Malaysian Journal of Social Sciences and Humanities (MJSSH) (e-ISSN : 2504-8562)
2025, Volume 10, Issue 3, e003315
DOI: https://doi.org/10.47405/mjssh.v10i3.3315

REVIEW ARTICLE

Environmental Implications of Breastfeeding and Its Role in Attaining the United Nations SDGs

Vasumathi A/P Subramanian[1*], Azlinda Azman[2]

[1]Department of Social Work, School of Social Sciences, Universiti Sains Malaysia, 11800, Pulau Pinang Malaysia
Email: vasumathi@student.usm.my
[2]Department of Social Work, School of Social Sciences, Universiti Sains Malaysia, 11800, Pulau Pinang, Malaysia
Email: azlindaa@usm.my

CORRESPONDING AUTHOR (*):
Vasumathi A/P Subramanian (vasumathi@student.usm.my)

KEYWORDS:
Breastfeeding
Sustainable Development Goals (SDG)
Infant Milk Formula
Environmental Impact

CITATION:
Vasumathi Subramanian, & Azlinda Azman. (2025). Environmental Implications of Breastfeeding and Its Role in Attaining the United Nations SDGs. *Malaysian Journal of Social Sciences and Humanities (MJSSH), 10*(3), e003315. https://doi.org/10.47405/mjssh.v10i3.3315

ABSTRACT

Breastfeeding is widely recognized for its numerous health benefits for both infants and mothers. Remarkably, increasing breastfeeding to a universal level could potentially save up to 823,000 infant lives and prevent breast cancer in approximately 20,000 mothers each year. However, the Sustainable Development Goals (SDG) did not specifically highlight breastfeeding as a target. More specifically, its potential role in promoting environmental sustainability has been largely overlooked. This paper aims to delve into the environmental impact of breastfeeding and its contribution towards achieving the SDGs. It will bring to light the often-ignored links between breastfeeding and environmental impact. In situations where breastfeeding is not prevalent, infant formula serves as a replacement. However, the production, packaging, distribution, and consumption of these substitutes pose various environmental challenges. Additionally, the challenges in strengthening the implementation of the International Code of Marketing of Breastmilk Substitutes and the need for global funding to promote breastfeeding practices are discussed as well. In a nutshell, joint effort and the strong role of government intervention in achieving the Global Breastfeeding Collective's target of a 70% exclusive breastfeeding rate by 2023, could impose a significant contribution into a broader sustainable development agenda.

Contribution/Originality: This review highlights the environmental impact of breastfeeding and its role in sustainability and climate action. It examines the carbon footprint of infant formula, resource conservation, and policy challenges, offering insights for governments and advocates to align infant feeding policies with global sustainability goals.

1. Introduction

Sustainable Development Goals (SDGs) embody 17 global goals as part of the 2030 Agenda for Sustainable Development adopted by the United Nations member states (UNDP, 2022). It provides a framework for addressing various social, economic, health and environmental challenges to achieve a more sustainable and equitable world. On the other hand, breastfeeding has a remarkable impact on the health and well-being of mankind, especially for babies and mothers. Scaling up breastfeeding at the universal level, can help save the lives of up to 823,000 babies as well preventing breast cancer among 20,000 mothers annually (Jones et al., 2003). Besides its huge impact on children and women's health, breastfeeding is considered the most sustainable food resource because it is a 'natural, renewable food' that is environmentally safe, produced and delivered to the customer without pollution, packaging or waste (Rollins et al., 2016).

Collaborating breastfeeding advocacy into SDG campaigns can contribute effectively to achieving many of the SDG targets. The most predominant and directly connected SDGs to breastfeeding are; SDG 2 – Zero Hunger (WHO, 2009); SDG 3 – Good Health and Well-Being (Victora et al., 2016; Binns et al., 2016) which relate to food security, availability, nutrition and contributes to maternal and infant well-being. Despite the abundance of evidence supporting breastfeeding's advantages, a specific target for breastfeeding has not been set as part of the SDGs.

On the surface level, the connection between breastfeeding and the environment may not be clear because its connection is indirect. The impact of breastfeeding is evident when infant formula comes in as a substitute whenever breastfeeding is scarce. There are various environmental burdens associated with the production, packaging, distribution and consumption of these products. Breastfeeding is deemed sustainable feeding option due to its renewable and natural nature. Otherwise, infant formula is perceived as unsustainable. In this regard, the manufacturing of infant formula has a large environmental and ecological impact. Such an ecological footprint often occurs when humans try to replicate natural processes like breastfeeding and as a result, it has a profound effect on the earth's resources. Thus, measuring the consumption of non-renewable resources can help determine the extent to which resources are needed to sustain human consumption (Linnecar et al., 2014).

The World Alliances of Breastfeeding Actions (WABA) has made a great effort to connect each of the 17 goals with breastfeeding. This has been incorporated into its annual World Breastfeeding Week (WBW) celebration as a WBW-SDG campaign (World Alliance for Breastfeeding Action, 2016). It underlines the link between investing in breastfeeding and achieving SDGs that aim to end poverty, fight inequality and tackle climate change by 2030. The theme of WBW celebration for 2020 was; Support Breastfeeding for a Healthier Planet (World Alliance for Breastfeeding Action, 2020b).

This trend has significant implications for the United Nations' Sustainable Development Goals (SDGs), particularly Goals 6,12, 13,14 and 15 which focus on clean water; responsible consumption and production; climate action; life below water and life on land. The Global Breastfeeding Scorecard 2022 reported that the current breastfeeding rates are not meeting the necessary targets to safeguard the health of women and children (World Health Organization and the United Nations Children's Fund, 2022a). From 2015 to 2021, only 47% of newborns commenced breastfeeding within the first hour of birth, falling short of the 70% target (UNICEF & WHO, 2023). However, significant progress was

made in exclusive breastfeeding during this period, with a rate of 48%, nearly achieving the World Health Assembly (WHA) target of 50% by 2025 (WHO, 2014). Despite this progress, further efforts are required to reach the 70% exclusive breastfeeding rate by 2030, a goal set by the Global Breastfeeding Collective in alignment with the timeline of the Sustainable Development Goals (SDGs).

