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From acute food insecurity to famine: how the 2023/2024 war on Gaza has dramatically set back sustainable development goal 2 to end hunger

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The widespread destruction and the devastating humanitarian toll caused by the ongoing war on Gaza have transformed this besieged Strip into a place of death and despair. This review will explore the implications of this war for food security, focusing on Sustainable Development Goal (SDG) 2, which seeks to fight malnutrition and food insecurity and achieve zero hunger by 2030. This work is based on a review of grey literature, such as reports from government and non-governmental agencies, as well as recent scientific journal publications. Our results show that the ongoing war on Gaza has exacerbated the already acute food insecurity that Gazans have been struggling with since the blockade was imposed in 2007. Restless bombardment and ground operations have damaged or even razed agricultural land and all food production infrastructure (such as bakeries, mills, and food processing facilities), destroying Gaza's food system. Facing catastrophic levels of hunger, some families, especially in northern Gaza have recently been resorting to eating animal feed and weeds to survive. With the starvation of civilians being used as a method of warfare, many experts and human rights organizations argue that Gaza is now the world's worst hunger crisis and its population is on the verge of famine, if not already there. Moreover, this unprecedented humanitarian crisis in Gaza could have significant consequences on global food security in its six pillars, jeopardizing the implementation of SDG 2. While international organizations are making efforts to mitigate the catastrophic food shortage and famine, more comprehensive and sustainable solutions are needed to address the root causes of food insecurity in Gaza and ensure that all residents have access to an adequate and nutritious diet.

KEYWORDS

food security, malnutrition, food shortage, sustainability, SDG 2, starvation war, weaponizing food

1 Introduction

According to the Food and Agriculture Organization (FAO) and other international agencies, food security refers to physical, social, and economic access to sufficient, safe, and nutritious food for all people at all times (FAO et al., 2020). To achieve food security, six pillars, namely availability, access, utilisation, stability, agency, and sustainability should be fulfilled simultaneously (Farcas et al., 2020; HLPE, 2020; Boyacı-Gündüz et al., 2021; Ben Hassen and El Bilali, 2022). Food security is central to the global development agenda and Sustainable Development Goals (SDGs), particularly SDG 2, which plays a crucial role in achieving zero hunger by the year 2030, with food security being an intrinsic component of it. SDG 2 is key to the success of the achievement of the entire SDGs due to its close interlinkage with society, economy, and the environment (Gil et al., 2019; Chen et al., 2023). SDGs offer some hope to driving sustainable solutions to problems, such as food insecurity. However, despite considerable efforts to end hunger over the last few years, which has led to slight improvements in some countries, the overall number of people facing high levels of acute food insecurity is on the rise again in many regions of the world, due mainly to armed conflicts (GRFC, 2023).

Food insecurity is a situation when people lack secure access and agency over sufficient amounts of safe and nutritious food that is necessary for normal growth and development of human beings (HLPE, 2020; GRFC, 2023). Food insecurity is one of the most pressing challenges facing humanity today, especially with the growing outbreak of pandemics and armed conflicts, and wars, which are widely recognised as the main contributors to food insecurity in various parts of the world. Particularly the COVID-19 pandemic and the Russia–Ukraine conflict have been extensively explored in recent studies, showing that these two extraordinary crises have been the most important drivers of food insecurity globally (Béné et al., 2021; Jagtap et al., 2022; Barakat et al., 2023; Mhlanga and Ndhlovu, 2023; Xu et al., 2023).

Many scholars and international organizations have developed various indicators to measure food insecurity. For example, integrated food security phase classification (IPC) is a global standard for the classification of food insecurity, and provides a common scale for measuring the severity of food insecurity. According to the IPC scale (Figure 1), acute food insecurity is classified into five phases, namely no/minimal for phase 1, stressed for phase 2, crisis for phase 3, emergency for phase 4, and catastrophe/famine for phase 5. Besides acute food insecurity, the IPC is used also to provide decision-makers with invaluable information about chronic food insecurity and acute malnutrition, making it a landmark in the fight against global hunger. Each phase is linked to priority response objectives for action, noting that phase 3 or worse requires urgent action. The IPC scale is commonly used by the international community to determine whether a famine is happening or likely happening in a country or a region (IPC, 2017, 2023).

The region located along the Eastern Mediterranean coast has frequently suffered from political instability and conflicts that have compromised food security and increased malnutrition (Al-Jawaldeh and Meyer, 2023). Particularly the Gaza Strip, a small and densely populated region in the Middle East, has been witnessing several hostilities and escalations of violence since the siege of Gaza began in 2007. Gaza has been blockaded for more than 16 years, with its

borders, economy, movement of people and goods, electricity, other vital resources being controlled by Israel, which has led to many food security, undernutrition, and associated health complications (El Kishawi et al., 2017; Albelbeisi et al., 2018; Abu Hamad et al., 2022). The UN once predicted that Gaza would be uninhabitable by 2020, and the urgent need to address challenging issues in Gaza, such as the unsuitability of 95% of Gaza municipal well water for human consumption and the problem of food insecurity, has been highlighted even before the outbreak of the current war (Al-Shalalfeh et al., 2018; Nassar et al., 2023).

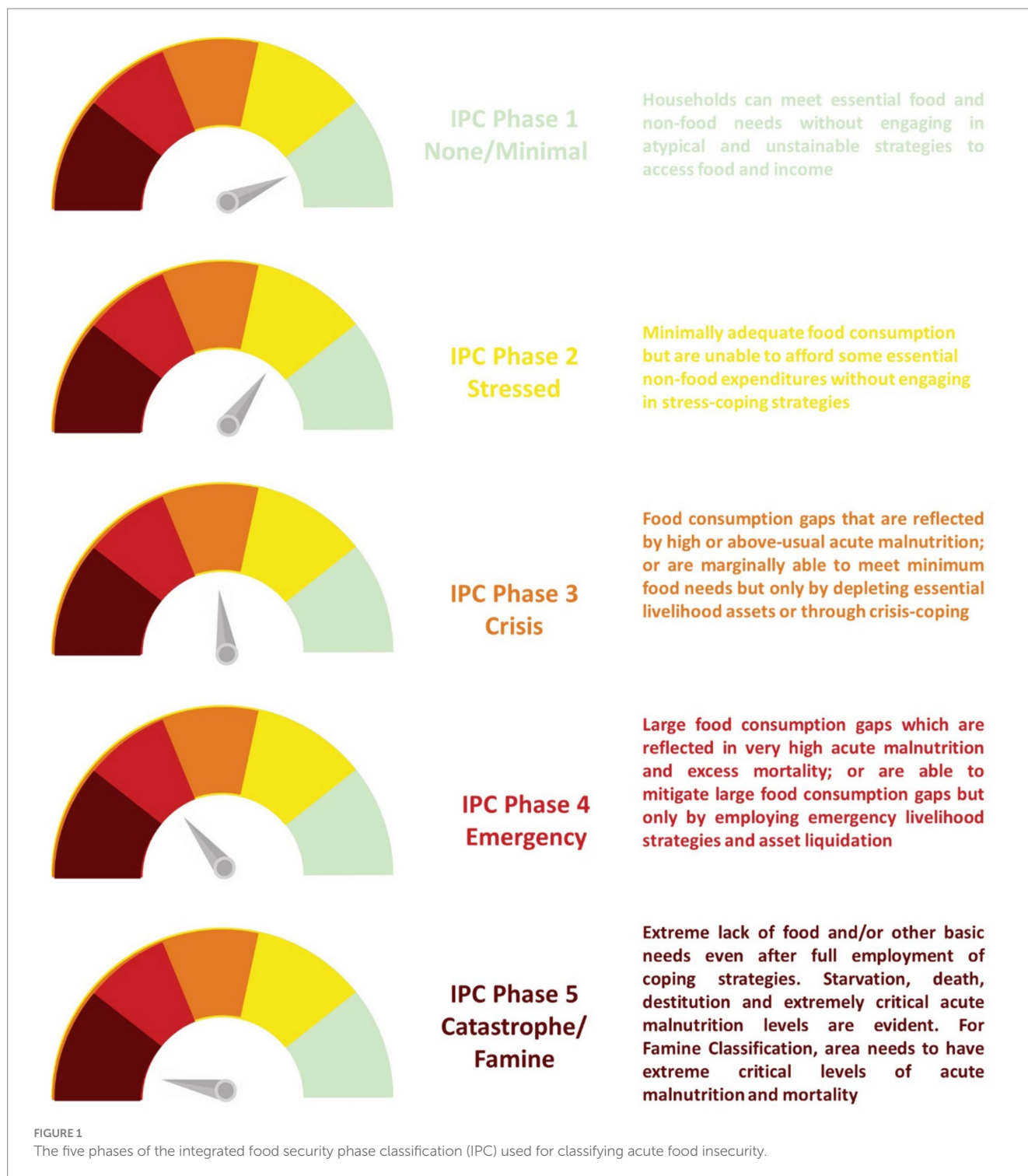
Since October 2023, the Gaza Strip has experienced one of the world's worst recent food crises due to the ongoing war. Indeed, many independent experts and advocacy organizations have warned that the tight blockage, forced displacement, and restless bombardment of buildings and facilities, including food production infrastructure are increasing the risk of shifting the food situation in the besieged Strip from acute food insecurity, due to decades-long blockade, to famine. According to the latest IPC report (covered up to 7 February), the entire population (2.2 million people) has been experiencing high acute food insecurity, with one out of four people being in the catastrophe phase (Bilukha et al., 2023; ESCWA, 2023; GRFC, 2023; Agha et al., 2024; IPC, 2024b).

