THE ROLE OF SCIENCE DIPLOMACY IN ACHIEVING SDG2: ZERO HUNGER

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Abstract

The Sustainable Development Goals (SDGs) are designed to address the major challenges facing societies. They outline a comprehensive framework for possible solutions to these challenges. SDG 2 aims to achieve global food security, improve nutrition and promote sustainable agriculture with the goal of "Zero Hunger". Science diplomacy plays an important role at critical points in the implementation of SDG 2. The most fundamental step in developing effective solution strategies is to understand the problem from all its aspects with a scientific approach. This goal can be achieved through the two-way interaction of the evidence and power of science and the communication and mutually beneficial potential of diplomacy. The use of science diplomacy to promote cooperation in various fields contributes to the dissemination of international research projects, research and development, technological advances and progress towards SDG 2. The importance of global policies to address food system challenges is emphasized. Policies and initiatives targeting food security, nutrition, sustainable agriculture and ending hunger are supported by science diplomacy principles that encourage investments and international cooperation in these areas. Through science diplomacy, scientific knowledge is shared more internationally and best practices and models can be disseminated between countries. Science can also contribute to improving diplomatic relations by building international bridges to achieve a common and correct goal. Science diplomacy can be effective in creating a moderate response to some diplomatic crises, such as wars, and can also contribute to solutions in situations such as economic crises and epidemics. Using science as a tool has the potential to preserve progress towards SDG 2 and prevent regression. Scientific evidence-based policies aimed at achieving SDG 2 should be guided by lifting trade embargoes between countries and increasing the efficiency of global food markets. Such an approach helps secure food supplies for societies. It supports the common goal of ending hunger. Countries are expected to engage in and support science diplomacy to achieve SDG 2 and end hunger. Furthermore, it is imperative to increase cooperation to harness the potential power of science diplomacy to achieve the global goal of "SDG 2: Zero Hunger."

Keywords

Food Security, Global Cooperation, SDG-2 Zero Hunger, Science Diplomacy, Sustainable Agriculture

Introduction

Science diplomacy serves as a valuable scientific tool in developing knowledge-based solutions, international partnerships, and collaborations needed to overcome global problems (Yıldırım & Akbulut, 2021). It encompasses collective efforts to address global needs and solve common problems (Gluckman et al., 2017). This intersection of science and foreign policy interests is considered an integral part of international relations (Flink & Schreiterer, 2010; Ruffini, 2017). In recent years, with the rise of global crises, the emphasis on science diplomacy has increased. This has made it important and interesting in the international arena (Simon, 2019).

The Sustainable Development Goals, set by the United Nations in 2015, include 17 goals aimed at ending poverty, protecting the planet, and ensuring peace and prosperity for all. These goals are aimed to be achieved by 2030 (United Nations, 2015). Science diplomacy is used to address multifaceted global challenges that affect all countries, such as the climate crisis, food insecurity, and pandemics, and to spread progress in an interconnected world (Flink & Schreiterer, 2010). Addressing such major global challenges requires a political response. Science-based diplomatic measures and policy recommendations provide an approach to problem-solving. This dynamic process of science and diplomacy coming together has an undeniable role (Kaltofen & Akuto, 2018). Science diplomacy plays an important role in achieving these goals. This study aims to outline this issue by providing a perspective on the role of science diplomacy in achieving Sustainable Development Goal 2: Zero Hunger.

Sustainable Development Goal 2-Zero Hunger (SDG2) and Science Diplomacy

The SDGs were created to address critical global challenges and focus on issues of fundamental importance to humanity. SDG2, also known as "Zero Hunger," aims to eliminate hunger globally, achieve food security, improve nutrition, and promote sustainable agriculture. A number of actions are being prioritized to achieve this goal. These include strategic steps such as increasing food production, improving food distribution networks, reducing food waste, and promoting sustainable farming methods. Food security and nutrition have a direct impact on people's overall well-being. Undernutrition leads to health problems such as stunted growth, wasting, and micronutrient deficiencies in children, negatively impacting their education and participation in the workforce, and jeopardizing economic progress and social stability. In this regard, achieving SDG2 is of utmost importance (United Nations, 2015). Figure 1 shows a tag cloud of key terms associated with science diplomacy and SDG2: Zero Hunger.

