALESSANDRO IELLAMO is an indendent consultant and has dedicated the past 12 years of his life working to protect, promote and support infant and young child feeding practices in several countries and regions of the world. He has done consultancy work with WHO, UNICEF, IBFAN Asia and other international organizations, facilitating in country and regional process that will help create and set up effective systems (hospital, workplaces, communities, regulation or marketing and promotion of relevant products) that create conducive conditions for women, families and communities to practice optimal breastfeeding and complementary feeding. He has authored and co-authored several papers on the issues related to infant and young child feeding, contributed to the development of tools and protocols to help governments and their partners. One of his latest work was leading the development of the World Breastfeeding Costing Initiative tool, and contributing to the writing to the “Need to invest in babies” by IBFAN Asia. He is now engaged in supporting emergency afflicted countries to ensure that emergency preparedness and response initiatives will protect breastfeeding and will help the affected populations protect breastfeeding.

PROF DR HJH ADLINA SULEIMAN, PJM MD (UKM), MPH (UM), MBA (SCU, AUST)**,** is the Head of the Community Medicine Unit at the Faculty of Medicine and Defence Health, National Defence University of Malaysia. She has been a pioneer staff in the setting up of three medical schools and is a member of the MMC/MQA accreditation team. She has 20 years experience teaching community medicine and has published articles in local/international journals on breastfeeding, depression among school children, stress among a diversified group of people, obesity among students and electromagnetic field radiation effect on health. She has been a breastfeeding advocate since 1991 and holds the post of Deputy President of the Malaysian Breastfeeding Mothers Support Association. She is a certified trainer of the WHO/UNICEF 40 hrs Breastfeeding Counselling Course and an assessor of hospitals that request for the BFHI certification.

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BP-33 Pitampura, Delhi 110034. INDIA
Phone: +91-11-42683059 27343606 Fax: +91-11-27343606
Email: bpni@bpni.org, info@ibfanasia.org
Website: www.bpni.org, wwww.ibfanasia.org/