IRAN UNDER SANCTIONS

The Unintended Environmental Implications of Iran Sanctions

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SAIS

ABOUT IRAN UNDER SANCTIONS

Iran's economy has been under sanctions in one form or another since the 1979 revolution. Yet little systematic knowledge exists on the short- and medium-term impacts of sanctions on the growth patterns of the Iranian economy, the general welfare of its people in the cities and rural areas, societal dynamics, civic space, and the country's environment. The focus has often been on a few metrics that flare up with tightening of sanctions: currency depreciation, inflation, and recession, which are then followed by increases in unemployment and poverty. But the more comprehensive picture is lost in political cacophony around the policy's merits. This is the gap that SAIS is filling with its Iran Under Sanctions project, which is a 360-degree in-depth view on the implications of sanctions on Iran. This first-of-its-kind research provides for an instructive case study on the use of sanctions as a tool of statecraft. For any questions or feedback on the project, please reach out to Ali Vaez at avaez2@jh.edu.

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EXECUTIVE SUMMARY

Economic sanctions have been actively used against Iran for four decades, seeking to isolate the country, hurt its economy and force its government to change policies and actions. In response, Iran has adopted a range of survivalist and unsustainable homegrown policies that have helped reduce the economic pressure of sanctions but have greatly accelerated environmental degradation.

Iran faces major environmental problems as the result of decades of short-sighted development plans and bad management. Sanctions are not the root cause of these problems. Yet, their role in catalyzing environmental degradation is notable.

This study is the first extensive overview of the environmental impacts of sanctions on Iran. Generally, these sanctions have impacted its environment by:

- restricting access to technology, service, and know-how;
- blocking international aid for the environment; and
- increasing the natural resource-intensity of the economy.

Sanctions have limited growth and ability to decouple the economy from natural resources, thus raising the role of natural resources in Iran's political economy. Overall, they have made production much costlier to the environment, which political leaders do not consider a policy priority as they manage Iran in survival mode while aggressively pursuing their ideology.

Sanctions have not been designed to cause environmental damage. Nor have response strategies been intended to harm the environment. Nonetheless, environmental damages are the inevitable outcome of the interdependent processes of enforcement and response. This study calls for increased attention to the unintended, trans-generational and trans-boundary environmental impacts of sanctions and exploring their potential human rights implications, for which both sanctioner and sanctionee should be held accountable.

I. INTRODUCTION

International economic sanctions have been in use for decades. Countries, individually or in coalition, and intergovernmental bodies impose them on states that in their view behave abnormally according to international norms and threaten their interests. They do not have the immediate and noticeable destructive and deadly impacts of war, so are seen as relatively humane and soft foreign policy tools. In practice, however, their consequences can go well beyond the economic sector.

Sanctions can be associated with major collateral damage to ordinary citizens and their economic welfare.[1] Resulting degeneration of human rights and emergence of food and health insecurity problems are among the frequently used humanitarian grounds to criticize their legitimacy and effectiveness.[2] The environment is another sector they can impact.[3] Nevertheless, investigations of their short- and long-term environmental implications are very limited.

Iran has been the target of major international economic sanctions by the U.S. UN and European Union (EU) over the past four decades.[4] Whether these sanctions have achieved their objectives is controversial, but it is indisputable that their impact has gone beyond Iran's economic sector.[5]

Top Iranian officials have frequently blamed sanctions for their environmental consequences, some claiming that they have caused "severe" and "irreparable" damage. These claims have not been verified, and knowledge on the sanctions' environmental impacts remains limited.

Iran is currently experiencing major environmental problems. Some of the evident signs of environmental degradation over the last four decades are increasing water shortage; drying rivers, wetlands and aquifers; air and waste pollution; soil erosion, deforestation, desertification, sand and dust storms; land subsidence and sinkholes; wildfires and biodiversity losses.[6] Top Iranian officials have frequently blamed sanctions for their environmental consequences, some claiming that they have caused "severe" and "irreparable" damage.[7] These claims have not been verified, and knowledge on the sanctions' environmental impacts remains limited.[8]

The main objective of this study is to provide the first overview of the collateral environmental harms of the international economic sanctions imposed on Iran.[9] Relying on a range of evidence, it illustrates how Iran sanctions have been associated with unintended environmental consequences.[10]

II. THE STATE OF IRAN'S ENVIRONMENT

Iran is dealing with a diverse range of environmental challenges. Water bankruptcy is the most recognized problem[11], with rapid growth of the population and its improper spatial distribution, economically inefficient and environmentally unsustainable agricultural growth and mismanagement of water as its major drivers, worsened in turn by climatic variability and change.[12]

Agriculture withdraws more than 90 per cent of Iran's water. Despite declining availability and frequent droughts, agricultural area and production have continued to grow to meet the growing food demand.[13] This growth that was greatly motivated by a food self-sufficiency agenda to minimize reliance on international markets would have been infeasible without the unsustainable use of water resources.[14] Total water use exceeds the total renewable surface and ground water budget. Non-renewable groundwater is tapped and surface water is stored behind big dams and diverted through inter-basin water infrastructure systems to satisfy growing demand.[15] Draining aquifers has led to declining groundwater levels,[16] and excessive surface water use has significantly reduced river flows (eg, Zayandeh-Rud, Karun, Dez, Karkheh, Kor, Qezelozan, and Sefidrud), drying up wetlands.

Lake Urmia, once one of the world's largest hypersaline lakes, has shrunk significantly, mainly due to the anthropogenic impacts of development in the north west.[17] Excessive dam building, increased water diversion and use for agricultural expansion, together with frequent droughts, led to the drying of Iran's largest wetland, which the 1971 Ramsar Convention had declared a Wetland of International Importance and UNESCO in 1976 had designated as a Biosphere Reserve.[18] That tragedy is a major symbol of environmental degradation, but it is not unique. Other major wetlands, such as Anzali, Shadegan, Bakhtegan, Jazmourian, Hoor Al-Azim, Hamoun, Gavkhouni and Parishan, have also shrunk due to reduced water inflows.

Water challenges are not limited to quantity problems. Declining availability, in addition to the increasing biological and chemical pollution from agricultural, in-

dustrial, medical and domestic effluent and waste, has resulted in quality degradation in underground and surface water resources.[19] This has made water unsuitable for various uses in some parts of the country.[20] The Caspian Sea in the north and Persian Gulf and Sea of Oman in the south are exposed to high pollution from river discharges and human activities in the coastal zones of Iran and neighbors.[21]

Deforestation is on the rise[22] due to ineffective forest protection, reduced water availability, frequent droughts, overcutting of trees and illegal logging, wildfires, urbanization and the conversion of forests into agricultural and industrial sites. Deforestation, land use changes, reduced soil moisture, over-grazing,[23] over-plowing, over-cropping and poor land management practices have increased soil erosion, wildfires, flood damages, landslides and desertification. Deforestation, agricultural activities, water and waste pollution and excessive use of fertilizers[24] and pesticides have impacted soil quality across Iran,[25] limiting land suitability for agriculture.[26]

Dried wetlands, abandoned farms, land use changes, deforestation, soil erosion and desertification have led to frequent dust and salt storms, threatening public health,[27] significantly damaging the ecosystem, reducing agricultural productivity and increasing soil loss and removal of valuable organic matter and soil nutrients.[28] Lower aquifer levels due to excessive groundwater pumping[29] have resulted in increasing land subsidence and the emergence of sinkholes[30] that threaten critical infrastructure.

Air quality degradation is a major problem in metropolitan areas. Rapid, unchecked urbanization, high population density, inefficient use of non-renewable energy and low-quality fuels, the growing and aging fleet of gasoline and diesel vehicles, limited public transportation capacity and vicinity to active industrial zones are among the typical causes of air pollution in big cities.[31] Tehran, the capital and most populated city, is among the world's top polluted megacities for ambient PM_{10} levels.[32]

Frequent dust storms cause air pollution in some other parts of the country, like the Sistan and Baluchestan Province,[33] Iran's second largest province by area, in the south east and bordering Afghanistan and Pakistan; Khuzestan Province[34] in the south west, bordering Iraq; and provinces in the west such as Kermanshah, Kohgiluyeh, Boyer-Ahmad and Kudistan. These areas are exposed to dust originating in neighboring countries, as well as the local dust sources produced by the drying of wetlands, reduced soil moisture, deforestation, soil erosion and desertification. In 2016, Zabol, a city bordering Afghanistan in the Sistan and Baluchestan Province, was the world's most polluted city in the World Health Organization (WHO) database in terms of PM2.5 levels.[35] In 2011, that database listed four Iranian cities

among the world's top ten most polluted cities in terms of PM10 levels. Ahvaz (Ahwaz), the capital of Khuzestan Province, was then the most polluted, followed by Sanandaj, capital of Kurdistan Province, as third, Kermanshah, capital of Kermanshah Province, as sixth and Yasouj, capital of Kohgiluyeh and Boyer-Ahmad Province, as ninth.[36]

Air pollution is a major public health threat,[37] with economic, social and even security implications. Air quality degradation reduces agricultural productivity and causes major damage to the ecosystem,[38] infrastructure and cultural/historic and natural heritage sites. In Tehran alone, the economic damage of morbidity and mortality of air pollution is estimated at $2.6 billion annually.[39] This value excludes the economic cost of reduced agricultural productivity, ecosystem service losses, infrastructure damages, quality of life and visibility degradation, education days lost by children and university students due to school closure,[40] and some other major indirect costs.