This study aims to conduct a scoping review of various sources (including peer-reviewed journal publications and grey literature) to highlight the potential implications of the ongoing starvation war on Gaza for both food security and food sustainability, focusing on SDG 2. The rest of this manuscript is organised as follows: After giving a general overview of SDG 2 (Section 2) and food security in Gaza before the ongoing war (Section 3), our study will show the impact of the ongoing war on Gaza on food security (Section 4). Examples of food weaponisation and the impact of the current war on SDG 2 will be shown in Section 5 and Section 6, respectively. In Section 7, we will discuss the potential global food security crisis that could be triggered by the escalation and repercussions of the war, while mitigation measures and recommendations will be suggested in Section 8. Finally, implications and limitations of this study will be given in Section 9 and conclusions will be drawn in Section 10.

2 General overview of sustainable development goal 2 to end hunger

About 9 years ago, the UN member states adopted a new agenda composed of 17 SDGs, including SDG 2, which seeks to create a world free of hunger in all its forms by 2023, achieve food security and improved nutrition, and promote sustainable agriculture. The targets of SDG 2 are mainly related to food security, agriculture sustainability, market, and agricultural investments (Gil et al., 2019; Otekinrin et al., 2019). The 8 targets of SDG 2 have been summarized in Figure 2.

While only 6 years remaining until the attainment of this ambitious goal, FAO reports and other sources, as well as recent publications demonstrate that reaching zero hunger in the coming few years will be a challenging task (FAO et al., 2020; Chen et al., 2023; Otekinrin, 2023). Recent estimates show that hunger is on the rise in many parts of the world, and it is still affecting between 690 and 783 million people in the world, with 24% of the population in Africa, 12.6% in Latin America and the Caribbean, and 9.7% in Asia being faced with severe food insecurity. By 2015, 7.6% of the world's

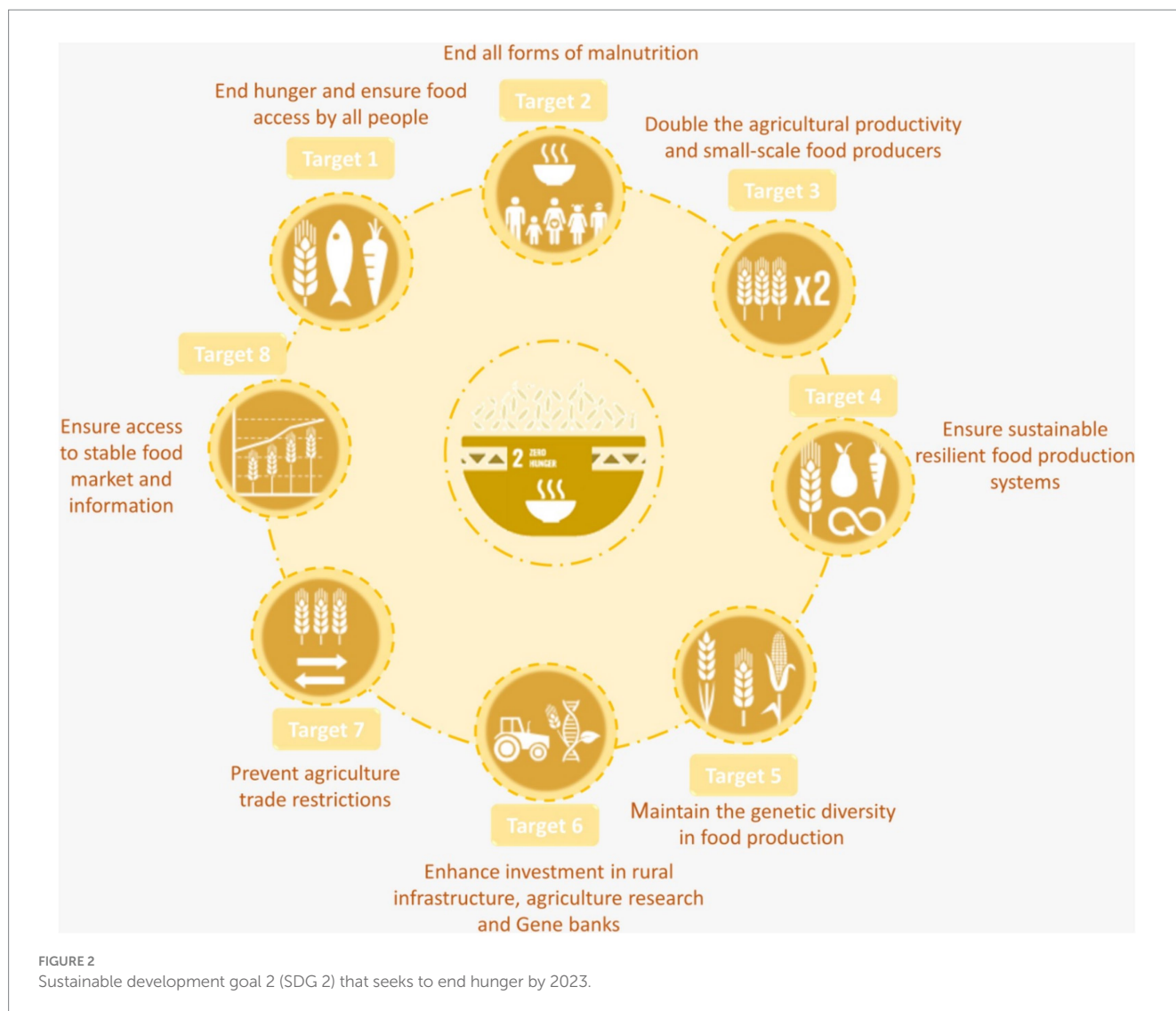


population found themselves in a state of severe food insecurity, while severe food insecurity raised to 11.3% in 2022 (FAO, 2023), which underscores the severity and the growing complexity of this crisis.

Achievement of the “zero hunger” goal is affected by various socioeconomic factors, including among others, pandemics, conflicts, climate change. However, the achievement of this goal is essential for the success of the other SDGs, especially SDG 1 (no poverty) and SDG 3 (health and well-being) (Arora and Mishra, 2022; Chen et al., 2023).

3 Pre-October 2023 food security in Gaza

The issue of food security in Gaza has been a longstanding concern influenced by various socio-political factors, with the Israeli blockade being a significant contributor. This section aims to explore the food security situation in Gaza before October 2023. The Gaza Strip, characterized by dense population, has dealt with economic and humanitarian challenges for decades.