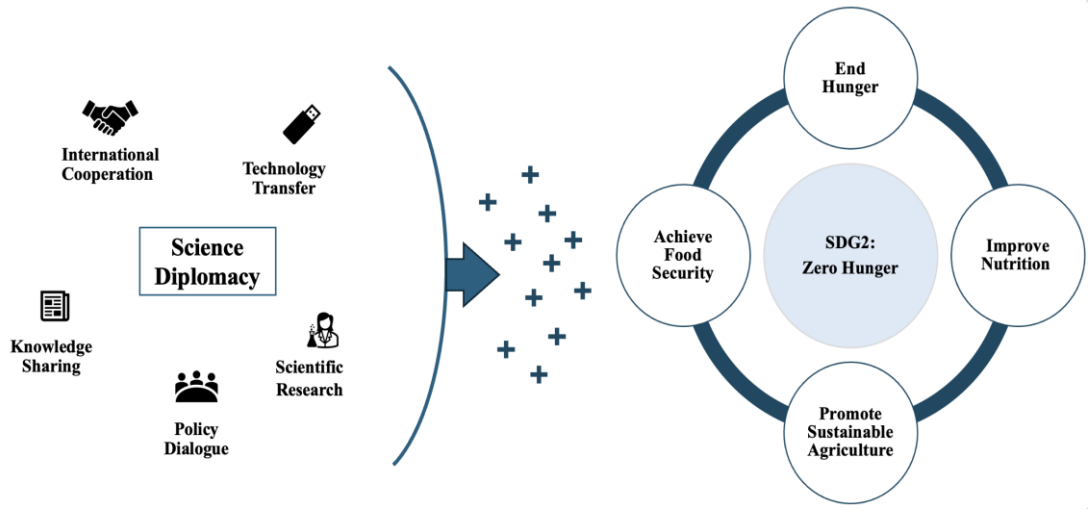
Figure 1
SDG2-Zero Hunger and Science Diplomacy

Science diplomacy facilitates the dissemination of international research projects, R&D studies, and technological advances in the field of science and technology. Due to these critical roles, science diplomacy is gaining importance in achieving SDG2 (McGrath, 2023). Science diplomacy is evaluated in three main categories (Royal Society & AAAS, 2010). The first of these is science in diplomacy. Science in diplomacy focuses on the importance of science and technology in promoting foreign policy goals. In the development of policies, evaluating scientific data with a holistic approach is very important for creating effective and long-lasting solutions. Science diplomacy plays an important role in integrating scientific evidence into the policy-making process by facilitating cooperation between scientists and policy makers (Turekian et al., 2015; Gluckman et al., 2017). At this point, the task of science in diplomacy is to ensure that policy makers increase the scientific quality and reliability of the proposals they present (Davis & Patman, 2015). The other category of science diplomacy is diplomacy for science. Diplomacy for science focuses on using international diplomatic tools to promote scientific research and facilitate collaborations among researchers (Royal Society & AAAS, 2010). This effort towards scientific activities can only be reciprocated with the diplomatic support of governments and international organizations (Ruffini, 2020). Through diplomacy for science, scientific knowledge can be disseminated globally and good and advanced practices can be shared between countries. Diplomacy for science fosters the development of common solutions by establishing connections between scientists, research institutions and governments in different nations (Turekian et al., 2015). This is critical in increasing scientific capacity and strengthening research infrastructure (Van Langenhove, 2017). Diplomatic efforts such as organizing international scientific symposiums, congresses and summits, and strengthening research funding through increased support are examples of diplomacy for science initiatives that strengthen scientific collaboration (Ruffini, 2020). Diplomacy for science is also very important when evaluated in line with SDG2. In low- and middle-income

countries, scientific capacity and infrastructure are quite limited. This makes it difficult for new and advanced applications to spread from high-income countries, which are at the center of scientific developments, to these countries. Therefore, it is essential to develop local scientific capacity as a priority. This is where diplomacy for science comes into play. It facilitates the strengthening of scientific capacity in developing countries by supporting scientific research and education initiatives. Thus, it promotes sustainable development in the long term (Van Langenhove, 2017). The last category of science diplomacy is science for diplomacy. Science for diplomacy focuses on the use of scientific concepts and applications to help define and achieve foreign policy goals. It plays strategic roles in strengthening international relations. With this approach, science is used to promote positive relations. It encourages the use of science as a tool to improve existing diplomacy, especially between countries that are experiencing tension. This form of diplomacy takes advantage of the tension-easing potential, unifying power, and attractiveness of scientific endeavors (Ozkaragoz Dogan, 2015; Davis & Patman, 2015; Royal Society & AAAS, 2010).

Figure 2

Science Diplomacy Contributions to Achieving SDG2:-Zero Hunger-



Science diplomacy offers solutions to various problems, including wars, economic crises, and epidemics. In this respect, science diplomacy has the potential to create a peaceful environment. In addition, it has a significant power in increasing the efficiency of global food markets and lifting trade embargoes between countries (Paarlberg, 2010). Using science as a tool in ensuring food security can contribute to the preservation and maintenance of the progress achieved (McGrath, 2023; Ruffini, 2023). Ultimately, science diplomacy plays a key role in achieving the goal of zero hunger with its elements such as international cooperation, scientific research, knowledge sharing, technology transfer, and policy dialogue (Figure 2). It continues its effect at all stages, starting from addressing the problem with all its scientific aspects to the development and implementation of effective solution strategies (Gluckman et al., 2017; McGrath, 2023; Ruffini, 2023).