Managing solid waste, including municipal,[41] industrial and hazardous,[42] agricultural, and bio-medical waste,[43] is another growing but overlooked environmental challenge. The average per capita municipal solid waste production is 745 grams per day.[44] This is much smaller than the daily municipal solid waste generation per capita in many developed countries, such as the U.S. (2.58 kg), Canada (2.33 kg), Australia (2.23 kg), Germany (2.11 kg), and France (1.92 kg).[45] Yet, this amount cannot be properly handled due to the lack of infrastructure, planning and investment in the waste sector. While the country collects 90 per cent of its municipal solid waste,[46] it sends most of it directly to landfills without recycling, due to lack of the required system for waste segregation at source. Landfill leachate is a major threat to surface and ground water, soil and the ecosystem. Plastic pollution is on the rise in the absence of recycling infrastructure, regulatory and incentive systems that can promote plastic use reduction and recycling. Other factors and drivers that have turned waste into one of the most pressing environmental challenges include but are not limited to: population growth; increased consumerism and production; unsustainable manufacturing and food production; inadequate landfill capacity and improper selection of landfill sites; lack of sufficient waste collection, processing, management and recycling infrastructure; absence of effective waste management regulations and institutions; ineffective cooperation among responsible authorities; and lack of systematic efforts and regulatory and financial frameworks to promote waste production reduction and recycling.

These environmental problems are a serious threat to the health of Iran's ecosystem, which contains 197 mammal species, 8,000 plant species, 227 reptile species, 535 bird species, 21 amphibian species, 160 freshwater fish species and 710 ma-

rine fish species.[47] Iran has 30 national parks, 170 protected areas, 45 wildlife refuges and 37 national natural heritage sites, covering nearly 11 per cent of its area and protected by the environment department. The financial, equipment, staff (specifically, a sufficient number of competent ranger patrols) and logistic restrictions of that department limit its capacity to properly protect these areas and the ecosystem that relies on them. The environmental problems, together with anthropogenic activities that directly harm flora and fauna (eg, road construction and road accidents involving animals, human-induced fire events, mining and industrial activities, logging and poaching and over-grazing), have caused major biodiversity losses over decades. Almost 100 vertebrate fauna species are considered vulnerable or endangered, according to the International Union for the Conservation of Nature (IUCN) Red List.[48]

Environmental problems have been exacerbated by climatic variability and change and extreme events. The latter – such as droughts and floods – have been common and costly.[49] Frequent, long and intense droughts in the past four decades reduced water availability and the yield of rain-fed agriculture, dried up wetlands and increased groundwater use, desertification and ecosystem damages, while floods, especially flash floods, were destructive and deadly. Scholars do not agree on the level of historical impacts of climate change.[50]Nevertheless, most projections portray warmer and drier conditions in the future that can further increase water shortage[51] and ecological damages that can reduce agricultural productivity. Moreover, climate change is expected to increase the frequency and intensity of extreme events such as floods, droughts, heat waves and wildfires. The environmental degradation makes Iranians and their ecosystem more vulnerable to extreme events. The widespread, costly and extreme flood events in Nowruz 2019 were unprecedented in recent decades and a wakeup call about the high variability of climate norms, the possible consequences of climate change[52] and the high vulnerability of a nation that has significantly manipulated its ecosystem.

Environmental degradation reflects unsustainable development. Efforts and plans to develop without sufficient attention to environmental impacts are now major threats to national security. Water shortage affects agricultural production, creating food insecurity risks. Unemployment caused by environmental degradation (eg, farmers and fishermen losing jobs) and poor living and public health conditions in certain areas (eg, rural and urban areas exposed to dust storms) can potentially promote migration and economic inequality, leading to social instability, tensions, protests and national security threats. Regardless of sanctions' impacts, environmental problems cannot be addressed without major reforms in environmental governance institutions,

management structure and development plans.

The environmental problems reviewed above arose not overnight, but after decades of unsustainable management based on short-sighted development policies.[53] Blaming everything on sanctions, as some Iranian officials do, is not justified. Like climate change, sanctions are not the driver or cause of current environmental problems, but one can still investigate if sanctions have catalyzed environmental degradation.

This study focuses on uncovering the underlying mechanisms that can explain why and how international economic sanctions might have impacted and continue to impact Iran's environment.[54] It will be supported by examples that suggest Iran's environment has been an inevitable victim of the economic sanctions enforcement-evasion game.

Iran's environmental problems arose not overnight, but after decades of unsustainable management based on short-sighted development policies. Blaming everything on sanctions is not justified. Sanctions are not the driver or cause of current environmental problems. Yet, Iran's environment has been an inevitable victim of the economic sanctions enforcement-evasion game.

III. THE ENVIRONMENTAL IMPACTS OF SANCTIONS

Sanctions have impacted Iran's environment in three general ways:

- restricting access to technology, service, and know-how;
- blocking international environmental aid; and
- increasing the natural resource-intensity of the economy.

A. RESTRICTED ACCESS TO TECHNOLOGY, SERVICE, AND KNOW-HOW

The impact of economic sanctions on Iran's banking system and financial transactions is undeniable. They have restricted money flow in and out of the country via official and sanction-free banking channels, limited access to export income and assets abroad, and devalued the currency. These outcomes reduce Iran's ability to buy goods, technology, knowledge and services (GTKS) in the international market, increasing the cost of foreign GTKS when acquired through unofficial channels and sanctions busting. The resulting increased cost further reduces Iran's interest in foreign GTKS and diminishes its potential capacity to gain access to GTKS in sectors it considers non-essential or nonurgent such as the environment.[55]

Iran's market has lost its appeal to international GTKS vendors under sanctions. Providing GTKS and doing financial transactions with Iran can be followed by major punishments and financial penalties. Vendors and financial institutions are reluctant to associate with Iranian business due to the resulting high risk of financial losses. This risk, in addition to the practical complexities and cost associated with getting U.S. Treasury licenses and the difficulties in exporting sanctions-exempt goods to and receiving money from Iran through official banking channels, have made vendors and financial institutions over-conservative. Iran business is avoided even when there is no sanctions violation, restricting

Tehran's ability to acquire the GTKS, which are already exempt from or can be exempted from sanctions.[56]

Sanctions lower international interest in financial investments in Iran, slowing technological and scientific progress, innovation and efficiency improvements in sectors such as energy, water, food/agriculture, mining, production and service that could potentially reduce the ecological footprint of Iran's development and benefit its environment.[57]

In the absence of economically competitive foreign GTKS, Iran faced two options:

i. Disregard the need to acquire specific GTKS

For example, the South Pars refineries use a specific type of absorbents to remove mercury from natural gas. Manufacturers such as Johnson Matthey (JM) and Axens have refused to sell absorbents it to Iran. As a result, mercury is not being properly removed from natural gas, damaging the environment with major public health implications at both production (refineries) and consumption (houses, offices, schools, hospitals, factories, etc.) points.

In some industries, companies that sold equipment to Iran in the past are reluctant to provide spare parts and needed service. Many have, without penalty, suspended long-term technical service contracts, such as software updates, operation optimization, new knowledge delivery, training, instrumentation, inspection, and maintenance/repair. This restricts Iran's access to the best available technology and know-how, reducing resource use efficiency and increasing the ecological footprints of multiple sectors.

There are numerous examples in the vehicle manufacturing and transportation industry, with major environmental implications for emissions. Iranian car manufacturers have continuously postponed adopting the Euro 5 emission standard, blaming sanctions for their limited access to required technologies. In 2018, the Tehran City Council's Construction and Transportation Commission suspended the budget for installing diesel particulate filters (DFPs) on 700 old buses used for public transport.[58] In 2019, on the request of Iran Khodro Company (a major vehicle manufacturer), Senior Vice President Eshaq Jahangiri ordered the industry, mines and business minister and the head of the environment department to waive the requirement for installing DFPs on diesel trucks due to sanctions. Such decisions directly impact air pollution, with significant socio-economic, health and environmental implications.[59]

ii. Settle for cheaper but lower quality GTKS

For example, after the re-imposition of U.S. sanctions in 2018, Siemens refused, fearing retaliation, to ship the syngass compressors it had produced for the Zanjan Fertilizer Project (ZFP) under an old purchase agreement.[60] ZFP ended up purchasing Chinese compressors with lower environmental standards, leading to higher emissions.

Similar stories have occurred in the methanol industry. Iran has the potential to become a leading methanol producer, but sanctions have cut access to state-of-the-art technology. Because JM and Haldor Topsoe refused autothermal reforming technology (ATR) to the Eslamabad-e Gharb refinery, this refinery is being launched with older technologies, leading to higher water and carbon footprints.[61] In an ethanol project in the south, Haldor Topsoe refused to deliver three items under an old contract, followed by use of domestic alternatives that did not meet the original design's environmental standards.

Hoor Al-Azim is a major trans-boundary wetland in the south west, overlying large oil fields. The original contract to extract oil in the Iranian part of Hoor Al-Azim was with INPEX Corporation, Japan's largest oil and gas exploration and production company. It pulled out in 2006, because of sanctions. The project was completed by Chinese and Iranian companies, but the original design specifications, suitable for oil drilling in wetlands, were not pursued. The implemented project and installed oil rig and equipment that are in operation are suitable for dry environments. As a result, this wetland was kept dry, and the release of large volumes of water into some parts of it has become prohibitive, lest it damage installed equipment. The drying up of Hoor Al-Azim reduced the project's cost under sanctions. In the long run, however, it has caused significant ecosystem damage and turned the wetland into a major regional dust source, affecting lives and health in Khuzestan Province during frequent, unprecedented storms.