Since 2007, Israel has enforced a stringent blockade on Gaza, severely limiting the movement of goods, including food and agricultural inputs, resulting in a dire humanitarian crisis. The blockade has brought profound effects on Gaza's economy, infrastructure, and social fabric. Import restrictions have sharply curtailed access to essential food items, leading to shortages, price escalations, significantly impacting food security. According to UNRWA, food security in Gaza has worsened significantly following the 2007 blockade, with 63% of individuals in the Gaza Strip experiencing food insecurity and relying on international aid. Ongoing political divisions among Palestinians further escalated the humanitarian and service delivery challenges on the ground. With 81.5% of the population living below the poverty line and an overall unemployment rate of 46.6% (48.1% for Palestinian refugees residing in camps) as of the third quarter of 2022, along with a youth unemployment rate of 62.3% (15–29 years, refugees, and non-refugees), the already precarious humanitarian situation in Gaza has been at risk of further deterioration. Access to essential services, such as clean water and electricity has been at crisis levels, significantly impacting various aspects of daily life. For instance, clean water was inaccessible to 95% of the population, exacerbating health risks.

Electricity availability averages around 11 h per day as of July 2023, but persistent power shortages severely disrupted essential services, particularly in healthcare, food production, water, and sanitation. Furthermore, these challenges continued to undermine Gaza's fragile economy, particularly affecting manufacturing and agriculture sectors. Urgent action was required to address these pressing issues and alleviate the suffering of Gazan residents. In other words, the economy has been devastated, resulting in widespread impoverishment and hindering the development of a highly skilled and educated society (UNRWA, 2023).

Preceding October 2023, Gaza was already confronting a humanitarian crisis, with a sizeable portion of its population dependent on food assistance. As per the United Nations, over half of Gaza's populace has experienced food insecurity, lacking access to a sufficient and nutritious diet. Alarming, malnutrition rates, particularly among children, has soared. According to Albelbeisi et al. (2018), at 6 months of age, the occurrence of underweight and stunting stood at 5 and 9%, respectively. However, by the time the children reached 24 months, these figures shifted to 4% for underweight and 20% for stunting. Wasting was most prevalent at 6 months, with a rate of 10%, but decreased notably to 3% by 24 months. Notably, a higher proportion

of girls exhibited stunting at 9, 12, and 18 months, underweight at 24 months, and wasting at 12 months. Early growth retardation in terms of length was more pronounced compared to weight, with stunting observed in one-fifth of boys and girls by the age of 2.

Constrained access to nutritious food has created a surge in malnutrition-related health complications, encompassing growth stunting, micronutrient deficiencies, and chronic ailments. The prevalence of low birth weight, as reported by the Palestinian Central Bureau of Statistics, was 10.7 nationally (11.8 West Bank, 9.1 Gaza Strip) between 2019 and 2020 (Assaf et al., 2023). Exposure to war and occupation in Gaza was associated with an increased prevalence of low-birth weight (Palestinian Central Bureau of Statistics, 2021). Several research studies were carried out in the Gaza Strip in this regard. Tsigga and Grammatikopoulou (2012) noted in their comprehensive study review that the prevalence trends of underweight and wasted children in the Gaza Strip showed a slight decrease after 2004. Albelbeisi et al. (2018) reported that stunting affected one-fifth of boys and girls by the age of 2, with girls exhibiting a higher prevalence compared to boys. El Kishawi et al. (2017) identified in their study that short maternal stature and parental consanguinity were linked to stunting in the Gaza Strip. Al Najjar and Al Shaer (2022) highlighted additional risk factors such as inadequate awareness of healthy diets, poverty, unfavourable socioeconomic conditions, urbanization, and lifestyle among communities. Furthermore, the political landscape and the blockade in the Gaza Strip were found to be associated with all the aforementioned risk factors (Radi et al., 2013). In the Gaza Strip, the prevalence of anaemia among secondary female students older than 15 years was 33.5 and 31% among women of reproductive age in 2019 (WHO, 2021).

Before the ongoing war, Gaza's food security situation was already risky, highly likely to be attributable to the long Israeli blockade. This blockade has stifled economic activity, disrupted food distribution networks, and worsened poverty and vulnerability among Gazan residents. Effectively addressing the underlying causes of food insecurity in Gaza necessitated the lifting of the blockade, fostering sustainable economic development, and ensuring uninterrupted access to vital humanitarian assistance and services. In the absence of interventions pre-October 2023, the humanitarian crisis in Gaza has been poised to escalate.

4 Impact of the ongoing war on Gaza on food security

The ongoing war on Gaza has led to severe food crisis (Figure 3), significantly impacting food security in its six pillars (i.e., availability, access, utilisation, stability, agency, and sustainability). Many recent reports show that the population of Gaza is at immediate risk of famine, if not suffering it already (IPC, 2024a; ReliefWeb, 2024a; FAO, 2024b).

4.1 Food availability

The physical food availability concerns the “supply side” of food security, covering aspects related to measurements of food production, stock, and net trade (de Oliveira Veras et al., 2021). Wars and armed conflicts can adversely impact food security through military operations that interfere with food production, storage, and mobility

in the war zone (Ben Hassen and El Bilali, 2022; Halmaghi et al., 2023; Béné et al., 2024). In the current war on Gaza 2023–2024, all of Gaza is a war zone, and every part of the Gaza Strip is affected by hostilities, carpet bombing, and shelling, destroying residential buildings, hospitals, schools, roads, transport means, and food production systems (including both plant crops and animal livestock). According to available data, 28% of cropland and more than 70% of fisheries have been destroyed (Anera, 2024) (Figure 4).

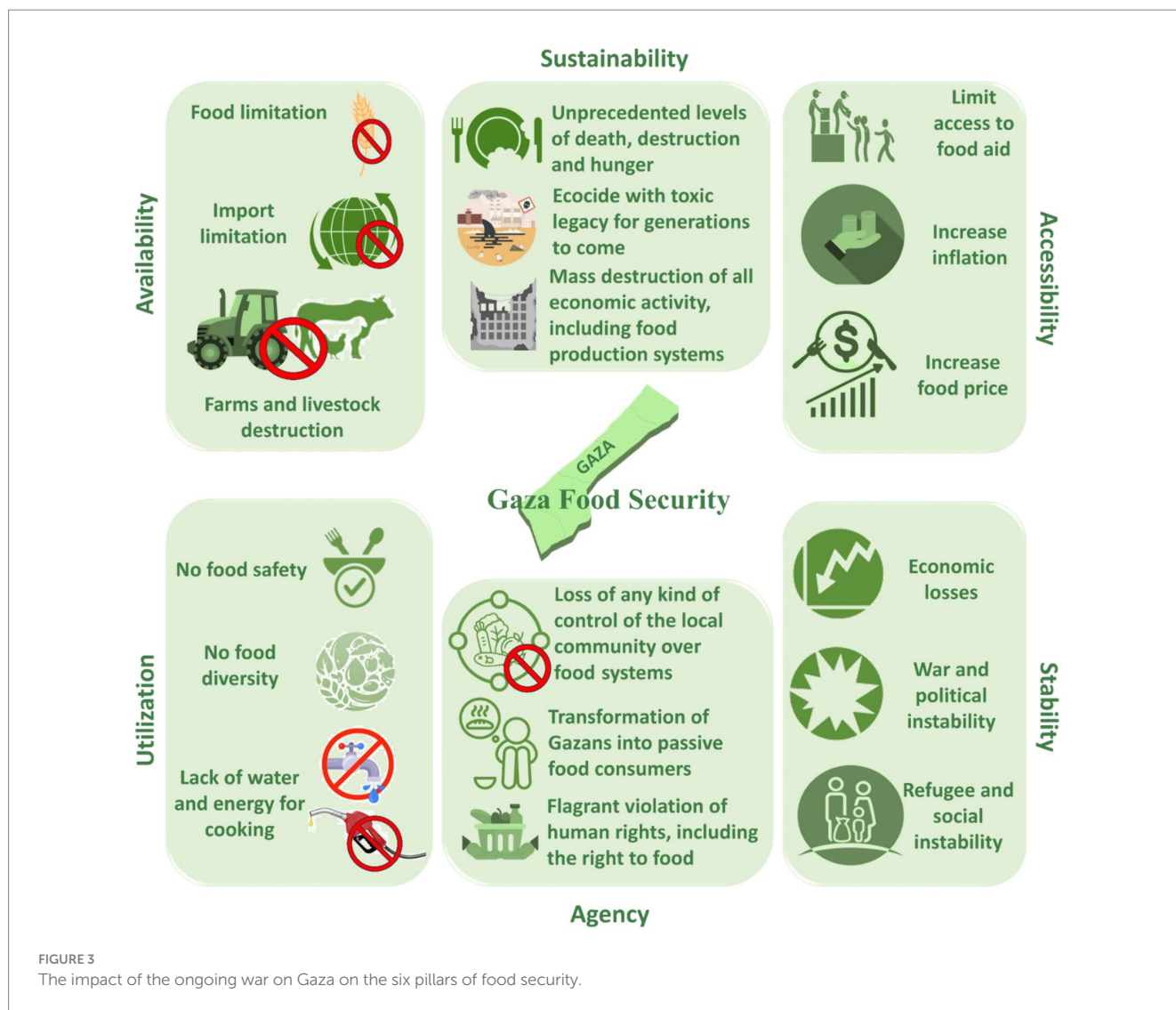
Food is far from being available in Gaza, and the situation only deteriorates with time. The war on Gaza has further damaged food availability by disrupting imports of all food and non-food items vital for food schemes, such as fuel and supplies required for agricultural production (FAO, 2024b). The war on Gaza was announced with an explicit intention to cause food insecurity in Gaza, since on October the 8th, 2023, Israel officially declared its intention to deprive Gaza of food, water, and energy (Human Rights Watch, 2023). Water and energy are interconnected with food for the provision of food security. The access to these three basic necessities (i.e., food, water, and energy) has been weaponised in the current war on Gaza (ESCWA, 2023).