Ending Hunger

Approximately 690 to 783 million people worldwide are affected by hunger, and nearly three-quarters of a billion people lack access to sufficient food, struggling with food insecurity (Concern Worldwide & Welthungerhilfe. 2024; FAO et al., 2023). It is estimated that 713-757 million people, corresponding to 8.9%-9.4% of the world population, were affected by hunger in 2023 (FAO et al., 2024). The Global Hunger Index (GHI) score for 2024 has been announced as 18.3. This is a small improvement of only 0.5 points compared to the 2016 GHI data. If progress continues at the pace observed since 2016, it is estimated that global hunger levels will not be reduced until 2160. The highest rates of hunger are observed in Sub-Saharan Africa and South Asia. Poverty, climate change, wars and crises in these regions continue to have serious negative effects on food security (Concern Worldwide & Welthungerhilfe, 2024).

Trade embargoes and political conflicts pose a major obstacle to efforts to ensure food security. Wars disrupt international trade markets and lead to increases in food prices. With their devastating effects, they not only halt significant progress against the hunger crisis, but often result in regression (WFP, 2024a). Food insecurity increases significantly in times of war and its effects last for a long time. Science diplomacy supports overcoming barriers to international food trade and contributes to finding solutions (Paarlberg, 2010).

A famine is declared when hunger occurs due to widespread malnutrition and difficulty in accessing sufficient and nutritious food (WFP, 2024a). The Dutch famine is a historical example of how war can destroy food resources. The blockade imposed in the west of the Netherlands during the Nazi occupation in World War II prevented the people from receiving food, creating a major hunger crisis. It is stated that approximately 20,000 people lost their lives due to famine in this process where millions of people face severe food insecurity (De Rooij et al., 2021). With the recent conflict in Gaza, existing infrastructure has been damaged, and agricultural activities and food supply chains have been interrupted. Food insecurity has increased in the region, especially in the hot zones where the war continues. It has become difficult for people to access sufficient and nutritious food. Despite the efforts of international organizations and countries such as WFP to provide humanitarian assistance to Gaza, the crisis in the region continues. Such events are a strong blow to the efforts to achieve SDG2. The conflict in Gaza draws attention to the fragility of global and regional food systems. Vulnerable groups, including refugees and internally displaced people who have been forced to leave their countries due to war or other reasons, are more vulnerable to hunger. They often need food aid to continue their lives (WFP, 2024b). Science diplomacy is a strategic and effective tool not only in diplomatic disputes but also in responding to economic, health or post-disaster crises (McGrath, 2023; Ruffini, 2023). Climate-related disasters such as rainfall imbalances and heat waves are one of the major causes of food insecurity. In addition to loss of life, they cause the destruction of livelihoods, soil degradation, and damage to crops and agricultural resources (WFP, 2024a).

Economic inequalities, war-affected economies, and rising food prices due to external factors make it difficult for poor populations to access nutritious food and exacerbate food insecurity. On the other hand, according to a United Nations Environment Organization (UNEP) report, approximately one-third of global food production is wasted and lost (UNEP, 2024). A significant portion of farmers experience crop losses due to limited access to technology and markets (WFP, 2024a). Each of these makes it difficult to achieve food security. The importance of science diplomacy and international cooperation in the prevention and management of all these crises is better understood (McGrath, 2023; Ruffini, 2023).

Science diplomacy is essential to understanding the causes of global hunger and developing effective solutions. International research initiatives and scientific collaborations can provide innovative solutions by focusing on the root causes of hunger. As a successful example, research in Africa and Asia has played a significant role in developing drought and disease-resistant agricultural products (Pingali, 2012). These and similar projects offer strategic opportunities to combat hunger. They can make crops more resilient to climate change by increasing the efficiency of agricultural practices. Science diplomacy supports the development of innovative agricultural technologies and facilitates their diffusion across countries. Breakthroughs in biotechnology and genetic engineering have enabled the production of more resilient and high-yielding plant varieties. International sharing of research outputs and technologies contributes significantly to the fight against hunger by optimizing agricultural production processes (Juma, 2015).

Achieving Food Security

Food security is the ability of all individuals to have access to safe and nutritious food that will enable them to live a physically and economically adequate, healthy and active life, in a manner befitting human dignity (FAO, 1996). Food insecurity, which is considered a global problem, is particularly prevalent in underdeveloped and developing countries. The severity of food insecurity results in hunger (Nkambule et al., 2021). In addition, chronic food insecurity can lead to malnutrition depending on its persistence and severity (National Research Council, 2006).

It is estimated that 2.2 billion people will experience moderate or severe food insecurity in 2023. This rate corresponds to 27.5 percent of the world's population (FAO et al., 2024). This rate was reported as 29.6 percent for 2022 (FAO, 2023). Food insecurity is more common among women and those living in rural areas. According to 2023 data, 31.9% of adults living in rural areas, 29.9% of those living in semi-urban and semi-rural areas, and 25.5% of those living in urban areas experienced moderate or severe food insecurity (FAO et al., 2024).