In 2010, when the sanctions on its gasoline imports were signed into law, Iran was importing 40 per cent of its gasoline. President Barack Obama had projected that penalizing its gasoline suppliers and increasing pressure on the international banking system to stop working with it would make it harder for Iran to buy refined petroleum, as well as the goods and services required to modernize the oil and gas sector, the backbone of its economy.[62] Petrol imports dropped by 75 per cent, but Iran immediately responded by increasing local refining capacity, producing cheap petroleum that could run vehicle engines but was highly destructive for the environment.[63] The locally pro-

duced petroleum contained ten times the level of contaminants of imported fuel. The sulphur level in diesel gas sold in Tehran was 8,000 parts per million (ppm), 800 times greater than the U.S. Environmental Protection Agency (EPA) standard.[64] Similar to the other examples, Iran tried to resist the sanctions' pressure on the oil and gas sectors by making choices that could help the country survive in the short run but carried major environmental and public health costs.

Relying on domestic GTKS delivery is not necessarily more effective economically but can in some cases help reduce national security risks. For example, while domestic wheat production can be costlier than importing that item, the fear of sanctioned food access and national security problems might justify for the leadership continuing conventional, inefficient, domestic production. Given the tensions Iran has experienced since the Islamic Revolution, food security is a significant public policy issue. Indeed, observing the experiences of other sanctioned countries and Iran's own vulnerability have made it a major phobia. As a result, Iran ambitiously pursues self-sufficiency in food production despite major negative impacts on water and environment.[65] Leaders consider it a national security necessity, a concern that has drastically intensified under extreme international pressure.[66] Though food is supposedly free of sanctions and importing at least part of the needs could decrease the economic and environmental costs of domestic production, Iran regards food-dependency as a major vulnerability. Sanctions have promoted similar self-sufficiency and minimal international-dependency policies in other sectors, such as car manufacturing, gasoline and pharmaceuticals, despite long-term environmental costs.

In all cases, the government has overlooked long-term environmental considerations in favor of matters it considers more urgent, such as addressing national security issues, creating new jobs and increasing revenue. Evidently, Iran's environment can take a major hit both when GTKS are required specifically for the environmental sector (eg, air quality monitoring equipment, environmental instruments, environmental/energy software, and training) and when GTKS are not required specifically for that sector, but would have considerable benefits (eg, hybrid cars, new more fuel efficient passenger aircraft, improved petrochemical technologies or cement production technologies with reduced carbon and water footprints).

Environmental research and education have also been impacted by economic sanctions. Impediments to transfer of research and training funds and financial interactions[67] have again been the major causes. Additional causes include the potential penalties of interacting with Irani-

an universities and citizens;[68] lack of clarity about what can constitute a transfer of knowledge that violates sanctions;[69] currency collapse;[70] limited access to equipment, instruments, software and know-how; decreased travel of researchers to Iran, including due to enforcement of the Visa Waiver Program Improvement and Terrorist Travel Prevention Act of 2015;[71] and more restricted access to training and capacity building programs. All these limit Iran's knowledge, innovation, technological and scientific advancement, education and capacity building essential to address crippling environmental problems.

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Figure 1. The message received by an Iran-based user when trying to register for the "Introduction to Sustainability" massive open online course (MOOC) on Coursera, an online education platform. Similar to other major online learning platforms such as EdXand Udacity, Coursera recognizes international sanctions and U.S. export control regulations as the main barriers to providing education service to users in Iran.

B. BLOCKED INTERNATIONAL AID FOR THE ENVIRONMENT

International environmental-related aid has also been among the direct targets of sanctions, with obvious negative impacts in opportunity loss. Aid and development funds, as well as cooperation with and receiving research/training support from intergovernmental agencies, are not subject to sanctions, but Iran's access has become strictly limited. The practical complexities that can arise during implementation of aid projects due to sanctions, the barriers to transfer of funds through official banking systems[72] and strong U.S. political influence as a large donor to intergovernmental organizations are among the major obstacles to Iran benefiting from the funds and services of intergovernmental and international organizations.

Since the 1992 Rio Earth Summit, the Global Environment Facility (GEF), established with the aim of helping tackle the planet's most pressing environmental problems, has funded many countries in areas such as land degradation, biodiversity, chemicals and waste, international waters, sustainable forest management and climate change. Iran has received nearly $31 million for 18 environmental projects[73] implemented through collaboration of its government, companies and non-profit organizations with intergovernmental agencies such as UNDP (UN Development Programme), UNEP (UN Environment Programme), FAO (Food and Agriculture Organization of the UN), the World Bank and UNIDO (UN Industrial Development Organization). However, GEF's financial support could have been as much as $52.67 million more. Influenced by sanctions, Iran funding was significantly reduced, starting with the fifth round (2010-2014), during which less than 15 per cent ($4.2 million) of the original allocation of $28.77 million could be utilized. In round six (2014-2018), the $17.21 million allocation remained completely unused. The $10.89 allocated in the seventh round (2018-2022) has zero utilization to date.

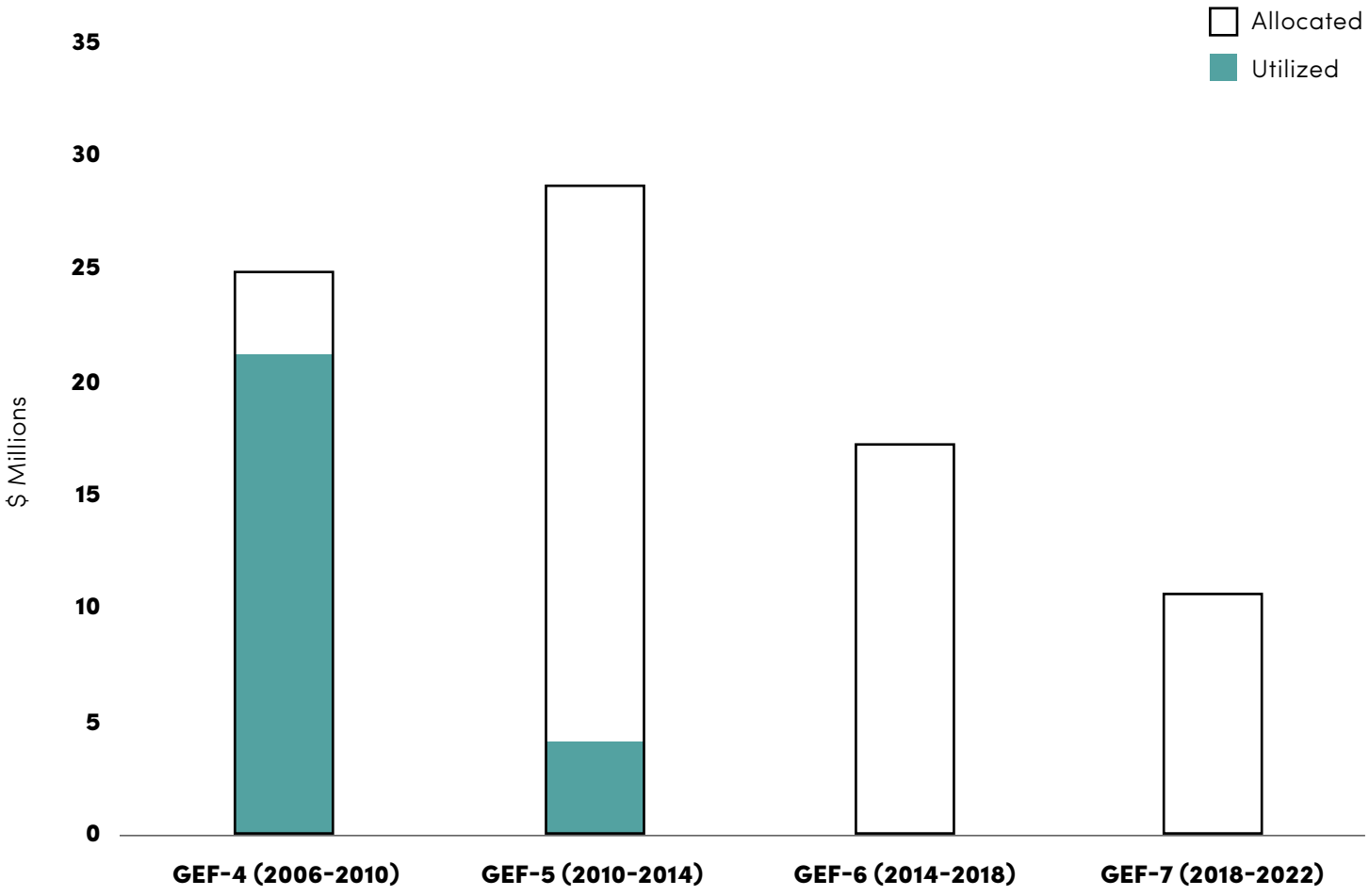

Figure 2. The support of the Global Environment Facility (GEF) for Iran projects in the last four funding rounds. The gap between the allocated and utilized funding in the fourth round was due to project cancellations, not driven by sanctions. In the other rounds, sanctions have limited access to allocated funding.