While breastfeeding is still making progress, the usage of infant formula is becoming a significant global trend. A study on infant feeding practices revealed that 79% of parents fed their infants U.S. infant formula brands, and 39% fed their infants imported infant formula brands (Cernioglo & Smilowitz, 2023). This underscores the widespread reliance on infant formula. On the commercial front, the Baby Milk & Infant Formula market is expected to reach US$50.67 billion in 2023 with an annual growth rate of 5.56% from 2023 to 2028 (Statista, 2023). This projection suggests that the consumption of infant formula milk is likely to increase in the coming years. The rise in the usage of infant formula milk is a global concern that has significant implications for Sustainable Development Goals (SDGs) 12 and 13.

While infant formula can be a necessary alternative for some mothers, its widespread use poses challenges to responsible consumption and production (SDG 12) and climate action (SDG 13). While it's crucial to respect every mother's feeding choice, it's equally important to understand the broader environmental implications of infant formula milk usage. This underscores the necessity to endorse, safeguard, and bolster breastfeeding across all societal strata.

1.1. Research Objectives

This paper intends to highlight the environmental impact of breastfeeding. Further, it discusses strategies to protect this practice especially related to the marketing of infant formula and the importance of funding breastfeeding promotions globally.

2. Literature Review

As defined by Martin et al. (2016) infant formulas are formulated to imitate the composition of human milk and are typically composed of cow's milk, vegetable oils, vitamins, and minerals. As these ingredients for are procured from global supply chains, undoubtedly, infant formulas are supplied to consumers through intricate supply chains (Baker et al., 2021). Subsequently, these formulas have a high carbon footprint as the process of procuring and producing these ingredients often span different countries (Baker et al., 2021; Baker et al., 2016). Despite their popularity, there is limited research on environmental impact of infant formula feeding, specifically those focusing on comparing the impacts of infant formula consumption against breastfeeding. To the best of the authors' knowledge, there are only two peer reviewed studies, Karlsson et al. (2019) and Amonkar et al. (2019) that compared the environmental impacts of formula feeding and breastfeeding using life-cycle assessment (LCA) methodology. Both studies focused on carbon footprint, which serves as an indication of global warming potential. Both studies used different methodologies and presented different perceptions, which led to inconsistent findings. Karlsson et al. (2019) argued that breastfeeding has two times lower carbon footprint than formula feeding. Likewise, Amonkar et al. (2019) found formula feeding has a lower carbon footprint than breastfeeding based on the assumption of most breastfeeding mothers would pump their milk, indicating the need for more 'tools' like breast pumps. Meanwhile, a study by Pope et al. (2021) highlighted that infant formula has

a significant water footprint. Notably, the study did not considered other aspects of environmental impact. Thus, examining other impact categories could help discover potential environmental trade-offs and how their impacts could conflict with each other.

Every step of infant formula production has some extent of environmental impacts. There are few steps involved starting with manufacturing and production, processing and packaging, transportation and distribution followed by consumption. The environmental impacts at each stage is further discussed below.

2.1. Production and Manufacturing of Infant Formula

As breast milk is produced naturally, breastfeeding is considered a clean, low carbon, climate-compatible and green sustainable solution (Linnecar et al., 2014). However, when breastfeeding is scarce the demand for infant formula increases and it demands the industry's expansion (Binns et al., 2020). One of the main raw materials that is needed in the manufacturing of infant formula is cow's milk and the ever-growing industry needs to ensure a steady supply of it. A comparison study conducted over four months of exclusive breastfeeding with formula feeding indicated that cow milk was the main source of environmental impact from the production of infant formula (Andresen et al., 2022).

This leads to the increasing need for land to raise dairy cattle to produce milk which is the raw material for this production. It involves clearing large land areas for grazing cattle leading to extensive deforestation. Growing deforestation has resulted in higher greenhouse gas emissions. Global warming is attributing to many factors, and one of the primary cause is the high greenhouse gas emissions over the last few years. According to the The Lactation Network, (2020), dairy farming contributes to the largest number of greenhouse gas emissions. As mentioned in Linnecar et al. (2014), 1.4 billion cattle are farmed globally and they contribute to approximate 40 per cent of all human-produced methane each year. In this light, the amount of greenhouse emission annually is double global milk production**.** This situation has escalated due to the rising demand for dairy globally corresponding to population growth. The increasing demand for dairly has also impact the need for space for cattle farms. The Lactation Network (TLN) in its' WBW 2020 reported that in the last 25 years, forests approximately the size of the India, have been cleared to make way for pastures and for feeding livestock. The surrounding areas often suffer from soil, water, and air pollution as a result of unsustainable dairy farming and feed production, leading to loss of forests, prairies and wetlands, all of which are ecologically important areas (The Lactation Network, 2020).

Infant formula manufacturing also requires a large amount of water. In this regard, water consumption is an further area of concern as infant milk production requires significant amount of water at all steps (Joffe et al., 2019). Water usage can be divided into three, green water (rainwater), blue water (the extraction of ground and surface water for us), and grey water (for diluting pollutants to meet quality standards). Another study by Mekonnen and Hoekstra (2011) stated that based on global average estimation of water usage in milk production, approximately 6.6 kg of raw milk is needed to produce 1 kg of infant formula. This necessitates the use of about 626 litres of blue water. The process of converting this milk into powder requires an additional 1.5 litres of water per kilogram or roughly 10 litres for each kg of infant formula. In the meantime, Linnecar et al. (2014), asserted that more than 4000 L of water is needed to produce 1 kg of breast milk-substitute powder. The water used in manufacturing powdered infant formula need to be heated to at least 70°C. This process requires the same amount if energy as charging 200

million smartphones each year (BMJ, 2019). Whitehead (2020) mentioned that while several low- to middle-income countries (LMIC) like Vietnam, which is experiencing a hike of up to 12% in its annual milk production in the past decade, these countries are projected to experience water stress due to climate change affecting major river systems like the Mekong.