The besieged Gaza was denied food supply from the crossings that connect it to the outer world. When families in the Gaza Strip were forced to leave their homes and towns and flee northern Gaza, they were not provided with food, means of transport, water, or shelter. Those who stayed in the north had their bakeries, flour stores, and food markets bombed. In previous researched wars in Gaza, receiving humanitarian aid resulted in better access to basic services and social safety nets, highlighting the significance of quick short-term humanitarian response in supporting the resilience capacity of households in Gaza (Brück et al., 2019). However, victims of the current war are suffering from impediments of humanitarian aid from entering the Gaza Strip (Human Rights Watch, 2023), not to mention reaching households and refugee camps. This has led to catastrophic levels of food insecurity in Gaza. As of 7 February 2024, 100% of Gaza population were already in Phases 3 and above, 53% in phase 4, while 26% in phase 5 (catastrophe) (IPC, 2024b).

4.2 Access to food

Physical and economic access to food focuses on guaranteeing household-level food security, considering sufficient food access, markets, and prices (The World Bank, 2023b). The consequences of war on food security are diverse, encompassing physical destruction and disruptions in trade and value chains (Messer and Cohen, 2015; Lin et al., 2022; Nguyen et al., 2023).

Agriculture plays an important role in the economy of the Gaza Strip and is part of the availability and accessibility dimensions of food security, including production, stocks, and net trade (Halmaghi et al., 2023; The World Bank, 2023b). Agricultural harvest, herds, and fish are the main food sources in the Gaza Strip for food security and export revenue (FAO et al., 2023). The main agricultural land is located in north and east Gaza, especially near Khan Younis. Most of the farms in this area have been destroyed, and Palestinians were impeded from safely reaching their land and harvesting their crops from the areas that survived the attacks. Many households all over the Gaza Strip grew fruits and vegetable crops in their homes. The carpet bombing and shelling and setting of explosives in houses have led to losing shelter, life investments, and food security (Buheji and Hasan, 2024).



During the first 5 months of this war, Gazans have been suffering from severe starvation, especially in northern Gaza where people have started dying of hunger in February and early March 2024. At the same period, ReliefWeb (2024a) reported the death of 15 children due to malnutrition at only one hospital (Kamal Adwan Hospital) in Gaza City and severe cases of starvation-related illnesses among children, indicating the existence of famine in Gaza. FAO predicted earlier that thresholds for acute malnutrition and non-trauma mortality may also be breached by mid-2024 if hostilities continue (FAO, 2024b).

Economic access to food is hindered by inflation in food prices combined with low or no household purchasing power, making the limited available quantities of food unaffordable for most households. For example, between September and November 2023, wheat flour and rice prices increased by about 50%, while vegetables increased by almost three times (Figure 5).

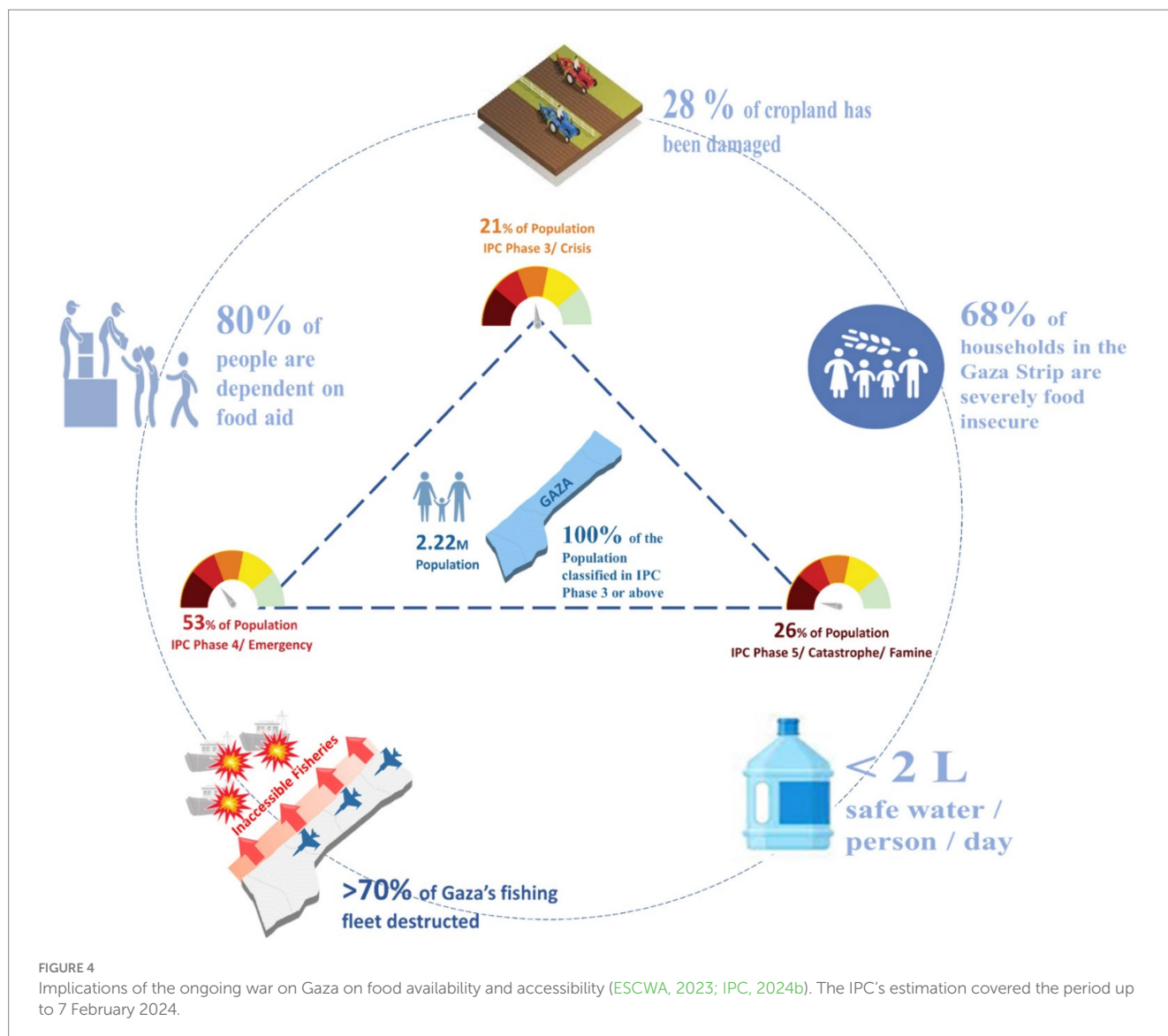
Almost at the same period, the prices of olive oil and chicken meat increased by 65% and about 90%, respectively (WFP, 2023; FAO, 2024a). Economic access to food is further constrained by a sharp decrease in incomes with the loss of jobs due to the war and the destruction of almost everything. Already in December 2023, it was

estimated that economic activities and employment had declined by 85% since the beginning of the hostilities (The World Bank, 2023a).