The World Bank is another agency whose support has been hampered by sanctions. It closed its last Iran project in 2012.[74] That project, the Alborz Integrated Land and Water Management Project with a World Bank commitment of $120 million, was approved in 2005, along with the the Northern Cities Water Supply and Sanitation Project project completed in 2010 with a $224 million World Bank commitment. The final assessment reports on both refer to a range of procedural challenges that resulted from the UN sanctions and impeded smooth delivery, including severely delayed release of funds from the World Bank, massive implementation delays, procurement disruptions and onerous approval processes, difficulty in transfer of funds and dealing with the banking system, the Northern Cities Water Supply and Sanitation Project the Northern Cities Water Supply and Sanitation Project and travel restrictions.[75]

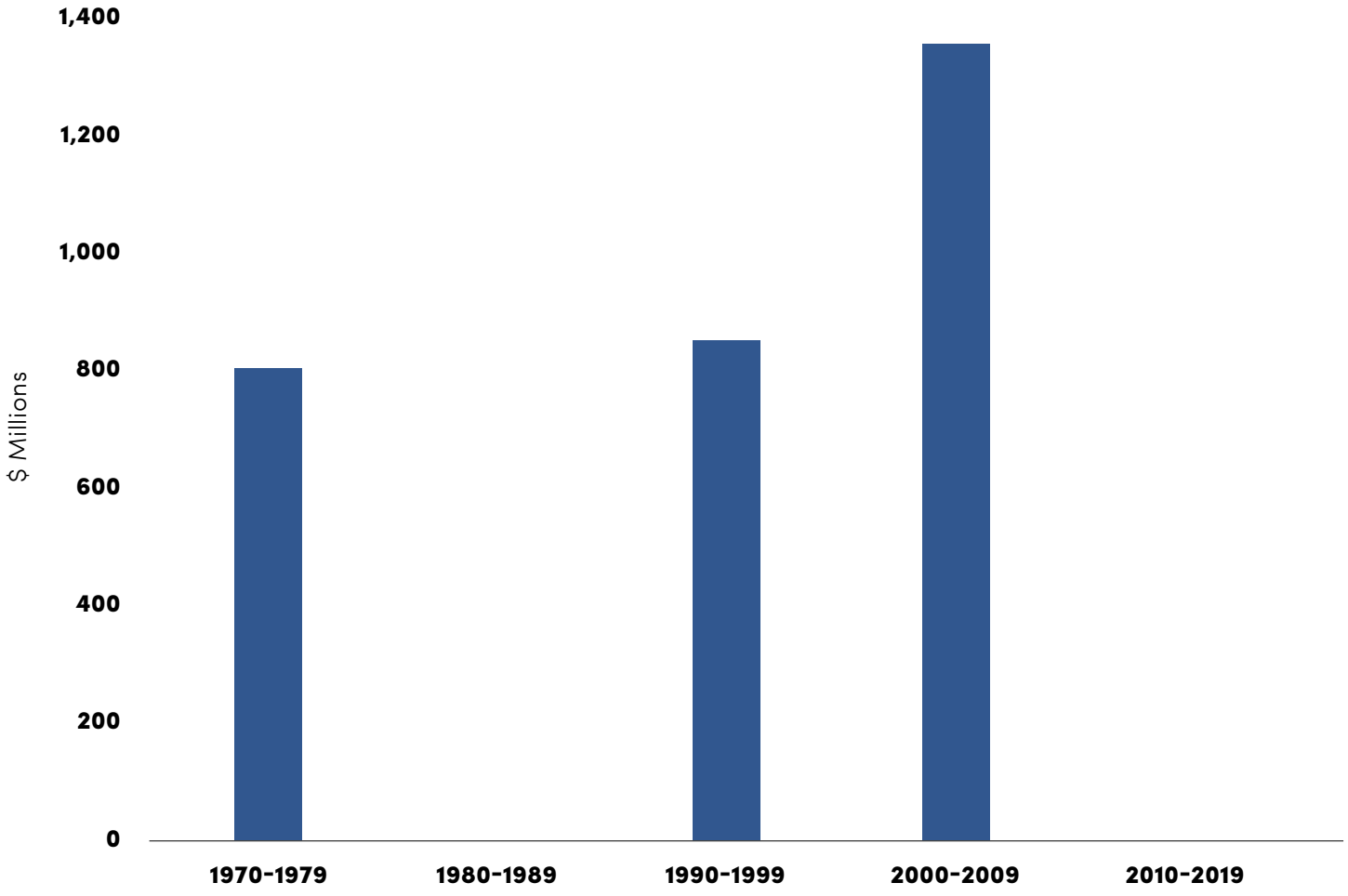

Figure 3. The World Bank's funding to Iran (1970-2019)

Another intergovernmental organization whose contribution to environmental improvements in Iran has been affected by economic sanctions is CGIAR (Consultative Group for International Agricultural Research), a global research partnership of funders and international agricultural research centers for a food secure future, involved in poverty reduction, food and nutrition security enhancement and natural resources improvement. The International Maize and Wheat Improvement Center (CIMMYT), a CGIAR center (international non-profit research-for-development organization) with the mission to contribute to food security, was collaborating with Iran to upgrade its wheat system by helping it produce new seed varieties for its hot and cold climates. [76]

Given Iran's food security initiatives and their direct water and environmental impacts, the environment would benefit greatly from agricultural improvements.

Yet, with re-imposition of U.S. sanctions and only a few months after launching its conservational agriculture center in Khuzestan in a joint project with Iran, CIMMYT discontinued project support and closed its Karaj office on 1 November 2018. The organization pointed to "growing constraints on CIMMYT's operations in Iran as a result of heightened sanctions" to justify its decision.[77] Two days later, the International Center for Agriculture Research in the Dry Areas (ICARDA), another CGIAR member, closed its Tehran office and announced discontinuation of its project support, referring to "growing constraints on ICARDA's operations in the Islamic Republic of Iran as a result of heightened U.S. sanctions".[78] A year earlier, ICARDA had reported a decision to fund a project for raising crop production in four water-scarce provinces of western Iran.[79]

Sanctions-induced practical complexities, mainly obstacles to transferring funds through the official banking system, have also impacted intergovernmental operations in Iran. Some intergovernmental bodies have found solutions to the financial challenges and continued to work with Iran, including those whose work has major environmental implications and are less under U.S. political influence, such as the WHO, FAO, UNEP, UNHCR (UN High Commissioner for Refugees), UNIDO, WFP (World Food Programme) and UNICEF.[80] This has not been so for many funding entities, regional donors, non-profit organizations and governments that were interested in Iranian environmental projects but faced difficulties in transferring funds, even for small projects. Additionally, the effort and time needed to receive a license from OFAC, the U.S. Treasury's Office of Foreign Assets Control, to support environmental projects in Iran is a major demotivation.[81] Even transferring cash and other relief after natural disasters such as the 2019 floods – exempt from sanctions as humanitarian aid – has proven difficult in practice, because of barriers in the international banking system.[82]

C. AMPLIFIED DEPENDENCE ON NATURAL RESOURCES

As has been shown, sanctions-produced limited access to knowledge, technology, goods and services, education and training and international aid, together with collapsed currency and money transfer obstacles in the banking systems, accelerate Iran's environmental degradation. Determined both to continue development and pursue plans that resulted in the enforcement of sanctions, Iran has loosened environmental considerations/regulations and even violated its own constitution to minimize the impacts of sanctions. As a result, it has been able to continue structural development by making huge environmental sacrifices that in many cases involve lasting, even irreversible consequences. The main question is why Iran has been willing to give up on environmental needs in favor of, for example,

defense infrastructure. In addition, why has a country that has made research and technological innovations in various sectors to reduce its dependency under sanctions not made similar progress in the environmental sector, where the required technology and even financial investments are significantly simpler and smaller? How does a country which makes ballistic missiles, launches satellites, enriches uranium, becomes a top dam builder in the world,[83] constructs one of the world's tallest towers (Milad Tower), produces 97 per cent of its needed medicine[84] and makes much other progress in sectors under sanctions, fail so drastically on the environment?

The answers lie in the causal dynamics that govern the overall behavior of the economy of a country under sanction in its pursuit of development. These dynamics establish the third category of the environmental impacts of sanctions: increased natural resource-intensity of the economy.[85]

Figure 4 illustrates the compound environmental impact of economic sanctions. This conceptual model uncovers the causal dynamics that establish an inverted-U-shaped relationship between economic development and environmental degradation similar to the well-known Environmental Kuznets Curve (EKC) (Figure 5). In the early stages of development (eg, in an agrarian society), economic growth is natural resource dependent. The rate of environmental degradation increases with natural resource-dependent growth (scale effect). Industrialization speeds up environmental degradation and economic growth while also creating job and profit opportunities in less natural resource-dependent sectors (eg, the service sector). Increased economic growth is associated with innovations and access to technologies and efficiency gains, reducing the resources needed and damages caused to the environment per unit of output (technique or technology effect). Additionally, a stronger economy has the ability to diversity itself, invest in less natural resource-dependent sectors, import goods and products, and protect its environmental sector, leading to a decrease in the rate of environmental damage per unit of income (composition effect). The gradual emergence of technique and composition effects reduces the rate of environmental degradation per unit of income/job produced as the economy grows. As soon as these effects outweigh the scale effect (turning point), further economic growth will be associated with lower levels of environmental degradation.[86]