Improving food production, distribution and consumption processes is essential to ensure food security. In this context, sustainable diet models are on the agenda, as well as measures such as increasing agricultural productivity, strengthening food supply chains and reducing food waste. Sustainable diets play an important role in meeting

nutritional needs, minimizing environmental impact and establishing a balanced relationship between food production and consumption. These diets advocate reducing the consumption of animal foods while encouraging greater consumption of plant-based foods. Sustainable diets not only improve the health of individuals but also contribute to environmental sustainability (Willet et al., 2019). The Mediterranean Diet brings with it many positive health benefits with the nutritional principles it adopts (Serra-Majem et al., 2020). In addition, it has been shown in many studies that its contribution to environmental sustainability is also significantly high (Lorca-Camara et al., 2024). In this respect, the Mediterranean diet has a remarkable position among sustainable dietary models (Lorca-Camara et al., 2024; Serra-Majem et al., 2020). Sustainable dietary models aim to provide access to sufficient, safe and nutritious food for everyone, as well as environmental, economic and social sustainability. Therefore, the sustainability of food systems is also taken into account in the context of sustainable dietary models. While these systems focus on environmental factors such as efficient use of natural resources, conservation of biodiversity and combating climate change, they also try to improve the living standards of farmers and agricultural workers (FAO, 2021). Scientific international research strives to provide recommendations and develop advanced technologies to increase the efficiency and sustainability of food systems (CGIAR, 2021). The progress made in this regard is of great importance in transferring advanced agricultural technologies and sustainable food production methods to developing countries, improving food security and reducing hunger (OECD, 2021). Science diplomacy has the potential to facilitate the global spread of sustainable food systems and encourage the adoption of sustainable diets.

Given the fragile state of food security, it is crucial to strengthen the resilience of food systems against external threats like as climate change and natural disasters. Therefore, it is vital to adopt sustainable agricultural practices and develop policies to reduce food waste (FAO, 2019). Science diplomacy supports efforts to ensure food security by maintaining its effectiveness in the development of these policies. Establishing seed and plant banks to protect biodiversity and support agricultural production is an important practice in this context. These banks contribute to food security by enabling the sharing of genetic resources among different countries (Lipper et al., 2014). Genetically modified crops are effective in increasing food security by providing higher productivity and resilience. Science diplomacy supports the global adoption and dissemination of these technologies. A successful example of this is the successful use of crops such as golden rice to improve food security in developing countries (Qaim, 2020).

Improving Nutrition

Undernutrition is a broad concept encompassing various forms of malnutrition, including wasting, stunting, underweight, obesity, nutrient deficiencies, and noncommunicable diseases that arise from diet (WHO, 2024). It is estimated that in 2023, undernourished people will constitute 9.1% of the world's population (FAO et al., 2024). According to the World Health Organization, in 2022, 2.5 billion adults were overweight (890 million of whom were obese) and 390 million were underweight (WHO, 2024). While wasting is an

indicator of acute malnutrition, characterized by low body weight for height, stunting indicates chronic malnutrition, resulting in shorter height for age. Underweight can indicate both chronic and acute malnutrition, and refers to low body weight for age. Hidden hunger, resulting from deficiencies of essential vitamins and minerals, leads to growth retardation, weakened immune systems, and impaired neurodevelopmental processes (UNICEF, n.d.). Despite scientific and technological advances, malnutrition continues to be a widespread problem (Tanumihardjo et al., 2007). It is reported that 149 million children under 5 years of age worldwide are stunted and 45 million are wasted. In addition, 37 million children are thought to be overweight or obese (WHO, 2024). One in three children under 5 years of age suffers from malnutrition, which is caused by undernourishment or excessive body weight (UNICEF, n.d.). Undernourished children are 12 times more likely to die than their healthy peers (WFP, 2024a), and half of all deaths in children under 5 are attributed to malnutrition. These deaths occur mostly in low- and middle-income countries with severe levels of food insecurity. Malnutrition is a major problem with lasting impacts on individuals, communities and nations (WHO, 2024).

Malnutrition poses a problem for individual well-being as well as for society and national progress. It is a significant obstacle to economic growth and social development that must be taken into account (Thompson & Amoroso, 2014). The negative effects of malnutrition include hindering economic progress, perpetuating poverty, affecting children's education and hindering the development of skills of adults in the workforce. In this respect, it leads to situations in the human capital and development of countries that will take a long time to overcome (WFP, 2024a). In addition to malnutrition, overnutrition problems such as obesity have reached serious levels globally. Obesity poses a serious threat to health and life expectancy. It increases the risk of chronic diseases such as diabetes, cardiovascular diseases and some types of cancer (WHO, 2024). This places a significant burden on both individuals and health systems. Improving nutrition requires increasing dietary diversity to ensure that people have adequate and balanced nutrition. This includes encouraging the consumption of foods such as fresh fruits and vegetables, whole grains, lean protein sources and healthy fats. In addition, it is important to reduce the consumption of processed foods and foods high in sugar, salt, and saturated fat (Turkish Ministry of Health, 2022). Addressing all forms of malnutrition is important to improve public health and promote economic growth. There is a widespread and common belief that creating behavioral changes in individuals to optimize nutrition is difficult but an absolute necessity (Patnode et al., 2017). Science diplomacy plays an important role in producing solutions to nutrition-related problems. Nutrition policies and programs are created based on the data of qualified research at the national and international levels. International collaborations facilitate the widespread implementation of fortification programs aimed at eliminating vitamin and mineral deficiencies (Horton, 2006). Science diplomacy is successful in promoting nutrition education and awareness initiatives through international collaboration. Organizations such as WHO and UNICEF partner with countries to support nutrition programs. These programs are designed to promote healthy eating habits, improve nutritional status, and contribute to the achievement of SDG2 (WHO, 2014). Indeed, in light of data on malnutrition and food insecurity, WHO and FAO have called for policy action on the SDGs