During crises, achieving food security needs effective approaches to balance the food, the affected population needs, food safety, food producers, food supply and distribution chain, the economic situation, and managing waste (Farcas et al., 2020). In the case of Gaza, the world failed to achieve the first item of providing enough food for people under physical siege with no means to import or produce food, meaning that the first two pillars of food security have not been addressed. Hostilities involving aerial bombardment, ground operations, and population-wide besiegement have resulted in extremely high-levels of acute food insecurity, where 85% of Gazans have been forcefully displaced to concentrate in Rafah (only 64 square kilometers), which is now massively overcrowded with around 1.9 million civilians.

4.3 Food utilisation

Food utilisation is the third dimension of food security and refers to the nutritional status of individuals related to feeding practices and



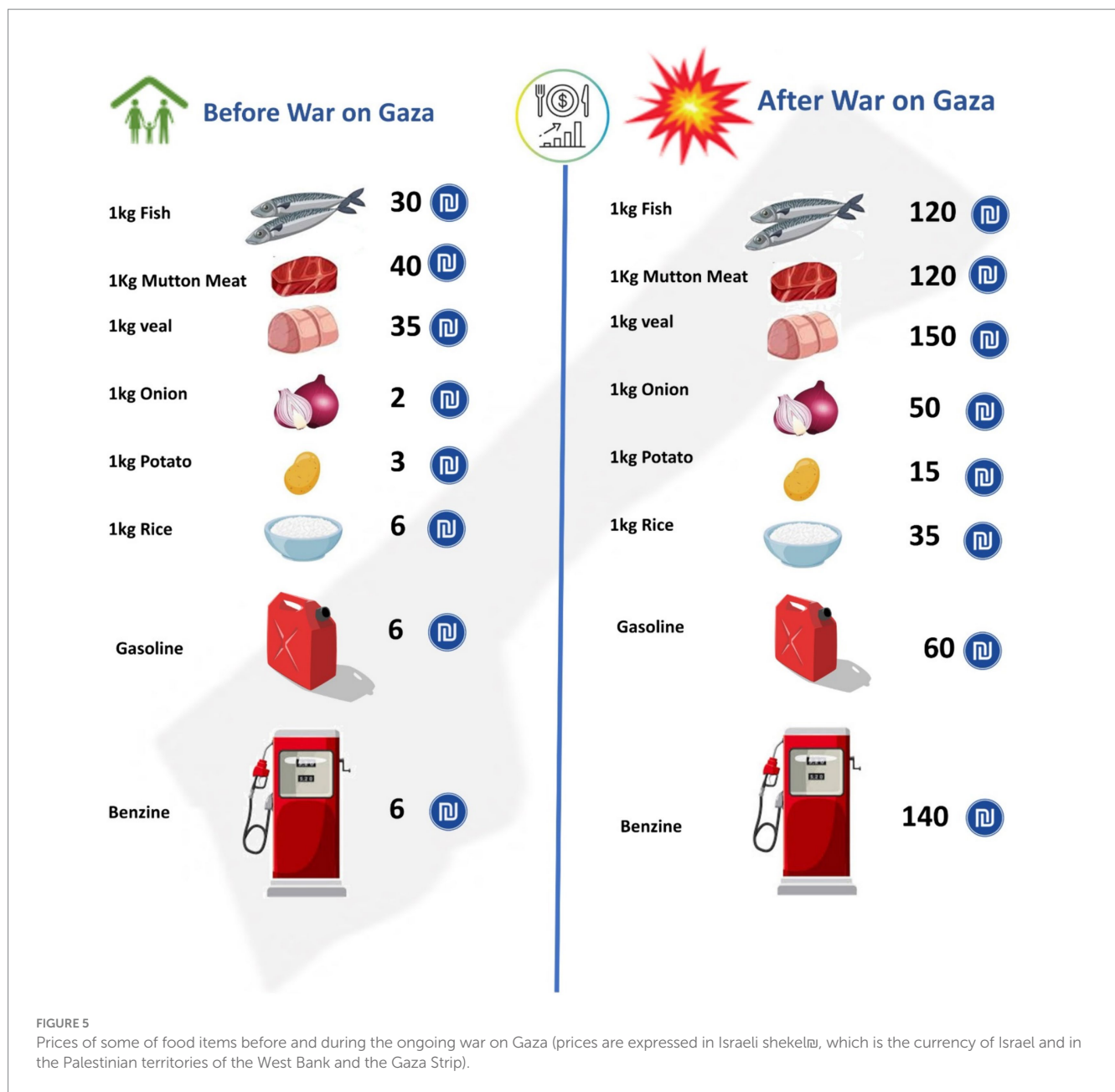
good care, including preparation, diversity, food safety, and fair intrahousehold food distribution (El Bilali et al., 2019; FAO, 2022). The ongoing war on Gaza has significantly jeopardised the food utilization pillar of food security. Indeed, as availability and access to food have been disrupted due to the ongoing war, hunger has become widespread in Gaza, especially among the most vulnerable population. Therefore, driven by extreme hunger, people scour the streets for anything to eat to survive, and aspects related to food safety and diversity have become less relevant or even obsolete for hungry families. A recently published report by humanitarian group Refugees International confirms that the conditions inside of Gaza are disastrous, highlighting the fact that famine-level hunger is rampant among Gazans (Refugees International, 2024).

Food utilisation has also been affected by a lack of safe water that can be used for drinking and food cooking, due to fuel unavailability, as most of Gaza's water is supplied from wells and underground aquifers requiring fuel for extraction and desalination. It is reported that the local population only has access to less than 2 liters of safe water per person per day for drinking and domestic hygiene (Bilukha et al., 2023).

Besides the issues related to food safety and diversity as well as limitation of safe water, another example that shows the severe disruption of the physical utilization of available and accessible food in Gaza is the restrictions imposed on cooking gas. Indeed, because of the lack of cooking gas, many reports show that Gazans have been forced to rely on burning firewood and wood rubbish, further complicating the utilization of available food (IPC, 2024b).