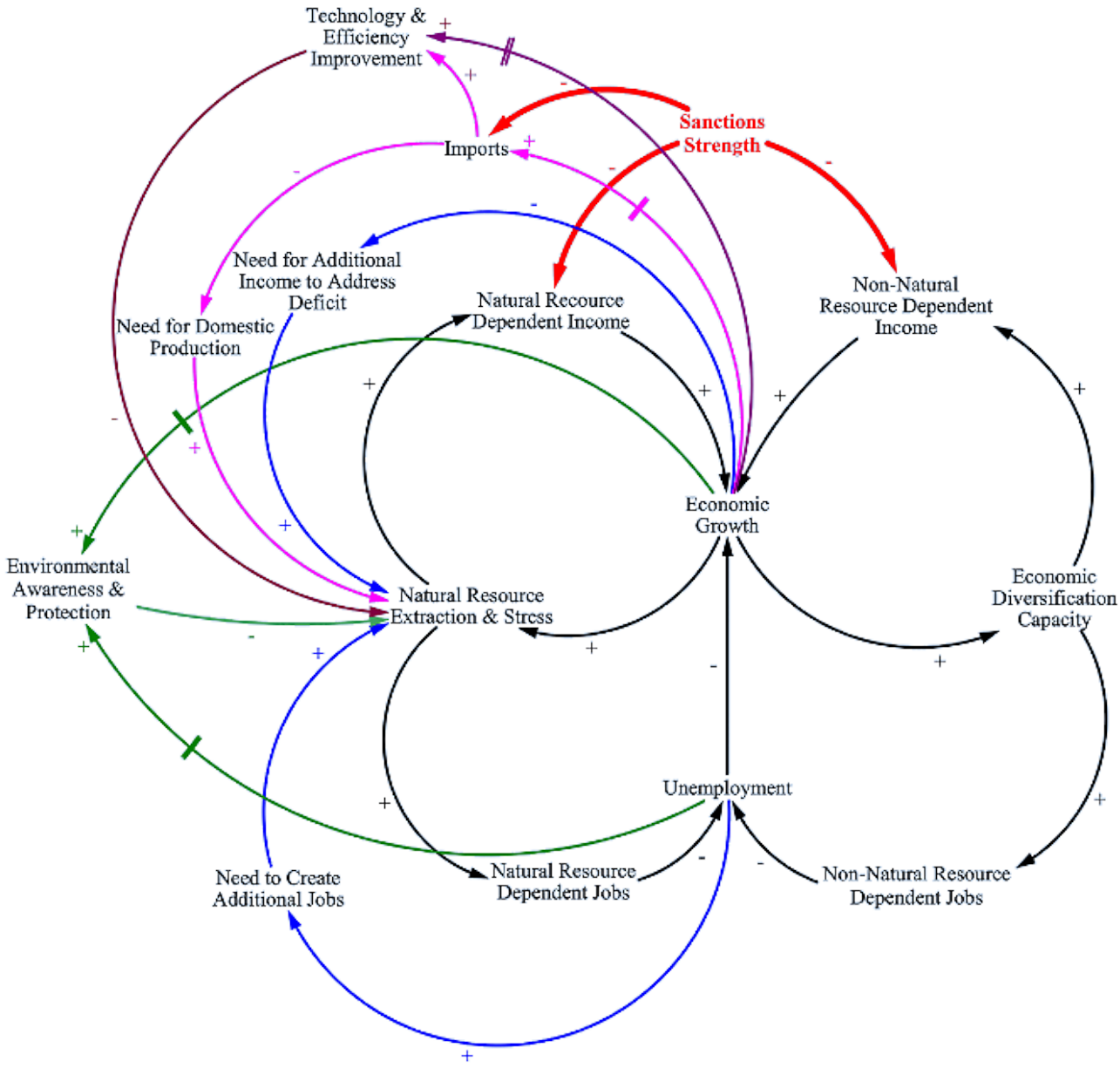

Figure 4. The underlying causal mechanisms that can increase environmental degradation in a sanctioned economy. Sanctions reduce income, imports and access to technology, thereby increasing both the dependency of the economy on natural resources and environmental degradation. + and -, respectively, reflect a positive (same direction) and a negative (opposite direction) impact. Double bars reflect lag time.[87]

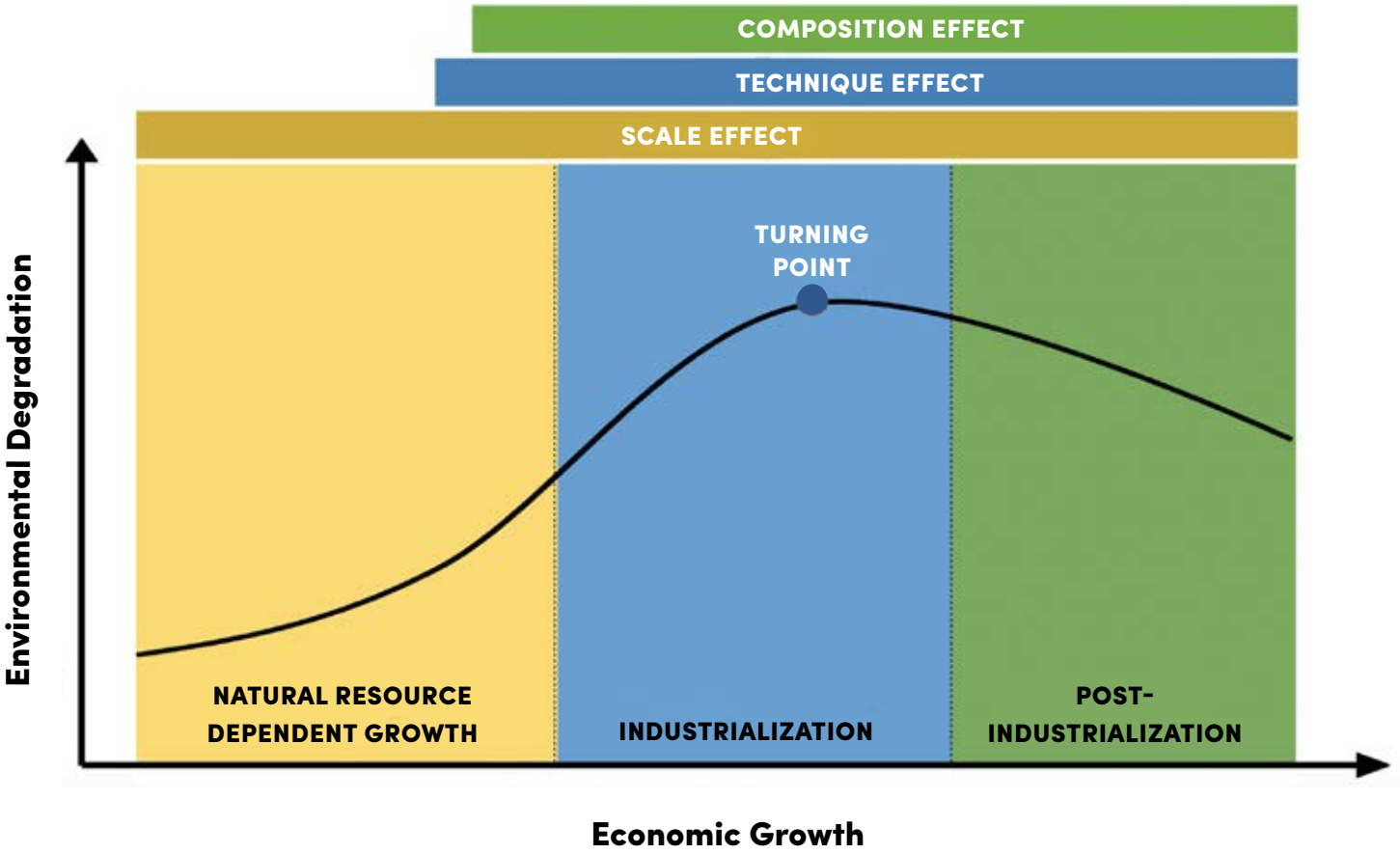

Figure 5. The relationship between economic growth and environmental degradation resembling the Environmental Kuznets Curve (EKC) hypothesis. Once the technique (technology) and composition effects together outweigh the scale effect, economic growth will be associated with lower levels of environmental degradation.[88]

In the course of development, economies face a range of internal (eg, poor management and corruption) and external (eg, pandemics, changing oil prices, global recession and inflation increase) variables that impact growth. A weakened economy loses its diversification capacity, faces increasing unemployment and is challenged with import and technology acquisition problems. Increasing pressure on natural resources is a popular strategy to defeat low growth, economic recession, income and production deficit and rising unemployment. By boosting natural resource-dependent growth, a deteriorating economy can compensate for production and import losses and decrease unemployment. This strategy periodically reduces pressure on the economy, while having long-term environmental consequences if the economy cannot get out of the low growth and recession trap.[89]

Sanctions function as major external forces that pressure the economy and restrict growth. They act similar to economic recession but can be more impactful and paralyzing.[90] In addition to causing major

economic disruptions, reducing income, and increasing unemployment, they can limit economic diversification and increase dependence on natural resources. They also directly hinder trade, imports and access to goods and technologies, with more pronounced effects than economic recessions. Under sanctions and embargoes, even when the capacity to export (eg, oil) or funds for purchasing a product (eg, gasoline) exists, the obstacles to transferring funds through official banking systems reduce imported goods, services and technologies and increase unemployment and the need for domestic production (eg, petroleum and wheat production in Iran). Reduced/negative economic growth and increased unemployment lower the capacity for environmental protection. Smaller environmental budgets due to shrinking national income and blocked international aid funds further weaken environmentalism. Overall, sanctions constitute a major barrier to decoupling income from natural resources, accelerate environmental degradation and make economic growth costlier to the environment.[91]