as part of the UN Decade of Action on Nutrition. These calls focus on six carefully selected key areas, ranging from creating sustainable, resilient food systems for healthy diets to creating safe and supportive environments for nutrition at all ages (WHO, 2024).

Promoting Sustainable Agriculture

Considering the global population growth and prevalence of malnutrition, investing in the agricultural sector is essential to ensure food security. It has been reported that the agricultural sector is 3.2 times more effective in reducing poverty compared to other sectors (Gorjian et al., 2020). Sustainable agriculture aims to harmonize the environmental, economic and social aspects of agricultural production. This is crucial for the conservation of natural resources, improvement of farmers' livelihoods and ensuring stable food production (Pretty, 2008). Science diplomacy has an important place in the advancement and dissemination of sustainable agricultural practices. It encourages international investments in sustainable agriculture, such as the establishment of seed and plant banks, conducting research and developing new technologies (McGrath, 2023). International collaborations make it easier to conduct scientific research on climate change and environmental sustainability (Gliessman, 2014; Ruffini, 2020). Sustainable agricultural methods such as agroecology and permaculture have become the focus of attention and widespread thanks to international research and information sharing. Climate change poses a significant threat to agricultural production and food security (UNFCCC, 2015). Evidence-based policies increase the success of sustainable agriculture and food systems. Science diplomacy ensures that scientific data is integrated into policy processes (Turekian et al., 2015). Activities such as water and soil management, protection of biodiversity, adoption of climate-smart agricultural techniques and support for small-scale farmers have a considerable power in achieving the determined goals (Gliessman, 2014). Science diplomacy encourages cooperation and innovative solutions among international stakeholders to address climate change. The Paris Agreement is an important step in this direction, advocating the use of scientific data to combat climate change and efforts and cooperation towards common goals (UNFCCC, 2015).

Challenges Facing Science Diplomacy in Achieving SDG2: Zero Hunger

In achieving SDG2, lack of funding, political barriers, cultural differences, and difficulties in accessing information and technology can reduce the impact of science diplomacy (Mazzucato, 2023; Royal Society & AAAS, 2010; Turekian et al., 2015; Juma, 2015). Inadequate funding can reduce the power of science diplomacy efforts and make it difficult to achieve SDG2. International collaborations and projects often require a significant budget. This makes the sustainable financing of science diplomacy activities essential. Inadequate funding for agricultural initiatives in developing countries can jeopardize the success of initiatives in this regard. One of the main issues that science diplomacy focuses on is the financing of sustainable development projects. International funds and donors are encouraged to support agricultural and food security projects in developing countries (Mazzucato, 2023). Science diplomacy can face political obstacles, especially during periods when tense diplomatic relations are evident. In order to

overcome these obstacles, it is necessary to understand the reasons and develop solutions. International research and collaborations help in this regard by promoting a moderate environment. Political tensions can hinder science diplomacy efforts and hinder international collaboration. Overcoming these political obstacles and improving diplomatic relations are essential for the continued success of science diplomacy (Royal Society & AAAS, 2010). Science diplomacy also plays a role in lifting trade embargoes between countries and strengthening food security. It promotes global stability and prevents disruptions to global food supply (Paarlberg, 2010; Royal Society & AAAS, 2010). Cultural differences among scientists can create difficulties for scientists and researchers working on joint projects. This can lead to communication problems and disruptions in the collaboration process. In addition, different cultural and traditional practices in agriculture can hinder the adoption of new methods. Science diplomacy emphasizes a deep understanding of different cultures. Strong communication and harmony among stakeholders, especially scientists, can make science diplomacy efforts successful (Turekian et al., 2015).

Due to patent rights, the dissemination of precision agriculture technologies is difficult. One reason for this can be shown as the hesitation of developing countries to share knowledge and technology, especially regarding patents and intellectual property rights. Overcoming barriers to access to knowledge and technology reinforces the success of science diplomacy initiatives. (Juma, 2015). Progress towards SDG2 can be accelerated by encouraging international research projects and partnerships that facilitate international exchange of knowledge and technology (Royal Society & AAAS, 2010).