On the other hand, breastfeeding requires no water and exclusively breastfed babies don't need water for the first six months of their life (Kramer & Kakuma, 2007).

2.2. Processing and Packaging of Infant Formula

In terms of the production of infant formula, there are several sub-processes including the production of skimmed milk, whey protein and lactose from raw milk before fraternizing them with vegetable oil at the production plant (Karlsson et al., 2019). As known, unprocessed raw milk is the standard for the infant formula ingredients skimmed milk, whey protein concentrates, and lactose. According to Karlsson et al. (2019), a total of 6.6 kg energy energy-corrected raw milk is required to produce 1 kg of infant formula powder. In this case, it is clear that tonnes of raw milk are required to meet the increasing demand of infant formula. Formula milk manufacturing also requires extensive land use with approximately 1 billion hectares, or 7% of the Earth's land surface has been cleared for feeding farm animals over the last century (FAO, 2019). In this light, large scale dairy production impacts biodiversity through deforestation and habitat loss as forests are cleared to create arable land for feed production. The cultivation of plants for feeding livestock leads to the fertiliser use, introduction of new species, and overgrazing attributed to high cattle numbers. This shows how dairy farms contribute to deforestation and massive land clearance that result in biodiversity loss globally.

As mentioned in IPBES (2019), the change of land use due to agricultural expansion of dairy farms and manufacturing, on the whole, is one of the main culprit for the global biodiversity loss. This situation is directly liked to climate change as it leads to the carbon sinks and the lossed of stored carbon. In New Zealand, Bowie et al. (2016) reported that only only 31 % of native plant species were able to survive after land conversion to dairy farming. Similarly, FAO (2010) claimed that drastic climate changes are linked to greenhouse gas emissions by dairy products production. Each year, dairy products manufacturing contributes 3.1 gigatonnes of CO2 equivalent annually (GtCO2e/year), or 3% of all anthropogenic emissions. The increasing emissions from the sector should be a matter of concern.

Electric generation through production of milk involving various steps does contribute to the greenhouse gas emission. Starting from gastrointestinal fermentation for ruminant digestion, and anaerobic manure decomposition, the denitrification process in manure management, processing technologies including dry-blending or wet drying and spray drying process; followed by packaging consumes large amount of energy, thus generating negative impact to the environment (FAO, 2018). Mostly, packaging of infant formula usually performed through tin cans. Each tin can only hold up to 0.8 kg of powder, thus requiring 0.14 kg of canning steel per kg of infant formula powder (Andresen et al., 2022). This clearly exhibits large amount of energy has to be utilized to produce canning steel in mass to accommodate the huge demand of infant formula milk (Andresen et al., 2022). Furthermore, the World Alliance for Breastfeeding Action in the WBW 2020 message projected that approximately 150 million cans of formulas are need to feed a million babies in the course of to years (World Breastfeeding Alliance , 2020a), if not recycled,

metal infant formula cans will be disposed and ended up in landfill sites. Moreover, improper disposal of plastic, aluminium and paper used for packing formulas could result in environmental pollution as these items may end up in the ocean. At the same time, formula feeding is also linked to emissions during transporting, distributing of formulas, as well as the production of feeding bottles and for sterilising bottles. It is estimated that consuming 1 kg of CMF lead to the emissions of between 11 and 14 kgCO2e. As breastfeeding do not require packaging and labels, it can help reduce harmful emissions to prevent environmental degradation. Other studies further discussed the link between formula feeding and global warming, as the former emits almost double greenhouse gasses than the later. Thus, lowering greenhouse gas emissions is ciritical in achieving climate targets and mitigating global warming in the future (Karlsson et al, 2019; Andresen et al., 2022).

2.3. Transportation and Distribution

The exact data required to measure the ecological footprint is not readily available, such as: whether is the milk produced domestically, where it comes from, how many cars are needed to produce the milk, how is the dairy run, how far away the milk collection points and how was the milk transported (Linnecar et al., 2014). However, the increasing market share of baby foods and greenhouse gases especially in China and India is worrying. Dadhich and Smith (2015) reported that the production of formula milk in China increased from 29400 to 56000 tonnes in 4 years, while in India, the volume hiked from 24480 to 27783 tonnes. At the same time, the total sale of formula in China contributed to 224,9287 tonnes of greenhouse gases while in India, it contributed to 111,226 tonnes of greenhouse gases. Emissions caused by to transportation of milk across different parts of the world also add up to the overall greenhouse gas emission becomes. This highlights the growing burden of formula feeding to the environment. While there are only 40-50 infant formula manufacturing companies globally, the produce about 3.8 million tonnes of infant formula each year. It involves transporting raw materials for production, packaging materials, and supplying the products to other countries by air. Hence, the process of transporting the formula , which begins with transporting raw materials to plants and ends with consumers around the world bringing them home incur considerable carbon footprint (FAO, 2018). As reported by Joffe et al. (2019), China imported almost 180 kilotons of packaged infant formula in 2015, with over 90% were imported from Europe. The sale and distribution of formula milks globally require an extensive supply chain across various levels of distribution in delivering formula milk to consumers.

Meanwhile, b**r**east feeding is a sustainable, natural source of food. It is environmentally safe and produced as it is delivered without pollution, unnecessary packaging, or waste (Linnecar et al., 2014). In other words, breastfeeding has the shortest food chain – mother to child**.** It is a completely sustainable source of nourishment and is considered 'hyper-local'.