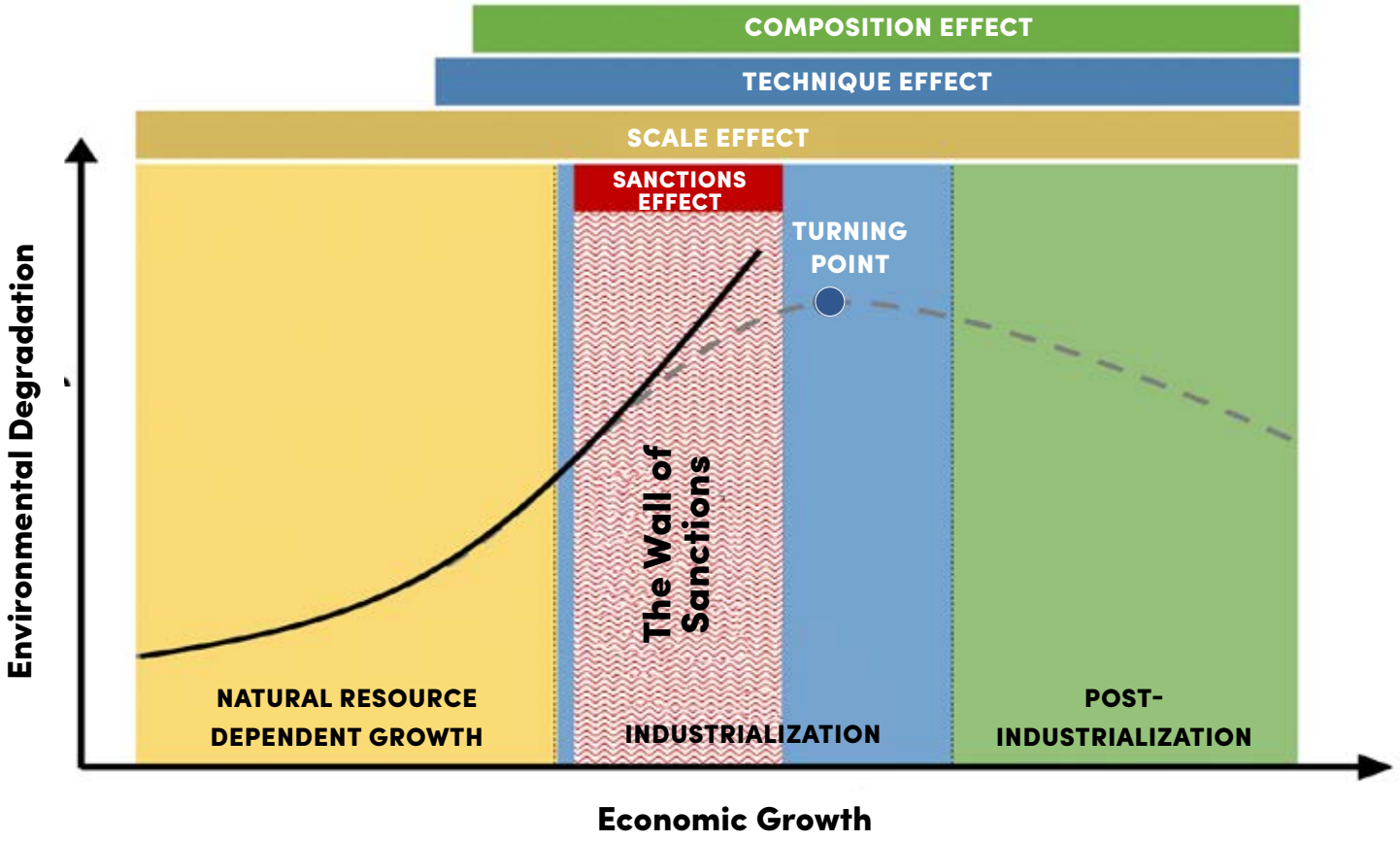

Figure 6. The "Wall of Sanctions", created by the "sanctions effect", functions as a barrier to changing the composition of the economy and dampens the technique and composition effects. The sanction effect increases the natural resource dependency of the economy and changes the shape of the EKC curve.[92]

A range of discussed cases show how sanctions have impacted Iran's environment by increasing its economy's natural resource intensity. In response to sanctions on gasoline imports, Iran needed to produce its own gasoline. The possible impact on food security of limited access to international markets encouraged Iran to pursue unsustainable agricultural policies so as to minimize dependency. Low-quality car manufacturing has been a strategy to cope with sanctions' impact on that industry. The reduced income, increased costs of imports and deficit of various goods are not the only justifications for such responses. Because unemployment is a significant national security threat, Iran desperately needs to create jobs. That is strong motivation to maintain and, if possible, expand economically and technologically inefficient natural resource-dependent sectors that degrade environment. All this reflects the increased role of natural resources in Iran's political economy.

The other important socio-economic and political factor is the reduced urgency of the environmental sector under sanctions.[93] Even in developed economies, environment loses its public policy priority during recession, so it is not surprising that Iran overlooks that sector. The importance-urgency matrix (Figure 7) explains why water and environmental matters do not generally have a high priority in public policy.[94] For a problem to rank high on the agenda of decision makers, it must be both relatively important and urgent. The relative importance and urgency of sectors vary between societies based on their socio-economic status and the circumstances they experience. Yet, almost in all, environment is relatively less important for the public and policy makers than issues like economic growth, employment, defence, energy and national security. Additionally, while extreme events (eg, dust storms, droughts, floods, wildfire and extraordinary air pollution) can periodically raise the relative urgency of its issues, the environment is considered non-urgent in comparison to many other topics.

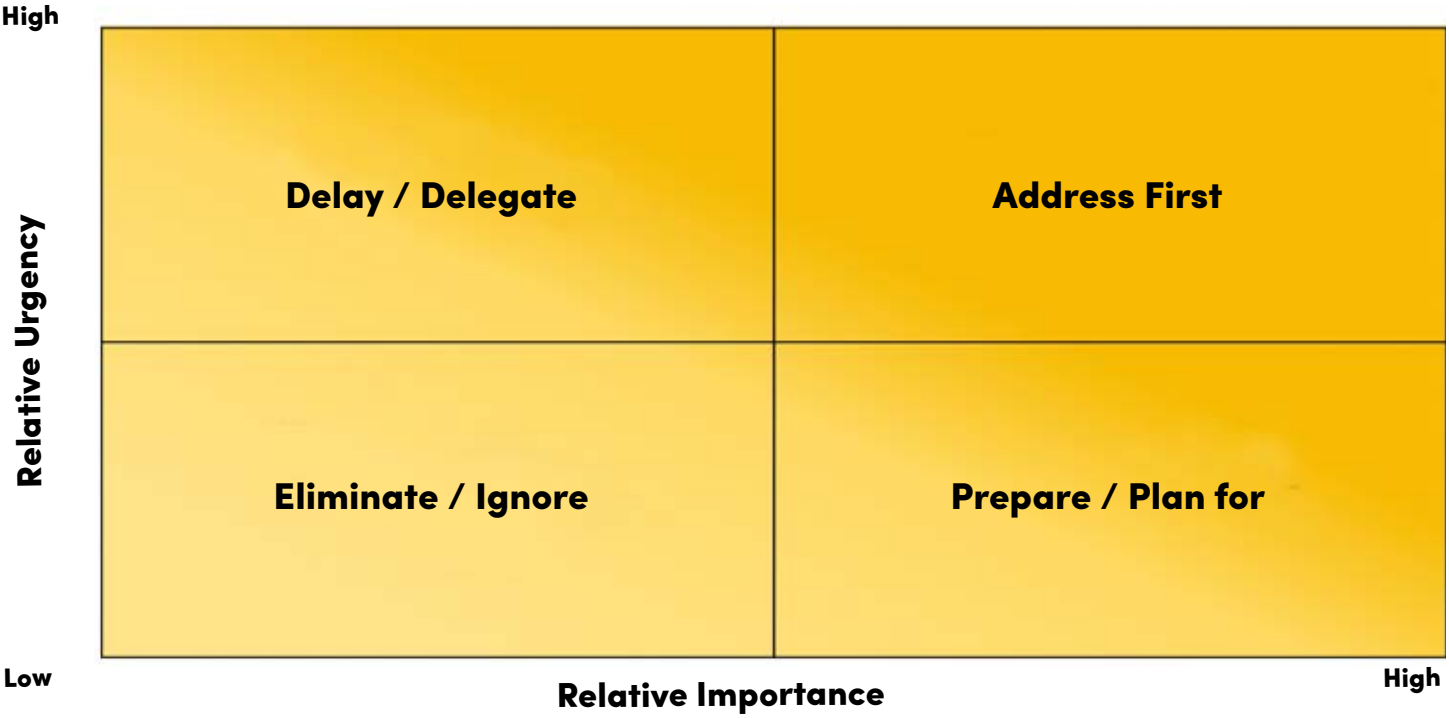

Figure 7. The Urgency-Importance Matrix or the Eisenhower Box. Based on this matrix, policy makers: 1) immediately address what is both important and urgent; 2) plan and prepare for what is important but not urgent; 3) delay what is urgent but is not important; and 4) ignore what is both unimportant and non-urgent. In a developing economy under sanctions like Iran, environment cannot earn the relative urgency and importance it deserves in comparison to many other topics.[95]