4.4 Food stability

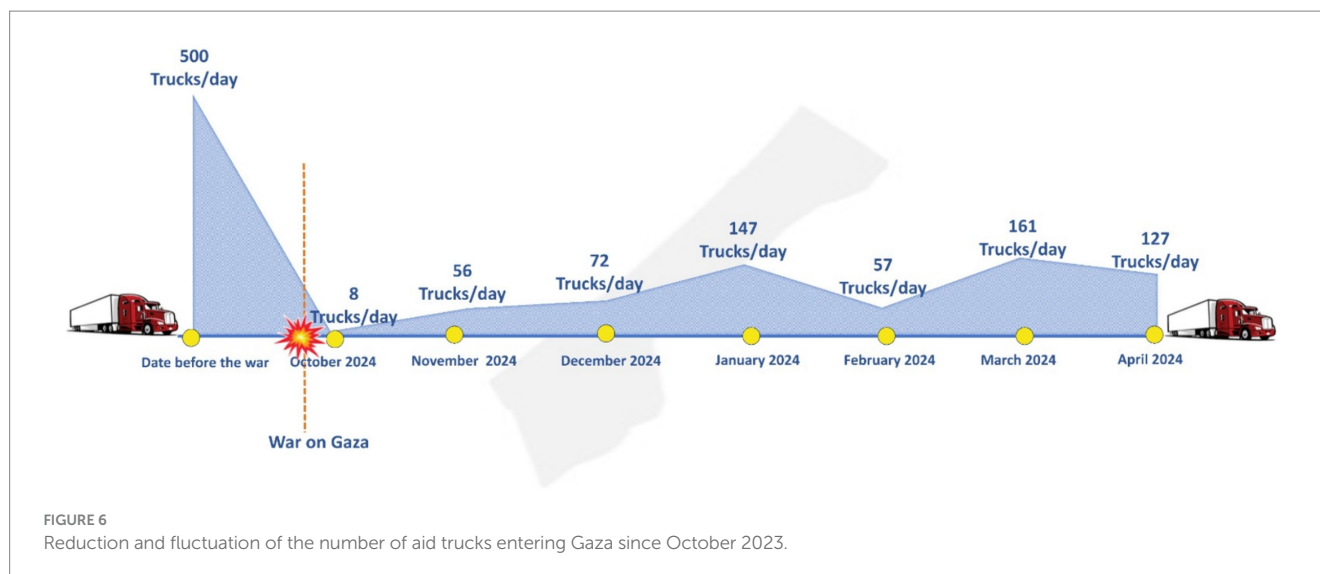
Food stability concerns the sustainability of the three other dimensions (i.e., availability, access, and utilisation) over time, ensuring adequate food intake throughout life (Lin et al., 2022; Halmaghi et al., 2023; Rabbi et al., 2023). The intensive bombardment and ground operations have made the situation in Gaza extremely volatile, with absence of any stability to access to food and other basic necessities and services. Unemployment and food price inflation are among the main economic contributors to instability of food security in the Gaza Strip (Bilukha et al., 2023; European Commission, 2024).



Another crucial factor that is compromising the stability pillar of food security is irregular humanitarian food aid provision. Indeed, now the entire population in Gaza has become dependent on humanitarian aid for their survival, while access to aid has been totally controlled by the occupation military. Food trucks of essential life-saving food commodities are queueing outside Rafah, waiting for clearance. Each food truck must be subjected to arbitrary Israeli inspections slowing aid delivery and reducing the rate of trucks entering into Gaza. At least 500 food trucks were entering Gaza before the outbreak of the ongoing war. Instead of increasing the number of trucks due to demolishing food production in Gaza, this has been decreased significantly (Figure 6). According to the UNRWA figures, only 8, 56, and 72 trucks per day were allowed to enter Gaza in October, November, and December 2023, respectively. An average of 147 trucks was entering Gaza daily in January 2024, while this was even dropped to only 57 trucks in the second and third weeks of

February after the ICJ ruling was announced, in clear in compliance with the issued provisional measures (OHCHR, 2024). In March and April 2024, the number of aid trucks entering Gaza was risen slightly as an average of 161 and 127 crossed into Gaza per day via Kerem Shalom and Rafah land crossings (UNRWA, 2024; ReliefWeb, 2024a,c).

Additionally, allegations have been raised by Israel concerning the participation of staff of UNRWA in the 7 October 2023 attack. Many countries have frozen their funding to this UN agency dedicated to Palestinian refugees, which have raised alarm for aggravating the humanitarian crisis of Palestinians in Gaza who have been already facing dire food, water, and medical shortages. Besides its direct disastrous impact, the ongoing war on Gaza is expected to have negative consequences on long-term food security due to soil degradation and contamination, and the destruction of agricultural land and food facilities. The loss of productive farmland not only



threatens the immediate food supply but also hinders the region's ability to recover and rebuild its food system after the war (UNCTAD, 2024).

4.5 Agency

It has been recently suggested that agency and sustainability should be formally recognized as dimensions of food security in food policy frameworks (HLPE, 2020; Clapp et al., 2022; Mockshell and Nielsen Ritter, 2024). Agency refers to "the capacity of individuals or groups to make their own decisions about what foods they eat, what foods they produce, how that food is produced, processed and distributed within food systems, and their ability to engage in processes that shape food system policies and governance" (HLPE, 2020). Béné and Devereux (2023) argued that greater attention must also be paid to agency and food sovereignty as emerging elements of food security, while Clapp et al. (2022) considered agency as an important aspect of addressing inequities and power imbalances within food systems.

The current war on Gaza has damaged and destroyed food production facilities and systems, making people in Gaza completely dependent on the entry of humanitarian assistance. This has led to the destruction of the capacity for Gazans to make any meaningful decision about and participate in food systems on their own terms in ways that allow them to be free from hunger and its associated deprivations. The agency pillar of food security requires engaged consumers to become active food citizens (Clapp et al., 2022), but the total blockade imposed by Israel has transformed the people in Gaza into passive food consumers. It is widely recognized according to the agency pillar that the local community (i.e., in this case, the inhabitants of the Gaza Strip) has the right to self-determination in any political and policy discussion that could affect their livelihoods or food systems. However, many discussions have been around over the last few months regarding the future of Gaza between Israeli and several regional and international actors but without any involvement of Palestinian communities. Moreover, the concept of agency is closely related to human rights, including the right to food (HLPE, 2020). Nonetheless, massive violations of these fundamental rights have been

repeatedly reported by Human Rights Watch and other non-governmental organizations, pointing out the struggle of the Palestinian population for land and food sovereignty (Human Rights Watch, 2023, 2024; CETIM, 2024).

4.6 Sustainability

Food sustainability can be defined as "the long-term ability of food systems to provide food security and nutrition today in such a way that does not compromise the environmental, economic, and social bases that generate food security and nutrition for future generations" (HLPE, 2020). The current war on Gaza has dramatically affected food sustainability in its 3 dimensions (i.e., social, economic, and environmental) in various ways.

From a social point of view, this war has led to catastrophic impacts on food sustainability due to unprecedented levels of death, hunger, and poverty for present and future generations in Gaza. Since the onset of the current war, Gaza has suffered unprecedented destruction of all food production facilities, including agriculture and fishing and related food processing and distribution. Besides the direct consequences on food security of the people of Gaza, such mass destruction will compromise the ability of the Palestinian food system to feed future generations. Destruction of agricultural assets and food infrastructure as well as soil and land contamination and degradation have extremely limited the functionality of the food system in Gaza, requiring large-scale investment and considerable time before recovery. From economic perspectives, the widespread destruction of farms, livestock, and other producing food facilities in Gaza has caused disastrous consequences on food systems and Gaza's economy that will likely take decades for Gaza to return to pre-October 2023 welfare levels (Nassar et al., 2023; UNCTAD, 2024).

Moreover, the environmental destruction caused by the current war on Gaza has been devastating to the point that it has been described as an ecocide (Fontaine, 2024). Growing evidence shows that this war is a serious contributor to huge environmental harm because of the widespread use of chemical warfare, such as white phosphorus and other toxic chemicals and explosives. Many reports

show that air, soil, and water pollution, as well as biodiversity loss and other potential ecological damages, are irreversible and irreparable consequences of the ongoing war, exacerbating Gaza's vulnerability amid climate change. This war is expected to leave a toxic legacy for generations to come due to the severe long-lasting damage to the environment and the resulting long-term consequences on human health and ecosystems (Fontaine, 2024; Pearce, 2024). Similar consequences of sustainability have been recently reported on others wars, such as the war in Ukraine (Pereira et al., 2022; El Bilali and Hassen, 2024).

5 Examples of food weaponisation

There is growing evidence showing that food is weaponised against civilians in Gaza. Indeed, Gazans have been starved since the beginning of this war, and those seeking humanitarian convoys have been systematically targeted by bombing raids or missile attacks. Human Rights Watch and other human rights groups and organisations have reported that Israel is using starvation of the people of Gaza as a method of warfare by attacking all food facilities necessary for the survival of the civilian population, such as bakeries, flour stores and mills, food storage facilities, and food market infrastructure. According to many references and experts, the destruction of Gaza's food producing systems and imposing restrictions on food aid entering Gaza (especially in northern Gaza where thousands of people have been facing extreme food shortages for months) are typical features of food weaponisation and using starvation of civilians as a method of warfare (ESCWA, 2023; Human Rights Watch, 2023; Hanbali et al., 2024; Refugees International, 2024; ReliefWeb, 2024b; FAO, 2024c).