2.4. Consumption

In regard to the consumption of infant milk formula, as mentioned in Andresen et al. (2022), formula fed infants consume more milk per day compared to breastfed infants. This is due to the predicted higher requirement of energy among formula-fed infants.

Similarly, it was observed that breastfed infants reported a lower milk intake during the first months of life compared to formula-fed infants (Mameli et al., 2016). In this regard,

based on the daily requirement of 0.82 kg ready-to-feed infant formula and an average of 6 servings per day, each infant requires close to 1 kg of infant formula. This requires approximately 6 L of water for sterilization (Andresen et al., 2022). Apart from that, formula feeding requires feeding bottles. It was also estimated that 0.0023 kg of plastic is required per 1 kg ready-to-feed infant formula. Feeding bottles need to be sterilised by boiling the bottle on a stove or electric kettle, which leads to higher electricity usage. This process accounted for 15% of the impact of freshwater eutrophication due to the electricity needed for these process (Andresen et al., 2022).

This number seemed alarming as with the rising demand of infant formula feeding necessitating more feeding bottles. Plastic accumulation will lead to severe environmental degradation that adversely affect human, wildlife and their habitats. Besides plastic accumulation, consumption of infant formula leads in some extent of food waste. Those parents feeding infant formula from a bottle are encouraged to allow for the child to regulate consumption and discard any leftover milk, resulting in direct food wastage (Hagemann et al., 2012; Clune et al., 2017) however, breastfeeding directly at the breast will not leave such additional discarded milk, thus no direct wastage found. By assumption, a post-partum mother exclusively breastfeed by feeding directly at the breast only during the first four months. In addition to direct feeding, many breastfeeding mothers use breast pumps to express milk either frequently or occasionally which might raise the environmental impact of expressed breastmilk (Smith, 2015; Verge et al., 2013).

In addition, the reconstitution of infant formula powder into liquid form requires about 7 litres of water for every 54 servings in a kg of infant formula. Whereas, sterilization of feeding bottles as recommended by the WHO requires 5 litres of water for 6 bottles per day, adding another 45 litres per kg of infant formula. Washing each bottle after use adds an estimated 11 litres of water per kg of infant formula. In total, it's estimated that around 699 litres of blue water or water drawn from surface or underground sources are required for the production and use of each kg of infant formula milk (or 13 litres per serving) leading to environmental impacts.

2.5. Other Environmental Impacts

There has been minimal research into the broader environmental implications of infant milk formula. In this regard, it is important to note that infant formula production relies heavily on milk from the dairy industry which is linked the environmental impacts like biodiversity loss, antimicrobial resistance, land use change, zoonotic diseases, soil degradation and air pollution. Infant milk formula is one of the most extensively marketed dairy products globally, with global imports reaching 1.47 million tonnes in 2019. The transport of formula milk across the globe requires considerable amounts of fossil fuels for transportation. While the contribution of transport to greenhouse gas emissions has been discussed earlier, the use of fossil fuels also implicates infant formula in the production of harmful air pollutants with detrimental effects on respiratory and cardiovascular health, including particulate matter, nitrogen oxides (NOx), and volatile organic compounds (World Health Organization and the United Nations Children's Fund, 2021).

The discourse above indeed evidences that bolstering breastfeeding efforts can contribute significantly to our planet's preservation. This aligns seamlessly with the connections drawn by the World Alliance for Breastfeeding Action (WABA) between breastfeeding and

the Sustainable Development Goals (SDGs). Upon analysis, it becomes clear that breastfeeding's environmental impact correlates directly with five of the SDGs.

Infant milk formula has a massive environmental impact. This necessitates a clear need for breastfeeding promotion and protection. Hence, breastfeeding promotion should be prioritised by the global health community. A comprehensive approach is needed to reduce infant milk formula consumption to sustainable levels and encourage breastfeeding, this calls for considerable government intervention through policy-making and regulation. A key part of these efforts is the implementation of the WHO International Code of Marketing of Breastmilk Substitutes. However, there are several challenges that need to be addressed in reducing the demand for dairy and booming breastfeeding culture at the global level to meet the SDG goals.

3. Research Methods

This study employs a narrative literature review to examine the environmental impact of breastfeeding and its role in achieving the United Nations Sustainable Development Goals (SDGs). The review synthesizes scientific literature, policy documents, and global reports to establish the connection between breastfeeding, sustainability, and environmental preservation.

A systematic search was conducted across PubMed, Scopus, Web of Science, Google Scholar, and ResearchGate to ensure the inclusion of peer-reviewed journal articles and high-impact research studies. Additionally, reports from organizations such as WHO, UNICEF, FAO, UNDP, and WABA were reviewed for policy insights and global perspectives.

The search was conducted using keyword combinations such as "breastfeeding and environmental impact," "formula milk and carbon footprint," "breastfeeding and Sustainable Development Goals," "infant feeding and climate change," and "infant formula and biodiversity loss." Additionally, the reference lists of key articles were examined to identify further relevant sources.

The inclusion criteria considered peer-reviewed journal articles, systematic reviews, and policy papers published between 2010 and 2023. Studies that analyzed breastfeeding’s impact on environmental sustainability, carbon footprint, and greenhouse gas emissions were prioritized. Additionally, research discussing global trends, policies, and regulations related to infant formula marketing and breastfeeding promotion was included. Reports from internationally recognized health and environmental organizations were also reviewed to ensure a comprehensive understanding of the topic.

The exclusion criteria eliminated articles focusing solely on the clinical aspects of breastfeeding without addressing environmental or policy perspectives. Non-English publications were excluded unless an official English translation was available. Additionally, opinion pieces or non-peer-reviewed sources lacking empirical data were not considered for this review. By implementing systematic selection criteria, this review ensures a rigorous, credible, and high-impact assessment of the environmental implications of breastfeeding.