The Power of Science Diplomacy in SDG 2 'Zero Hunger': Organizations and Projects

Many institutions and organizations serve and mediate science diplomacy to achieve SDG 2: Zero Hunger. Some of the leading organizations serving this purpose are the Food and Agriculture Organization of the United Nations (FAO), the World Food Programme (WFP), the Consultative Group on International Agricultural Research (CGIAR), the International Fund for Agricultural Development (IFAD) and the United Nations Children's Fund (UNICEF). Each of these large-scale, high-impact organizations contributes to SDG 2 by effectively using science diplomacy. Table 1 lists the contributions of these organizations to science diplomacy and SDG 2 and their projects on this subject. In addition to the institutions and organizations mentioned above, many more organizations contribute directly or indirectly to SDG 2. While science diplomacy supports the establishment and existence of these organizations, organizations also encourage cooperation on projects through science diplomacy.

Table 1

Organizations and Projects Contributing to Science Diplomacy and SDG2: Zero Hunger

Organization	**Relationship to Science Diplomacy and SDG2: Zero Hunger'**	**Project and Contribution**
United Nations (UN)	It carries out projects to end hunger and increase food security. It promotes scientific exchanges and development of global policies.	**Zero Hunger Challenge:** It aims to end global hunger.
World Health Organization (WHO)	It uses scientific research data to develop health policies collaboratively on a global scale.	**Essential Nutrition Actions:** It aims to improve nutrition by promoting basic nutritional practices through health services.
Food and Agriculture Organization (FAO)	It promotes scientific research and technological advancement to improve global food and agricultural policies. It develops sustainable agricultural practices and projects for food security.	**Save Food:** It is a global project to reduce food loss and waste.
World Food Programme (WFP)	It fights global hunger. It aims to create sustainable food systems and end hunger.	**Smallholder Market Support:** It aims to help small-scale farmers increase their agricultural production and achieve sustainable livelihoods.
Consultative Group on International Agricultural Research (CGIAR)	It carries out projects to increase agricultural productivity. It encourages innovation in agriculture by sharing scientific data.	**HarvestPlus:** It aims to develop and distribute micronutrient-enriched food products. Within the scope of the project, products such as corn and sweet potatoes enriched in iron and zinc were developed.
International Fund for Agricultural Development (IFAD)	It focuses on reducing poverty and increasing food security in rural areas. Supports small-scale farmers. Promotes sustainable development.	**Adaptation for Smallholder Agriculture Programme (ASAP):** It helps small farmers adapt to climate change. It provides financing and technical support to make agricultural practices resilient to climate change.
United Nations International Children's Emergency Fund (UNICEF)	It supports research to improve children's nutritional status. Promotes policy development.	**Nutrition in Emergencies:** It aims to quickly meet the nutritional needs of mothers and children in emergencies.
Organisation for Economic Co-operation and Development (OECD)	It supports policies with scientific data. Implements projects for innovative practices in agriculture and sustainable food production.	**Agricultural Policy Monitoring and Evaluation:** It aims to monitor and evaluate agricultural policies.

Conclusion

The SDG2 aims to eliminate hunger, ensure food security, improve nutrition and promote sustainable agriculture by 2030. In achieving this goal, science diplomacy provides significant support through elements such as policy making, technology transfer, scientific research, knowledge sharing and international collaborations. It is of great importance that this support is used effectively by all stakeholders to achieve all

dimensions of the SDG2 target. Science diplomacy paves the way for important steps in achieving food security, improved nutrition, the dissemination of sustainable agricultural practices and addressing global hunger. In addition, it ensures that the scientific data required to create more efficient and sustainable solutions are integrated into policy-making processes. Moreover, it facilitates the funding of international research projects and R&D studies. It develops scientific capacity and research infrastructure. It contributes to the development and implementation of evidence-based policies by bringing scientists and policy makers together for a common purpose. Science diplomacy has a two-way relationship with organizations such as FAO, WFP, CGIAR, IFAD and UNICEF. Science diplomacy continues to contribute to SDG2 through these foundations. On the other hand, challenges such as insufficient funding, political tensions, wars, cultural differences and limited access to information and technology can hinder the impact of science diplomacy in achieving SDG2. Active awareness-raising and strategic action are needed to overcome these challenges. As a result, science diplomacy is an indispensable tool for achieving SDG2. It makes it possible to accelerate progress. It is essential for all stakeholders to fully leverage the potential of science diplomacy and collaborate with determination to achieve SDG2. Leveraging the opportunities offered by science diplomacy to achieve SDG2 is an important step towards a healthier, more sustainable and fairer world.

References

Concern Worldwide & Welthungerhilfe. (2024). *2024 Global Hunger Index: The State of Food Security Worldwide*. https://www.globalhungerindex.org

Consultative Group on International Agricultural Research (CGIAR). (2021). *Research program on climate change, agriculture and food security (CCAFS).* CGIAR.

Davis, L. S., & Patman, R. G. (2015). *Science diplomacy: New day or false dawn.* World Scientific Publishing.