One of the clearest examples of food weaponisation was shown in February 2024 when around 1,000 innocent unarmed civilians seeking food from aid trucks were killed and injured in northern Gaza. This so-called "flour massacre" was condemned by the United Nations and many countries since images of white flour mixed with the blood of those who gathered in the hope of being saved from starvation shocked the world. Other similar incidents of attacking civilians while waiting for humanitarian aid have been repeatedly reported in March 2024 along the Gaza Strip (OHCHR, 2024). For example, on 1 April 2024, an Israeli drone fired at a convoy belonging to the World Central Kitchen, killing seven humanitarian aid workers (BBC, 2024a).

The international community is providing urgent assistance to Gaza and has been pressuring Israel to facilitate the transfer of more aid into the enclave. However, only a few trucks have managed to reach Gaza, especially the northern part of the Strip. Facing catastrophic levels of hunger, many sources reported that some families, especially in northern Gaza are resorting to eating animal feed and weeds to survive (Euro-Med Human Rights Monitor, 2024; BBC, 2024b). To alleviate the starvation of civilians in Gaza, many countries have been looking for ways to deliver food supplies by sea and air, but hurdles remain in getting food to its starving population. Indeed, serious concerns were raised about delivering food and other essential resources by air when five Palestinians were killed and 10 injured in March 2024 by aid airdrop after a parachute landing a humanitarian airdrop failed to open (The Guardian, 2024a). Currently, plans are being prepared to build a temporary port off Gaza's coast to increase and accelerate deliveries of humanitarian aid. However, many

argue that this would not be an effective solution to the urgent aid crisis in Gaza due to the time needed to set up the port (about 2 months) and the fear of using it as a control point and later evacuating Gaza from its population by encouraging the "voluntary emigration" of residents of the Strip.

6 Impact of the ongoing war on Gaza on SDG 2

The negative impact of wars and armed conflicts (such as the war in Ukraine) on sustainability with its three pillars, the social, economic, and environmental dimensions has been abundantly explored and demonstrated in various recent publications (Pereira et al., 2022; Chishti et al., 2023; da Costa et al., 2023; Neik et al., 2023; Béné et al., 2024). Food security remains a global challenge that is aligned with several SDGs, including SDG 1—No Poverty, SDG 2—No Hunger, SDG 3—Good Health and Well-Being, SDG 13—Climate protection, and SDG 15—Life on land (Pandey and Pandey, 2023). Particularly, SDG 2 is closely related to food security. The ongoing war on Gaza has significantly pushed back all the targets of SDG 2 that aims to achieve zero hunger by 2023.

Farming and fishing stakeholders are particularly vulnerable to food insecurity and have been highly affected by the ongoing war due to the mass destruction of agriculture and aquaculture exploitations and harvests. Even during the very early stage of this war (on 17 November 2023), satellite data showed that the war caused extremely heavy damages and losses in farmland and agricultural infrastructure, livestock, fisheries, and other food production systems (ESCWA, 2023). As a result, and as previously discussed, the outcome of such destruction is a catastrophic increase in hunger, food insecurity, and malnutrition in Gaza. Therefore, the achievement of the goal of ending hunger (especially target 2.1) will become more challenging in Gaza and the surrounding region. Lack of food has led to alarming levels of acute malnutrition and starvation (target 2.2), resulting in people falling dead of hunger, especially babies and children. According to the Palestinian Ministry of Health, at least 25 children have died from malnutrition and dehydration in northern Gaza by 12 March 2024. Even the medical crews in Gaza have suffered from malnutrition and had nothing to eat at the end of the first fasting day of Ramadan 2024 (Al-Jazeera, 2024).

The effects of wars on food security extend beyond immediate concerns, influencing long-term agricultural production and food supply chains (Deng et al., 2022; Kemmerling et al., 2022). When the current war on Gaza ends, environmental and economic damages will last for decades, leading to severe decrease in agricultural productivity and loss of income of small-scale food producers (target 2.3) (Buheji and Al-muhannadi, 2023; UNCTAD, 2024). Residence agriculture practices and sustainable methods were being adopted in Gaza, and starting to show success in 2020, with use of hydroponic, greenhouses, smart irrigation, and solar cells technologies (Muhie, 2022). However, the ongoing war has significantly damaged such sustainable food production projects and harmed all natural resources and ecosystems in Gaza, which will likely lead to reducing their resilience and adaptation to climate change and other natural or human caused disruptions (target 2.4).

In addition to their impacts on natural resources and ecosystems wars can lead to destruction of natural habitats for many species of

animals and plants as well as loss of biodiversity and genetic diversity (target 2.5) (Gallo-Cajiao et al., 2023; Shahini et al., 2024). Plant exposure to white phosphorus used in the current war and loss of farm animals due to bombardment underscore the significant toll that this war has taken on agricultural livelihoods as well as plant and animal genetic resources for food and agriculture in Gaza.

7 Potential global food security crisis due to the escalation and repercussions of the war

The effects of the war on Gaza have also started to create regional disruptions, and humanitarian aid diversion. The impacts on global food prices and trade can be significant. The international community's response has been strained. The efforts to address immediate needs and support long-term recovery of many areas around the region should be reinforced by effective mitigation measures (FAO, 2024c). ESCWA/UNDP (2023) mentioned that learning from past conflicts, there will be a potential regional spillover of the war on Gaza and on the progress towards SDGs in the region. Moreover, an earlier International Monetary Fund report warns that countries bordering high-intensity conflict zones in the Middle East and North Africa (MENA) usually experience a decline in average annual GDP growth by 1.9 percentage points (de Imus et al., 2017). This resulted in a constrained fiscal space, limiting the capacity to invest in sustainable development initiatives such that it may have a disproportionately negative impact on projects relevant to women development and vulnerable groups.

The disruptions in supply chains and fluctuations in global oil and gas prices might have an effect on Jordan and Egypt imports of gas. If the conflict results in shipping disruptions even oil imported from Saudi Arabia via tankers in the Red Sea could lead to an energy crisis. This might further aggravate the exchange rate leading to higher interest rates to combat inflation. ESCWA/UNDP (2023) warns that resultant inflationary trend would have implications for the broader economic stability of the MENA countries, and might lead to additional stress on both local and refugee populations who have already been facing an increased cost of living.

8 Mitigation measures and recommendations

Food security in Gaza is in a state of emergency as the result of catastrophic risks across the Strip and there is only a short window of time in which the international communities to act. With limited or no access to humanitarian assistance, a fast and rapid deterioration in the nutrition status of women, infants, and children under 5, resulting in wasting and risk of death is most likely, which necessitate an urgent response to save lives of people.

Food is one of the few things that people struggle to access as lack of food is threatening human life and survival. Hunger is becoming a key fact and threat to the people's lives in many parts of Gaza due to the ongoing war, blockade of borders, as well as mass destruction, which gives enough reasons that we should all be concerned and involved in tackling the growing food security and famine crisis. Looking at the size of the current crisis in Gaza, it is clear that

achieving durable solutions will require both short- and long-term approaches, with the ongoing war and unavailability of food to be placed at the centre of all decision-making at global forums and, most importantly, a commitment from the international communities and humanitarian agencies.

The first element when building successful solution strategies is to ensure the political will to secure the urgent food needs of the people, especially the most vulnerable groups through opening the borders and ensuring a wide-ranging food delivery that targets everyone in the strip. The food security crisis must not be only discussed among humanitarian agencies but rather the entire world must be involved. Children are the most vulnerable to the crisis and we need to feed each and every child to save lives, especially given the alarming and shocking reports and images showing children dying from malnutrition and dehydration over the last few weeks.