In developing economies and more so in a sanctioned one, environment cannot earn the attention it deserves. Issues that can cause immediate national security problems, such as unemployment, poverty, hunger, shortage of essential goods like pharmaceuticals and energy sources, are prioritized. The impacts of environmental degradation do not normally appear immediately, and if they do, they might seem less important and urgent than so many other problems that have been created by decades of bad management and short-sighted policies that have pushed Iran into crisis management mode.[96] While operating in this mode, leaders deal with one crisis after another while losing capacity to deal with long-term problems such as environmental degradation. Defence is another issue that has received a top priority in sanctioned countries such as Iran, but also North Korea, and Cuba. Access to weapons and missiles is considered vital by leaders whose ideology and goals have caused the sanctions.[97] This explains why Iran has succeeded in building missiles and launching a military satellite but not in the less challenging production of high-quality cars, diesel particulate filters and other technologies that could benefit the environment.[98]

IV. CONCLUSIONS

When considering the environmental impacts of sanctions, the following points should be kept in mind:

- Economic sanctions impact the environment but ought not be used to justify environmental degradation. Like others in the developing world and its region, Iran would have had environmental problems even without sanctions. These have accelerated environmental degradation but are not the main driver of its short-sighted development policies. Sanctions should not be presented as an excuse for all environmental problems or for decisions by Iranian leaders with unfortunate outcomes, such as not satisfying environmental water rights; promoting population growth; unsuitable land use change and urbanization plans; violation of the constitution's Article 50; and securitization of the environmental space.[99]
- The environmental impacts are unintended but inevitable under the current sanctions schemes. Neither sanctioners nor sanctionee sought to cause lasting environmental damage with major health and human rights implications. Nonetheless, the sanctions schemes do cause considerable damage to the environment for which both are liable and should be held accountable.[100]
- Environmental impacts do not always appear immediately. Once they appear, they cannot be removed immediately, and some may be irreversible, so the lifting of sanctions will not result in quick improvement in all environmental areas.
- The game of sanctions involves a series of actions, counteractions and circumstances. While we can look back and explore their overall impacts on the environment, it is not possible to reliably project how Iran's environment would look today under different circumstances and alternative sanction designs. Like other variables, such as the oil price and Iran/U.S. domestic politics, sanctions have been evolving in both strength and scope. Their impacts accumulate and normally appear in the long run. Sanctionee and sanctioner continuously revise their respective strategies for minimizing and maximizing them. Understanding these dynamics and appreciating the evolving nature of the problem are important when interpreting findings.
- The environment is just one sector affected by sanctions. To judge the overall effectiveness of sanctions and collateral damage, we need to simultaneously consider all impacts and

their trade-offs. On its own, this study is insufficient to gauge the effectiveness of sanctions in achieving their purpose; it cannot comprehensively capture the collateral and unintended damages. We cannot conclude solely on its basis, therefore, if sanctions should be lifted or tightened. Nonetheless, it suggests that the overlooked environmental impacts are significant and deserve careful examination. Future studies can explore what new schemes, mechanisms, reforms and legal exemptions might be introduced to minimize and counter the lasting environmental implications of sanctions.

Iran suffers from a range of environmental problems, rooted in decades of unsustainable development, lack of foresight and bad environmental governance. The problems will intensify unless serious policy reforms are implemented and immediate actions taken. Yet, the current environmental governance structure and the state of the country's political economy offer minimal hope for meaningful change in the environmental degradation trends.

This study explored whether sanctions have played a role in the degradation process. While they cannot be blamed as the cause of Iran's environmental problems, their impact as a degradation catalyst is undeniable. Their effect on the international banking system, the economy and trade have effectively limited Iran's access to technology, know-how, service and aid, with major environmental implications. They have meaningfully hindered economic growth and ability to decouple the economy from natural resources. This makes economic production much costlier to the environment, as leaders manage the country in survival mode.

The environmental damages of sanctions are trans-generational and trans-boundary. Their impacts cross political and geographical borders, with implications for Iran's immediate neighbors, the wider Middle East region and the whole planet. Given their significance, the problems have already affected Iran's relationships with near-by countries, such as Iraq, Turkey and Afghanistan, and can threaten regional stability in the long run, even after sanctions are lifted.

The trans-generational and trans-boundary aspects of environmental problems, as well as the violations of human rights to safe, clean, healthy and sustainable environment caused by the enforcement of sanctions and efforts to avoid their grips. call for more serious attention to the consequences of sanctions. The humanitarian exemptions attached to sanctions do not cover environmental matters. If sanctions continue, these exemptions should be revised to minimize or avoid negative environmental impacts and the consequential violation of human rights by both sanctioning and sanctioned parties.

The environmental damages of sanctions are trans-generational and trans-boundary. These damages and the violations of human rights to safe, clean, healthy and sustainable environment caused by the enforcement of sanctions and efforts to avoid their grips. call for more serious attention to the consequences of sanctions.

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54. See Madani (2020) for more information on the potential sources of error in analyzing the environmental impacts of sanctions.

55. Though, the environment is an urgent subject from the technical and sustainable development standpoints, it has been treated as non-urgent from the public policy standpoint. See the next sections and Madani (2019a) for further information, Madani K. (2019a) The value of extreme events: What doesn't exterminate your water system makes it more resilient, Journal of Hydrology, 575: 269-272, doi: https://doi.org/10.1016/j.jhydrol.2019.05.049.

56. The international media, Iranian officials and scientific literature have repeatedly claimed that U.S. sanctions have hampered Iran's ability to import medicine, medical equipment and food. Kokabisaghi, 2018; Tehran Times (2019b) U.S. lying that sanctions exempt food, medicine: Iranian minister, September 17, 2019, https://www.tehrantimes.com/news/441421/U-S-lying-that-sanctions-exempt-food-medicine-Iranian-minister, Accessed: August 30, 2020; Bernnan D. (2020) Iran Foreign Minister Claims U.S. Sanctions Make It 'Virtually Impossible' to Fight Coronavirus, March 19, 2020, https://www.newsweek.com/iran-foreign-minister-javad-zarif-claims-us-sanctions-virtually-impossible-fight-coronavirus-1493181, Accessed: August 31, 2020; Cunningham E. (2020) As coronavirus cases explode in Iran, U.S. sanctions hinder its access to drugs and medical equipment, The Washington Post, March 29, 2020, https://www.washingtonpost.com/world/middle_east/as-coronavirus-cases-explode-in-iran-us-sanctions-hinder-its-access-to-drugs-and-medical-equipment/2020/03/28/0656a196-6aba-11ea-b199-3a9799c54512_story.html, Accessed: August 30, 2020; Stone R. (2020) Iran confronts coronavirus amid a 'battle between science and conspiracy theories', Science, doi: 10.1126/science.abb9389. This is so, though "the sale of food, medicine, or medical devices to Iran" is exempt from the U.S. sanctions under a "general license". BBC (2020) Coronavirus: Iran and the US trade blame over sanctions, December 9, 2019, https://www.bbc.com/news/world-middle-east-52218656, Accessed: August 31, 2020; U.S. Department of the Treasury (2020), Iran Sanctions, Frequently Asked Questions, June 5, 2020 update, https://home.treasury.gov/policy-issues/financial-sanctions/faqs/topic/1551, Accessed: August 30, 2020; Flicker S. M., Greenbacker L. K. D., Hutchison T. R., Flynn H. S. (2020) Humanitarian aid to Iran under existing sanctions–an important reminder in a time of pandemic, Paul Hastings LLP., April 21, 2020, https://www.paulhastings.com/publications-items/details/?id=84f02f6f-2334-6428-811c-ff00004cbded, , Accessed: September 1, 2020. https://youtu.be/xJncj6xviLw

57. The re-imposition of sanctions in 2018 reduced interest in investing in the energy market. For example, the British renewable energy investor Quercus was one of the companies which ceased all activities in Iran, including its plan to construct a €500 million solar power plant with 600 megawatt (MW) capacity. Karsgiannopoulos L. (2018) Exclusive: UK's Quercus pulls plug on $570 million Iran solar plant as sanctions bite, Reuters, August 14, 2018, https://www.reuters.com/article/us-iran-sanctions-quercus-exclusive/exclusive-uks-quercus-pulls-plug-on-570-million-iran-solar-plant-as-sanctions-bite-idUSKBN1KZ0ZR, Accessed: August 29, 2020.

58. DFP is a device that removes diesel particulate matter or soot from a diesel engine's exhaust gas. City Council members said filters would not be effective, due to the low quality of Iran's diesel. Opponents, including some members of the council and the environment department, argue that this has no technical basis, and the filters are necessary to reduce Tehran's air pollution. Tehran Bus Company is a subsidiary of Tehran Municipality, which is overseen by the Islamic City Council of Tehran. More than half of its about 6,000 buses run on diesel. The average age of its fleet is 11 years. More than half belong to the "old" category, defined as at least eight years old. By 2023, almost 90 per cent of the fleet will be "old" if there is no retrofit.

59. Besides the limited and costly access to DFPs under sanctions, it has been argued that the diesel produced in Iran is not of proper quality, making DFPs dysfunctional and redundant. The environment department rejects this, but even if the argument is valid, sanctions have been introduced as the major obstacle to improving the quality of produced fuels. So, regardless of the validity of the claim, one can conclude that the economic sanctions have directly impacted air quality in Tehran, as a catalyst that intensifies air pollution.