De Rooij, S. R., Bleker, L. S., Painter, R. C., Ravelli, A. C., & Roseboom, T. J. (2021). Lessons learned from 25 Years of Research into Longterm Consequences of Prenatal Exposure to the Dutch famine 1944–45: The Dutch famine Birth Cohort. *International Journal of Environmental Health Research*, *32*(7), 1432–1446. https://doi.org/10.1080/09603123.2021.1888894

FAO, IFAD, UNICEF, WFP & WHO. 2024. *The State of Food Security and Nutrition in the World 2024 – Financing to end hunger, food insecurity and malnutrition in all its forms.*

Flink, T., & Schreiterer, U. (2010). Science diplomacy at the intersection of S&T policies and foreign affairs: Toward a typology of national approaches. *Science and Public Policy, 37*(9), 665–677. https://doi.org/10.3152/030234210X12778118264530

Food and Agriculture Organization (FAO), International Fund for Agricultural Development, United Nations Children's Fund, World Food Programme, & World Health Organization. (2023). *The state of food security and nutrition in the world 2023: Urbanization, agrifood systems transformation and healthy diets across the rural–urban continuum.* Food and Agriculture Organization of the United Nations.

Food and Agriculture Organization (FAO). (1996). *Food, agriculture and food security: Developments since the World Food Conference and prospects for the future: World Food Summit.* Food and Agriculture Organization of the United Nations.

Food and Agriculture Organization (FAO). (2019). *The state of food security and nutrition in the world 2019.* http://www.fao.org/publications/sofi/2019/en/

Food and Agriculture Organization (FAO). (2021). *Committee on World Food Security (CFS) voluntary guidelines on food systems and nutrition.* Food and Agriculture Organization of the United Nations.

Food and Agriculture Organization (FAO). (2023). *Prevalence of undernourishment.* https://www.fao.org/sustainable-development-goals-data-portal/data/indicators/2.1.1-prevalence-of-undernourishment/en

Gliessman, S. R. (2014). *Agroecology: The ecology of sustainable food systems.* CRC Press.

Gluckman, P. D., Turekian, V. C., Grimes, R. W., & Kishi, T. (2017). *Science diplomacy: A pragmatic perspective from the inside*. Science & Diplomacy.

Gorjian, S., Minaei, S., MalehMirchegini, L., Trommsdorff, M., & Shamshiri, R. R. (2020). Applications of solar PV systems in agricultural automation and robotics. In S. Gorjian & A. Shukla (Eds.), *Photovoltaic solar energy conversion* (pp. 191–235). Elsevier.

Horton, S. (2006). The economics of food fortification. *Journal of Nutrition, 136*(4), 1068–1071.

Juma, C. (2015). *The new harvest: Agricultural innovation in Africa.* Oxford University Press.

Kaltofen, C., & Acuto, M. (2018). Science diplomacy: Introduction to a boundary problem. *Global Policy, 9*(1), 8–14. https://doi.org/10.1111/1758-5899.12621

Lipper, L., Thornton, P., Campbell, B. M., Baedeker, T., Braimoh, A., Bwalya, M., Caron, P., Cattaneo, A., Garrity, D., Henry, K., Hottle, R., Jackson, L., Jarvis, A., Kossam, F., Mann, W., McCarthy, N., Meybeck, A., Neufeldt, H., Remington, T., … & Torquebiau, E. F. (2014). Climate-smart agriculture for food security. *Nature Climate Change, 4*, 1068–1072.

Lorca-Camara, V., Bosque-Prous, M., Bes-Rastrollo, M., O'Callaghan-Gordo, C., & Bach-Faig, A. (2024). Environmental and health sustainability of the mediterranean diet: A systematic review. *Advances in nutrition (Bethesda, Md.)*, *15*(12), 100322. https://doi.org/10.1016/j.advnut.2024.100322

Mazzucato, M. (2023). *Financing the sustainable development goals through mission-oriented development banks.* UN Department of Economic and Social Affairs; UN High-level Advisory Board on Economic and Social Affairs; University College London Institute for Innovation and Public Purpose.

McGrath, P. F. (2023). The sustainable development goals, science diplomacy and TWAS. In S. Arnaldi (Ed.), *Science diplomacy: Foundations and practice* (pp. 105–116). EUT Edizioni University di Trieste.

National Research Council. (2006). *Food insecurity and hunger in the United States: An assessment of the measure.* National Academies Press.

Nkambule, S. J., Moodley, I., Kuupiel, D., & Mashamba-Thompson, T. P. (2021). Association between food insecurity and key metabolic risk factors for diet-sensitive non-communicable diseases in sub-Saharan Africa: A systematic review and meta-analysis. *Scientific Reports, 11*(1), 1–19.

OECD. (2021). *Agricultural policy monitoring and evaluation.* OECD Publishing.

Ozkaragoz Dogan, E. (2015). *Science diplomacy in the global age: Examples from Turkey and the world* [Unpublished doctoral dissertation]. Middle East Technical University.

Paarlberg, R. (2010). *Food politics: What everyone needs to know.* Oxford University Press.