In order to achieve durable solutions to address the food insecurity and famine in the Gaza Strip, commitments from every stakeholder, including UNRWA, WFP, FAO, WHO, UNICEF and others are required to move towards a sustainable and equitable food, water, and health delivery and services, and build capability of the local government to feed and treat malnourished children and mothers. Although the UN system activated the Nutrition and Health Clusters to ensure the smooth delivery of essential food aid and medicines to the most vulnerable groups, still a stronger collaboration across humanitarian, development, peace, and security partners is critical for more and faster delivery in challenging environments, which is critical in the current response to address the food insecurity and famine in the Gaza strip. It is recommended to continue to support communities to help them reclaim their livelihoods, regain cohesion, and build resilience to future shocks. With protracted and recurrent crises as the new norm, the humanitarian agencies must do more to ensure the availability of the information, systems, and processes to help the Strip cope with the current crisis and to find innovative solutions via non-state actors, including the UN/NGOs agencies.

In the area of resource mobilisation and finance, we recommend developing mechanisms for financial protection for people in emergency settings, mobilising and coordinating resources to ensure flexible funding availability to cover priority urgent needs, and reviewing and adapting contingency funding specifically to prioritise essential food staff, nutrition, and medicine needs during the ongoing emergency situation. Ensuring a continuum of food supply and essential nutrition services through integrating food security and nutrition interventions into the national food and health sectors' response plans during emergencies is a priority. Additionally, it is important to maintain a continuous supply of essential food aid and medicines, including the severe acute malnutrition kit and necessary technologies for managing acute malnutrition at health facilities. Moreover, it is necessary to provide rapid training in food aid, food supply chain, and nutrition, focusing on vulnerable groups, including displaced and poor people in emergency settings. In the short term, it is crucial to foster cultural and local initiatives, such as *Tekias* (Palestinian community kitchens) that provide daily meals to families who are struggling to ensure enough food and water to stay alive.

The integration of food security and nutrition information systems and its indicators in emergency reporting systems is recommended for better targeting and assessment of impact of aid,

including initial rapid assessment, regularly map service needs, as well as food security and nutrition surveillance as part of the emergency dashboard for the humanitarian settings. It is crucial to activate social protection system and encourage income generating projects through promoting national projects gradually when the security situation is improved as part of the recovery plans focusing on national food production.

When the war in Gaza ends and during the recovery phase, it is recommended to diversify (i) markets (by reducing imports and multiplying trade partners), (ii) production (through sustainable intensification), (iii) crops (focusing on various food sources that provide macronutrients such as energy, protein, and fat), and (iv) technology (focusing on biotechnology and other new production technologies), in order to minimise the impact of the war, as recommended in other wars, such as the war in Ukraine (Neik et al., 2023). In the long term, developing resilient and sustainable food systems will be crucial to overcome food insecurity issues and other challenges in an integrated social-ecological way in the most vulnerable and fragile regions (Queiroz et al., 2021), such as the Gaza Strip.

9 Implications and limitations of this study

This study is the first to provide a general overview of the impact of this war on the six pillars of food security in Gaza and the various target of SDG 2. It serves as a springboard for future work and research to identify patterns of the ongoing war, showing its implications for constraining progress in achieving other SDGs. Results of this study show that the ongoing war on Gaza is normalising the weaponisation of food and basic necessities, undermining the achievement of SDG 2 and food security. The massive humanitarian crisis resulting from this war has significantly impacted food availability, accessibility, utilisation, and stability. The ongoing war on Gaza is causing immense suffering for 2.3 million people and a gloomy future for the 2030 Agenda. The already acute food insecurity in the besieged Strip is being now shifted into an unprecedented famine. Moreover, the study underscores the fact that potential escalation and repercussions of the war could lead to global food security crisis. Therefore, this research provides significant insights and information to political leaders around the world to build international partnerships and lead coordinated efforts to immediately stop the war and alleviate the humanitarian crisis in Gaza.

Given the early stage of research on the impact of the ongoing war on Gaza on food security and SDGs, the study has certain limitations, related to the used references and the expected outcomes, especially on the long term. Indeed, the study is partially based on short and fragmented reports and news coming from Gaza, which can impact the accuracy of results, potentially introducing biases or incomplete insights. Thus, the obtained results might not exactly represent the situation on the ground, highlighting the need for more detailed studies. Moreover, there is a certain degree of uncertainty, especially about the far-reaching consequences of this war since the outcomes will depend on both the evolution of this war and the response of the international community.

10 Conclusion

The 2023 war on Gaza has had profound and devastating effects on the besieged Strip, transforming it into a landscape of death and despair. Currently, there is no sign that the ongoing war will end soon, meaning that aspects related to food availability, access, utilisation, and stability will be further affected in the coming weeks and months.

The war's impact on food security, specifically in relation to SDG 2, is of utmost concern. The relentless bombardment and ground incursions in Gaza have led to devastating consequences for food security, exacerbating the already existing acute insecurity caused by years of blockade and previous military attacks. One of the most significant consequences of the war has been the widespread destruction of essential food facilities, including bakeries and food factories. These facilities play a crucial role in producing and distributing food items that are essential for daily sustenance. The massive use of weapons and missiles has destroyed food production facilities and farmland, leaving many families with no choice but to resort to desperate measures, such as consuming animal feed and weeds, to stave off hunger. Targeting such infrastructure has disrupted the food supply chain, resulting in food shortages and price increases for basic food items. For example, access to bread, a staple food, has become increasingly limited, further worsening food insecurity. More alarmingly, evidence shows heinous repetitive attacks of civilians while waiting for flour and food distribution, especially in northern Gaza, which have triggered worldwide condemnations.

The destruction of agricultural land and food facilities also has long-term implications for food security. The loss of productive farmland not only threatens the immediate food supply but also hinders the region's ability to recover and rebuild its food system after the war. The reconstruction of agricultural infrastructure and revitalization of food production systems will require significant investment and resources, further straining humanitarian efforts in the region. As civilian starvation is weaponized in this conflict, Gaza faces the grim reality of becoming the world's worst hunger crisis, with the specter of famine looming over its population. The deliberate targeting of Gaza's food system not only violates fundamental human rights but also undermines global efforts to achieve zero hunger by 2030. This unprecedented assault on Palestinians not only threatens the lives and livelihoods of those directly affected but also has far-reaching implications for the environment and global food security.

The international community's response to the Gaza crisis is of utmost importance and involves several key actions. Firstly, urgent humanitarian assistance, including vital supplies such as food, medical aid, and shelter, must be swiftly delivered to alleviate the suffering of the innocent civilians in Gaza. Additionally, influential states and regional bodies must engage in diplomatic efforts aimed at resolving conflicts and addressing the root causes of the crisis. This will ensure the protection of civilians and guarantee their access to food as a fundamental human right. Furthermore, world leaders must exert political pressure on the conflicting parties to adhere to humanitarian law, prioritize the protection of civilians, and facilitate access to aid to those in need. This encompasses condemning attacks on civilian infrastructure and advocating for the lifting of restrictions that exacerbate the dire situation in Gaza.

In addition to immediate assistance, long-term development support is essential. Investment in rebuilding infrastructure, boosting

the economy, and improving living conditions is crucial for the people of Gaza. This involves supporting reconstruction efforts, promoting education and healthcare, and facilitating economic development in this war-torn region. Lastly, the promotion of human rights, which includes ensuring food security for all, is indispensable. States must prioritize the safeguarding of the rights of Gazan civilians and hold those responsible for violations accountable. Failure to effectively address the Gaza crisis not only further deepens the suffering of the people of Gaza but also undermines the broader goals of sustainable development and global food security. Therefore, the international community must come together and take decisive action to alleviate the crisis and pave the way for a better future for the people of Gaza.

Author contributions

AbH: Methodology, Supervision, Visualization, Writing – original draft, Writing – review & editing. KA-M: Data curation, Writing – original draft. HH: Writing – original draft. AhH: Writing – original draft, Visualization. KK: Writing – original draft. MB: Supervision, Writing – original draft. AJ: Funding acquisition, Writing – original draft.

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