4. Results

Breastfeeding is a critical component of sustainable development, contributing to health, nutrition, and economic growth, which are all key elements of the Sustainable Development Goals (SDGs). However, promoting breastfeeding in the current era presents several challenges.

4.1. Aggressive Marketing of Infant Formula

In recent years, the aggressive marketing of infant formula milk has become a topic of significant concern. This is due to the impact it can have on breastfeeding rates, infant health, and parental decision-making. Manufacturers of infant formula milk have been known to employ assertive marketing strategies to promote their products. These tactics range from providing free samples in hospitals, advertising campaigns featuring healthy, happy infants, to using health claims that suggest formula milk is scientifically comparable to breast milk. Infant formula milk companies employ nuanced marketing techniques to promote their products. In many cases, they use healthcare systems as platforms for their aggressive advertising efforts (Hastings et al., 2020). Market research reveals that these companies often respond to the introduction and aggressive marketing of new categories of products with equally assertive tactics (Mahase, 2022). These companies also tend to utilize creative and aggressive promotion strategies, often influencing first-foods systems transformations (Zisovska et al., 2018). In some instances, they even resort to disparaging specific brands in their counter-marketing strategies (Mahase, 2022). Breastmilk substitutes are also marketed through the distribution of gift packages at discharge that contain samples of breastmilk substitutes or coupons, often in bags with the manufacturer's name or logo (U.S. Department of Health and Human Services, 2011).

Despite the known benefits of breastfeeding, aggressive marketing tactics by infant formula companies are widespread. Companies are found to be violating the international code of Marketing of Breast-Milk Substitutes and undermining maternal and child health (Piwoz & Huffman, 2015). WHO and UNICEF established the International Code of Marketing Breastmilk Substitute (Code) in 1981 to curb the unethical marketing of breastmilk substitutes in medical settings (World Health Organization and the United Nations Children's Fund, 1981). The code's overarching goal is to uphold the superiority of breastmilk and to support infants' safe and optimal nutrition by safeguarding, promoting, and encouraging breastfeeding. The implementation of the Code has been challenging as it involves a complex interplay of interests. On one side, there are under-resourced national and international organizations, as well as non-governmental groups advocating for breastfeeding. On the other side, there are multinational corporations that invest and earn millions in the marketing of infant formula (Lutter, 2012). Currently, only 13% of countries globally have enacted laws that align with the Code and the objectives of the Global Breastfeeding Collective (GBS). The GBS has set a goal to increase this percentage to 40 by 2030 (World Health Organization and the United Nations Children's Fund, 2021). To achieve this target, all member nations must establish effective, unbiased, and independent systems for monitoring compliance with the Code. This will help enforce its guidelines and halt the unethical marketing practices associated with infant formula (World Health Organization and the United Nations Children's Fund, 2022b).

A recent joint report by the World Health Organization and the United Nations Children's Fund (2022b) spotlighted the considerable influence of formula milk companies on infant feeding practices. The report outlined five key methods these companies employ. Firstly,

their marketing strategies are personalized, persuasive, and have a significant impact. Secondly, they utilize misleading marketing tactics that play on the fears and aspirations of parents. Thirdly, they distort scientific and medical facts to back up their claims and push their products. Fourthly, they intentionally target doctors, fully aware of the substantial influence these professionals have over formula milk product recommendations. Lastly, their marketing tactics can potentially erode the confidence of parents in breastfeeding.

The ongoing challenge of curtailing infant formula marketing and its undermining effect on breastfeeding has persisted for many years. In response to these tactics, there is a call for comprehensive and escalated measures. Governments, health professionals, civil society, and other stakeholders must take substantial steps to halt the unethical promotion of formula products and assist parents with their infant feeding practices (Rollins et al., 2016; World Health Organization and the United Nations Children's Fund, 2022a). If not, we may eventually face a situation where formula milk companies claim they can 'end hunger' by providing their products to children. This underscores the urgency of addressing this issue.

4.2. The Significant Transformations Triggered by COVID-19

Apparently, the COVID-19 pandemic, coupled with increasing food costs, could potentially worsen all types of malnutrition. This can be attributed to factors such as reduced household income, the unavailability of reasonably priced nutritious food, decreased physical activity, and interrupted essential nutrition services. However, the complete impact of the pandemic on child nutrition may not become evident for several years (Headey et al., 2020; United Nations, 2022). There are rising worries that the pandemic has unintentionally disrupted the achievement of SDGs (United Nations, 2022). Indirectly, this has wedged all forms of breastfeeding-supportive efforts as well. The Global Breastfeeding Scorecard 2021 highlighted the significant impact that COVID-19 has had on breastfeeding practices and efforts to promote it (World Health Organization and the United Nations Children's Fund, 2022b).

Despite WHO's continued advice on skin-to-skin care and rooming-in, some hospitals began separating mothers from their newborns to comply with general population social distancing guidelines. The pandemic has limited opportunities for mother-to-mother support, peer counselling, and other community support programs. This has also affected the routine provision of breastfeeding counselling services due to social distancing measures and health workers' other commitments.

Misunderstandings about breastfeeding in the context of COVID-19 have led some mothers with the virus to choose not to breastfeed their babies for fear of transmitting the disease. In some regions, infant formula companies have seized the opportunity presented by the pandemic to market their brands and products, providing free formula milk, presenting themselves as authorities on COVID-19 in pamphlets, and discouraging breastfeeding in videos.

In most countries, the collection of community-wide breastfeeding data and the evaluation of breastfeeding initiatives have been put on hold. Specifically, some mothers with COVID-19 have decided not to breastfeed their babies out of concern for COVID-19 transmission, out of misconceptions. Having said that, infant formula companies in certain countries misused this pandemic to market their names and goods, offering free formula milk

distribution, posing as authorities on COVID-19 in brochures, and discouraging breastfeeding in videos. In fact, digital marketing advancement and online shopping benefits during this pandemic have made the infant formula industry a boom (World Health Organization and the United Nations Children's Fund, 2022b).