Patnode, C. D., Evans, C. V., Senger, C. A., Redmond, N., & Lin, J. S. (2017). Behavioral counseling to promote a healthful diet and physical activity for cardiovascular disease prevention in adults without known cardiovascular disease risk factors: Updated evidence report and systematic review for the US preventive services task force. *JAMA, 318*(2), 175–193.

Pingali, P. (2012). Green revolution: Impacts, limits, and the path ahead. *Proceedings of the National Academy of Sciences, 109*(31), 12302–12308.

Pretty, J. (2008). Agricultural sustainability: Concepts, principles and evidence. *Philosophical Transactions of the Royal Society B: Biological Sciences, 363*(1491), 447–475.

Qaim, M. (2020). *Genetically modified crops and global food security.* CABI.

Royal Society & American Association for the Advancement of Science. (2010). *New frontiers in science diplomacy: Navigating the changing balance of power.* The Royal Society.

Ruffini, P. (2017). *Science and diplomacy: A new dimension of international relations* (1st ed.). Springer.

Ruffini, P. B. (2020). Conceptualizing science diplomacy in the practitioner-driven literature: A critical review. *Humanities and Social Sciences Communications, 7*, 124. https://doi.org/10.1057/s41599-020-00609-5

Ruffini, P. B. (2023). Science diplomacy: On several basic notions and key questions. In S. Arnaldi (Ed.), *Science diplomacy: Foundations and practice* (pp. 15–34). EUT Edizioni Università di Trieste.

Serra-Majem, L., Tomaino, L., Dernini, S., Berry, E. M., Lairon, D., Ngo de la Cruz, J., Bach-Faig, A., Donini, L. M., Medina, F. X., Belahsen, R., Piscopo, S., Capone, R., Aranceta-Bartrina, J., La Vecchia, C., & Trichopoulou, A. (2020). Updating the Mediterranean Diet Pyramid towards Sustainability: Focus on Environmental Concerns. *International Journal of Environmental Research and Public Health*, *17*(23), 8758. https://doi.org/10.3390/ijerph17238758

Simon, D. (2019). Introduction: Science and public policy - relations in flux. In D. Simon, S. Kuhlmann, J. Stamm, & W. Canzler (Eds.), *Handbook on science and public policy* (pp. 1–10). Edward Elgar Publishing.

Tanumihardjo, S. A., Anderson, C., Kaufer-Horwitz, M., Bode, L., Emenaker, N. J., Haqq, A. M., Satia, J. A., Silver, H. J., & Stadler, D. D. (2007). Poverty, obesity, and malnutrition: an international perspective recognizing the paradox. *Journal of the American Dietetic Association*, *107*(11), 1966–1972. https://doi.org/10.1016/j.jada.2007.08.007

Thompson, B., & Amoroso, L. (2014). *Improving diets and nutrition: Food-based approaches.* Food and Agriculture Organization of the United Nations.

Turekian, V. C., Gluckman, P. D., Kishi, T., Grimes, R. W., & Hambley, T. W. (2015). The emergence of science diplomacy. *Science & Diplomacy, 4*(1).

Turkish Ministry of Health, (2022). *Türkiye Beslenme Rehberi (TÜBER) 2022*. Sağlık Bakanlığı Yayın No: 1031

UNICEF. (n.d.). *Nutrition.* https://www.unicef.org/nutrition

United Nations Environment Programme (2024). *Food Waste Index Report 2024. Think Eat Save: Tracking Progress to Halve Global Food Waste*. https://wedocs.unep.org/20.500.11822/45230

United Nations Framework Convention on Climate Change. (2015). *Paris agreement.* https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

United Nations. (2015). *Transforming our world: The 2030 agenda for sustainable development.* https://sdgs.un.org/2030agenda

Van Langenhove, L. (2017). *Tools for an EU science diplomacy.* Publications Office of the European Union.

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L. J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J. A., De Vries, W., Majele Sibanda, L., Afshin, A., … & Murray, C. J. L. (2019). Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. *Lancet (London, England)*, *393*(10170), 447–492. https://doi.org/10.1016/S0140-6736(18)31788-4

World Food Programme. (2024a). *Ending hunger.* https://www.wfp.org/ending-hunger

World Food Programme. (2024b). *Gaza updates: WFP responds to hunger crisis as Rafah incursion cuts access to warehouse.* https://www.wfp.org/stories/gaza-updates-wfp-responds-hunger-crisis-rafah-incursion-cuts-access-warehouse

World Health Organization. (2014). *Global nutrition targets 2025: Policy brief series.* https://www.who.int/nutrition/publications/globaltargets2025 policy brief overview/en/

World Health Organization. (2024). *Malnutrition.* https://www.who.int/news-room/fact-sheets/detail/malnutrition

Yıldırım, G., & Akbulut, D. (2021). The relations between science diplomacy and science public relations are in the process of becoming a model for Turkey, with examples from the American Association for the Advancement of Science (AAAS) and the Royal Society. *Galatasaray University Communication Journal, 6, 75–106.* https://doi.org/10.16878/gsuilet.867946

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