4.3. Insufficient Financial Support for Breastfeeding Initiatives

While it's true that formula milk can be a lifesaver for mothers who can't breastfeed for medical reasons, it's also important to note that breast milk offers unique health benefits that cannot be entirely replicated by formula milk. However, there is a distinct lack of funding for breastfeeding programs at a global level. This lack of support exacerbates the problem, as parents do not receive adequate information or assistance to make informed decisions about infant feeding (Mahase, 2022). A significant number of countries do not allocate sufficient funds or policy backing to effectively endorse, safeguard, and support breastfeeding (World Health Organization and the United Nations Children's Fund, 2017a). Alarmingly, there is no existing data on governmental spending towards breastfeeding.

However, the GBS-led Breastfeeding Scorecard does monitor donor contributions for breastfeeding (World Health Organization and the United Nations Children's Fund, 2022a). The World Bank estimates that a $4.70 investment per new-born is required to meet the World Health Assembly's (WHA) global objective of achieving at least 50% exclusive breastfeeding by 2025 (World Health Organization and the United Nations Children's Fund, 2017a). Yet, as of 2017, only seven countries worldwide received donor funding of at least US$5 per birth, with most countries receiving less than US$1 (World Health Organization and the United Nations Children's Fund, 2017a, 2017b; 2021). An assessment by the World Health Assembly (WHA) revealed that for every US$1 put into breastfeeding, an economic benefit of US$35 is generated. The report also indicated that investing US$5.7 billion by 2025 could save 520,000 children's lives and help meet the WHA's exclusive breastfeeding target (World Health Organization and the United Nations Children's Fund, 2017b). There is a significant correlation between the donor funding a country receives for breastfeeding programs and its breastfeeding rates. For example, with every additional dollar in donor funding per birth, the rate of exclusive breastfeeding in the first six months increases by an average of 2.9 percentage (World Health Organization and the United Nations Children's Fund, 2017b).

4.4. Summary

Despite the data highlighting the need for investment in breastfeeding for the collective good of the global populace, rallying support for breastfeeding advocacy remains a hurdle. It's important to distinguish between advocating for breastfeeding and promoting commodity-based interventions like vaccines or medications. The latter often receive more support due to easier monitoring and commercial incentives. Hence, it's essential to incorporate breastfeeding into programs aimed at preventing non-communicable diseases in women and children and reducing infection-induced morbidity and mortality during infancy (Rollins et al., 2016). Meanwhile, infant formula companies invest hundreds of millions in research and marketing (Pérez-Escamilla, 2020). Modifying national policies and boosting funding for breastfeeding could potentially save hundreds of thousands of lives (World Health Organization and the United Nations Children's Fund, 2017a). While numerous reports underscore the need for increased funding for breastfeeding advocacy and its benefits, none offer specific strategies on lobbying for such

funding. Addressing this gap is critical for improving global breastfeeding rates and achieving Sustainable Development Goals (SDGs).

5. Conclusion

Breastfeeding is a natural, renewable source of nutrition that aligns closely with five Sustainable Development Goals (SDGs): SDG6, SDG12, SDG13, SDG14, and SDG15. It offers a complete nutritional package for infants, promoting healthy growth and development. By encouraging breastfeeding, the demand for infant formula can be condensed, indirectly aiding environmental conservation. The manufacturing of infant formula contributes to carbon dioxide emissions, water use, and waste, thereby exacerbating environmental degradation. On the other hand, breastfeeding produces virtually no waste and has a minimal carbon footprint. However, sustaining breastfeeding faces significant challenges, predominantly due to aggressive and evolving marketing strategies by infant formula companies. These tactics can skew public opinion and lead to declining breastfeeding rates. The COVID-19 pandemic has added to these difficulties by disrupting healthcare services, limiting lactation support access, and increasing maternal stress, all negatively impacting breastfeeding initiation and continuation. Furthermore, numerous countries still have insufficient funding for breastfeeding advocacy, stalling many promotional activities. This lack of adequate funding inhibits the execution of comprehensive, sustainable interventions. Addressing this issue requires a multi-faceted approach, including societal promotion of breastfeeding, enhanced implementation of the Code, stricter monitoring of infant formula marketing, and lobbying for increased breastfeeding support funding. By surmounting the obstacles to breastfeeding promotion, individual and public health can be enriched while making substantial contributions towards achieving the United Nations' Sustainable Development Goals for sustainable, equitable, and healthier societies.

Ethics Approval and Consent to Participate

As this study is a literature review that does not involve human participants, primary data collection, or experimental procedures, ethical approval was not required.

Acknowledgement

The authors would like to express their gratitude to the researchers, policymakers, and institutions whose work contributed to this review. This paper was presented at the 3rd International Conference on Sustainable Development Goals (ICSDG2023), held on December 5–6, 2023, at the Royale Chulan Penang in Penang, Malaysia. The authors appreciate the valuable feedback and discussions received during the conference, which helped refine and strengthen this manuscript.

Funding

This study received no funding from any governmental, non-governmental, or private organizations.

Conflict of Interest

The authors report no conflicts of interest related to this work and declare that there is no potential conflict of interest regarding the research, authorship, or publication of this article.

References

Amonkar, Y., Chowdhury, N., Song, Y., Wu, J. S., Vaidya, P., & Meinrenken, C. J. (2019). Life cycle GHG emission comparison of infant nursing using breast milk versus formula. *Journal of Environmental Accounting and Management*, *7*(1), 59-72.

Andresen, E. C., Hjelkrem, A. G. R., Bakken, A. K., & Andersen, L. F. (2022). Environmental impact of feeding with infant formula in comparison with breastfeeding. *International Journal of Environmental Research and Public Health*, *19*(11).

Baker, P., Santos, T., Neves, P. A., Machado, P., Smith, J., Piwoz, E., & McCoy, D. (2021). First-food systems transformations and the ultra-processing of infant and young child diets: The determinants, dynamics and consequences of the global rise in commercial milk formula consumption. *Maternal & child nutrition*, *17*(2), e13097.

Baker, P., Smith, J., Salmon, L., Friel, S., Kent, G., Iellamo, A., ... & Renfrew, M. J. (2016). Global trends and patterns of commercial milk-based formula sales: is an unprecedented infant and young child feeding transition underway?. *Public health nutrition*, *19*(14), 2540-2550.

Binns, C. W., Lee, M. K., Maycock, B., Torheim, L. E., Nanishi, K., & Duong, D. T. T. (2020). Climate Change, Food Supply, and Dietary Guidelines. *Annual Review of Public Health*, *42*, 233–255.

BMJ (2019). *Environmental cost of formula milk should be a matter of global concern. ScienceDaily.* https://www.sciencedaily.com/releases/2019/10/191002183657.htm

Bowie, M. H., Black, L., Boyer, S., Dickinson, N. M., & Hodge, S. (2016). Persistence of biodiversity in a dryland remnant within an intensified dairy farm landscape. *New Zealand Journal of Ecology*, *40*(1), 121-130.

Cernioglo, K., & Smilowitz, J. T. (2023). *Infant feeding practices and parental perceptions during the 2022 United States infant formula shortage crisis*. *BMC pediatrics, 23*(1), 320.

Clune, S., Crossin, E., & Verghese, K. (2017). Systematic review of greenhouse gas emissions for different fresh food categories. *Journal of Cleaner Production*, *140*, 766-783.

Dadhich, J. P., & Smith, J. P. (2015). *Carbon Footprints Due to Milk Formula. A study from selected countries of the Asia Pacific region*. https://www.bpni.org/report/Carbon-Footprints-Due-to-Milk-Formula.pdf

FAO. (2010). *Greenhouse Gas Emissions from the Dairy Sector: A Life Cycle Assessment; Food and Agricultural Organization of the United Nations*: Rome, Italy.

FAO (2018). *Climate change and the global dairy cattle sector: The role of the dairy sector in a low-carbon future. FAO.* https://openknowledge.fao.org/server/api/core/bitstreams/8749a956-0725-414f-8c35-58a5db0c2b5c/content

FAO. (2019). *The Global Dairy Sector: Facts; Food and Agricultural Organization of the United Nations*: Rome, Italy, 2019

Hagemann, M., Ndambi, A., Hemme, T., & Latacz-Lohmann, U. (2012). Contribution of milk production to global greenhouse gas emissions: An estimation based on typical farms. *Environmental Science and Pollution Research*, *19*, 390-402.

Hastings, G., Angus, K., Eadie, D., & Hunt, K. (2020). Selling second best: How infant formula marketing works. *Globalization and Health*, *16*(1), 1-12.

Headey, D., Heidkamp, R., Osendarp, S., Ruel, M., Scott, N., Black, R., Shekar, M., Bouis, H., Flory, A., Haddad, L., Walker, N., & Standing Together for Nutrition consortium (2020). Impacts of COVID-19 on childhood malnutrition and nutrition-related mortality. *Lancet, 396*(10250), 519–521.

IPBES. (2019). *Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (Version 1).* Zenodo. https://doi.org/10.5281/zenodo.6417333

Joffe, N., Webster, F., & Shenker, N. (2019). Support For Breastfeeding is An Environmental Imperative. *BMJ (Clinical research ed.), 367*, l5646.

Jones, G., Steketee, R. W., Black, R. E., Bhutta, Z. A., Morris, S. S., & Bellagio Child Survival Study Group (2003). How many child deaths can we prevent this year? L*ancet , 362*(9377), 65–71.

Karlsson, J. O., Garnett, T., Rollins, N. C., & Röös, E. (2019). The carbon footprint of breastmilk substitutes in comparison with breastfeeding. *Journal of Cleaner Production*, *222*, 436-445.

Kramer, M. S., & Kakuma, R. (2012). Optimal duration of exclusive breastfeeding. *The Cochrane database of systematic reviews, 2012(*8), CD003517

Linnecar, A., Gupta, A., Dadhich J., & Bidla N. (2014). *Formula for Disaster: Weighing the impact of formula feeding Vs breastfeeding on environment*. Breastfeeding Promotion Network of India.

Lutter, C. K. (2012). Short Communication. The International Code of Marketing of Breast-milk Substitutes: lessons learned and implications for the regulation of marketing of foods and beverages to children. *Public Health Nutrition*, *16*(10), 1879–1884.

Mahase E. (2022). Formula milk industry "misuses and distorts" information to manipulate parents, says report. *BMJ,* 376, 433.

Mameli, C., Mazzantini, S., & Zuccotti, G. V. (2016). Nutrition in the first 1000 days: the origin of childhood obesity. *International journal of environmental research and public health*, *13*(9), 838.

Martin, C. R., Ling, P. R., & Blackburn, G. L. (2016). Review of infant feeding: key features of breast milk and infant formula. *Nutrients*, *8*(5), 279.

Mekonnen, M. M., & Hoekstra, A. Y. (2012). A global assessment of the water footprint of farm animal products. *Ecosystems*, *15*(3), 401-415.

Piwoz, E. G., & Huffman, S. L. (2015). The impact of marketing of breast-milk substitutes on WHO-recommended breastfeeding practices. *Food and nutrition bulletin*, *36*(4), 373-386

Pope, D. H., Karlsson J. O., Baker, P., & McCoy, D. (2021). Examining the Environmental Impacts of the Dairy and Baby Food Industries: Are First-Food Systems a Crucial Missing Part of the Healthy and Sustainable Food Systems Agenda Now Underway? *Int. J. Environ. Res. Public Health,* 18, 12678. doi: 10.3390/ijerph182312678.

Rollins, N. C., Bhandari, N., Hajeebhoy, N., Horton, S., Lutter, C. K., Martines, J. C., Piwoz, E. G., Richter, L. M., Victora, C. G., & Lancet Breastfeeding Series Group (2016). Why invest, and what it will take to improve breastfeeding practices?. *Lancet (London, England)*, *387*(10017), 491–504. https://doi.org/10.1016/S0140-6736(15)01044

Statista (2023). *Baby Milk & Infant Formula - Worldwide.* https://www.statista.com/outlook/cmo/food/baby-food/baby-milk-infant-formula/worldwide

Smith, J. P. (2015). Markets, breastfeeding and trade in mothers' milk. *International Breastfeeding Journal*, *10*(1), 1-7.

The Lactation Network. (2020). *5 Environmental Benefits of Breastfeeding: Support Breastfeeding for a Healthier Planet*. The LactationNetwork. https://lactationnetwork.com/blog/environmental-benefits-breastfeeding/

UNDP. (2022). *The SDGs In Action*. United Nations Development Programme. https://www.undp.org/sustainable-development-goals

World Alliance of Breastfeeding Action (2016). *Breastfeeding:- A Key to Sustainable Development. UNICEF and WHO joint message for World Breastfeeding Week 2016.* https://waba.org.my/archive/breastfeeding-a-key-to-sustainable-development-unicef-world-breastfeeding-week-2016-message/

World Alliance of Breastfeeding Action (2020a). *WBW 2020 Action Folder*. https://worldbreastfeedingweek.org/2020/wbw2020-action-folder/

World Alliance of Breastfeeding Action. (2020b). *WBW 2020 : Support Breastfeeding for Healthier Planet*.https://worldbreastfeedingweek.org/2020/wp-content/uploads/2020/06/action-folder-2020_A4-1.pdf

Whitehead. (2020). *Dairy majors investing heavily as Vietnam ramps up milk production*. DAIRY Reporter.

World Health Organization and the United Nations Children's Fund. (1981). *International code for marketing breastmilk substitutes.* https://iris.who.int/bitstream/handle/10665/40382/9241541601.pdf?sequence=1

World Health Organization. (2009). *Infant And Young Child Feeding Model: Chapter For Textbooks For Medical Students and Allied Health Professionals*. https://iris.who.int/handle/10665/44117

World Health Organization. (2014). *Global nutrition targets 2025: Breastfeeding policy brief*. https://www.who.int/publications/i/item/WHO-NMH-NHD-14.7

World Health Organization and the United Nations Children's Fund, (2017a). *Nurturing The Health And Wealth Of Nations: The Investment Case For Breastfeeding*. https://cdn.who.int/media/docs/default-source/breastfeeding/global-breastfeeding-collective/global-bf-collective-investmentcase.pdf?sfvrsn=3545408_5&download=true

World Health Organization and the United Nations Children's Fund. (2017b). *Global breastfeeding scorecard, 2017 : tracking progress for breastfeeding policies and programmes*. https://cdn.who.int/media/docs/default-source/breastfeeding/global-breastfeeding-collective/global-bf-scorecard-2017.pdf?sfvrsn=d5ebb905_5&download=true

World Health Organization and the United Nations Children's Fund (2021). *Global Breastfeeding Scorecard 2021 : Protecting Breastfeeding Through Bold National Actions During The COVID-19 Pandemic and Beyond.* https://iris.who.int/bitstream/handle/10665/348546/WHO-HEP-NFS-21.45-eng.pdf?sequence=1

World Health Organization and the United Nations Children's Fund (2022a). *Global breastfeeding scorecard 2022 : protecting breastfeeding through further investments and policy actions*. https://iris.who.int/bitstream/handle/10665/365140/WHO-HEP-NFS-22.6-eng.pdf?sequence=1

UNICEF & World Health Organization. (2023). *Global breastfeeding scorecard, 2023: Tracking progress for breastfeeding policies and programmes.* United Nations Children's Fund (UNICEF).

https://www.unicef.org/media/150586/file/Global%20breastfeeding%20scorecard%202023.pdf

World Health Organization and the United Nations Children's Fund (UNICEF (2022b) *How the marketing of formula milk influences our decisions on infant feeding*. https://iris.who.int/bitstream/handle/10665/352098/9789240044609-eng.pdf?sequence=1

United Nations (2022). *The Sustainable Development Goals Report 2022* - https://unstats.un.org/sdgs/report/2022/

U.S. Department of Health and Human Services (2011). *The Surgeon General's Call to Action to Support Breastfeeding.* https://www.ncbi.nlm.nih.gov/books/NBK52682/pdf/Bookshelf_NBK52682.pdf

Vergé, X. P., Maxime, D., Dyer, J. A., Desjardins, R. L., Arcand, Y., & Vanderzaag, A. (2013). Carbon footprint of Canadian dairy products: Calculations and issues. *Journal of dairy science*, *96*(9), 6091-6104.

Victora, C. G., Bahl, R., Barros, A. J. D., França, G. V. A., Horton, S.,Krasevec, J.,Murch,S., Sankar, M. J., Walker, N., Rollins, N. C., Allen, K., Dharmage, S., Lodge, C., Peres, K. G., Bhandari, N., Chowdhury, R., Sinha, B., Taneja, S., Giugliani, E., & Richter, L. (2016). Breastfeeding in the 21st century: Epidemiology, mechanisms, and lifelong effect. In *The Lancet*, 387(10017), 475–490).

Zisovska, E., Stamenkovska, M., & Gjurcevski, J. (2018). The impact of marketing on healthy feeding in infancy and childhood. *Macedonian International Journal of Marketing*, *8*(2), 56-63.