60. Siemens chose not to risk losing $20 billion annual revenue (about 20 per cent of global sales) in the U.S., where it employs some 50,000 workers, so as to make a very small profit in Iran. Petroff A. (2018) Siemens CEO: We can't do new deals with Iran, CNN Business, May 18, 2020, https://money.cnn.com/2018/05/14/investing/iran-sanctions-siemens-europe/index.html, Accessed: September 1, 2020. Many other companies have refused business with Iran, lest they lose their strong U.S. market.

61. Neighboring Turkmenistan successfully put into operation the world's largest ATR-based methanol plant with Haldor Topsoe's help in 2020. Burgess M. (2020) World's largest ATR-based methanol plant now operational, Gasworld, January 14, 2020, https://www.gasworld.com/worlds-largest-atr-based-methanol-plant-now-operational/2018325.article, Accessed: September 1, 2020. Burgess M. (2020) World's largest ATR-based methanol plant now operational, Gasworld, January 14, 2020, https://www.gasworld.com/worlds-largest-atr-based-methanol-plant-now-operational/2018325.article, Accessed: September 1, 2020.

62. Colvin R. (2010) Obama says new U.S. sanctions on Iran toughest ever, Reuters, July 1, 2010, https://www.reuters.com/article/us-obama-iran/obama-says-new-u-s-sanctions-on-iran-toughest-ever-idUSTRE66001Z20100702, Accessed: August 30, 2020.

63. Soroush and Madani (2014).

64. Mawer, C. (2014) Air pollution in Iran, BMJ, 348:g1586, doi: https://doi.org/10.1136/bmj.g1586; Ghorayishi A. (2014) Choking to death in Tehran, Newsweek, March 20, 2014, https://www.newsweek.com/2014/03/28/choking-death-tehran-248027.html, Accessed: September 1, 2020.

65. Madani (2014); Madani et al. (2016); Mirzaei et al. (2019); Maghrebi et al. (2020).

66. Creating and maintaining jobs has been another motivation for expanding agriculture, the sector upon which a significant portion of the population depends.

67. Stone R. (2018) Science in Iran languishes after Trump reimposes sanctions, Science, doi: 10.1126/science.aav2811.

68. Public universities and research institutes in Iran are considered government institutions and their staff government employees. So, in theory, financial interactions and knowledge transfer can violate sanction rules.

69. Madani K., Nikazmrad R. (2015) Do-it-yourself sanctions threaten science dialogue with Iran', The Guardian, February 23, 2015, https://www.theguardian.com/world/iran-blog/2015/feb/23/us-sanctions-science-iranian-students-umass, Accessed: August 30, 2020; Seeley, 2015; Seeley M. (2015) How sanctions laws affect publishing: OFAC provides new guidance, Elsevier, December 8, 2015, https://www.elsevier.com/connect/how-sanctions-laws-affect-publishing-ofac-provides-new-guidance, Accessed: August 15, 2020.

70. Butler D. (2019) How US sanctions are crippling science in Iran, Nature, 574: 13–14. doi: 10.1038/d41586-019-02795-y.

71. According to this act, which became law in 2016, the citizens of 38 countries who could previously travel to the U.S. under the Visa Waiver Program must obtain a visa for such travel, if they have visited or been present in Iraq, Syria, Iran, Sudan, Libya, Somalia, or Yemen after 1 March 2011.

72. Iran also has problems paying its membership dues to intergovernmental organizations through the official financial routes and fund transfer channels that are conventionally used.

73. GEF (Global Environmental Facility) (n.d.: no date given), Iran: Country-At-A-Glance, https://www.thegef.org/country/iran, Accessed: September 1, 2020. This amount is small, compared to Iran's national income and its government's annual budget. But given the low budget allocations for the environment and environmental activism in the country, relatively small international environmental aid funds have been impactful.

74. The World Bank recently approved a $50 million COVID-19 emergency response project, which makes Iran one of the 100 developing countries that will receive its COVID emergency response funding. Funded "on an exceptional basis based on humanitarian needs", it will be implemented by the WHO, which will receive the money; there will be no payments to the government. Nguyen S. N. (2020) Project Information Document - Iran COVID-19 Emergency Response Project - P173994. Washington, D.C., World Bank Group, http://documents.worldbank.org/curated/en/355851588064171417/Project-Information-Document-Iran-COVID-19-Emergency-Response-Project-P173994, Accessed: August 30, 2020. The last previous World Bank emergency response funding for Iran was in 2004, following the 2003 Bam earthquake.

75. IEG (Independent Evaluation Group) (2013) Iran - Northern Cities Water Supply & Sanitation Project, ICR Review, Report Number: ICRR13925, Washington, D.C. : World Bank Group, http://documents.worldbank.org/curated/en/920841474636998379/Iran-Northern-Cities-Water-Supply-Sanitation-Project, Accessed: August 31, 2020; IEG (Independent Evaluation Group) (2014) Iran - Alborz integrated land and water management project, ICR Review, Report Number: ICRR14218, Washington, D.C. : World Bank Group, http://documents.worldbank.org/curated/en/127941474564344139/Iran-Alborz-Integrated-Land-And-Water-Management-Project, Accessed: August 31, 2020.

76. Financial Tribune (2018) CIMMYT Opens Research Center in Iran, March 16, 2018, https://financialtribune.com/articles/economy-domestic-economy/83693/cimmyt-opens-research-center-in-iran, Accessed: September 1, 2020.

77. CIMMYT (2018), Suspension of CIMMYT activities in Iran, CIMMYT, November 18, 2018, https://www.cimmyt.org/news/suspension-of-cimmyt-activities-in-iran, Accessed: September 2, 2020.

78. ICARDA (2018) Suspension of ICARDA activities in Iran, November 4, 2018, https://www.icarda.org/media/press-release/suspension-icarda-activities-iran, Accessed: August 31, 2020.

79. CARDA (2017) Enhancing food security in Iran, September 26, 2017 https://www.icarda.org/media/news/enhancing-food-security-iran, Accessed: August 31, 2020.

80. Except for UNICEF, none of these intergovernmental organizations has a head office in the U.S.

81. The "humanitarian exception" in U.S. sanctions does not automatically apply to environmental aid, but receiving an OFAC licence for environmental work has been possible in practice through lengthy processes.

82. Reini J. (2019) U.S. sanctions imperil aid to Iran's flood victims, Inter Press Service (IPS) News Agency, August 6, 2019, http://www.ipsnews.net/2019/08/u-s-sanctions-imperil-aid-irans-flood-victims, Accessed: October 10,

2020; Reuters (2019) Flood-hit Iran getting no financial aid from abroad due to U.S. sanctions: statement, April 7, 2019, https://www.reuters.com/article/us-iran-floods-redcrescent-idUSKCN1RJ0GY, Accessed: October 10, 2020.

83. Madani (2014).

84. Kebriaeezadeh A. (2019) U.S. sanctions are killing cancer patients in Iran, Foreign Policy, August 14, 2019, https://foreignpolicy.com/2019/08/14/u-s-sanctions-are-killing-cancer-patients-in-iran, Accessed: August 30, 2020.

85. See Madani (2020) for the illustration of the causal dynamics that lead to increased economic dependence on natural resources under sanctions.

86. See Ibid for further details.

87. Figures 4-6 are adapted from ibid

88. Ibid.

89. Ibid.

90. Ibid.

91. Ibid.

92. Ibid.

93. Ibid.

94. Madani (2019a).

95. Figure 7 is adapted from Ibid.

96. Madani (2014).

97. Generally, the sanctioners must not expect the sanctionee to give up easily on actions that the sanctioners consider "abnormal". Under pressure, the sanctionee may become more ambitious in pursuing its "abnormal" plan and willing to use its resources aggressively, compromising long-term national benefits in favor of its "abnormal" goals. This is an unsustainable strategy with long-term costs, including major environmental damage, but it works in the short run for a sanctionee functioning in survival mode. Sanctions and international political pressure have also increased Iran's "thirst for development" and desire to build engineering infrastructure that can be presented as symbols of development (eg, dams, roads, refineries, the Milad Tower). These are generally associated with long-term environmental costs, but they can create jobs, boost the economy and earn pride. Madani, 2020; Madani, 2014.

98. Sanctions and international conflicts also impact a sanctioned country's attitude toward international environmental cooperation. Iran signed the Paris climate change accord but has not ratified it due to domestic politics. It is hard to tell if Iran would have ratified the accord if the U.S. had not re-imposed sanctions, but in the current situation, early ratification seems very unlikely. With regard to research and knowledge production, the change of attitude toward international cooperation and reduced international interaction can result in reduced transparency and more limited access to information.

99. Iran has increasingly securitized its environmental space, fearing that environmental problems can become an effective unifying cause for political opposition and turn into a significant national security threat. Madani K. (2019b) The environment was once a safe space for activism in Iran. No longer, The Guardian, February 28, 2019, https://www.theguardian.com/commentisfree/2019/feb/28/environment-safe-space-activism-iran-hardline-forces, Accessed: August 31, 2020; Madani K. (2019c) Why is Iran so paranoid about environmentalism?, Medium, November 14, 2019, https://medium.com/@kavehmadani/why-is-iran-so-paranoid-about-environmentalism-ace0c9617478, Accessed: August 31, 2020.

100. While this study does not focus on human rights implications of sanctions' environmental impacts, states have major human rights obligations that relate to "the enjoyment of a safe, clean, healthy and sustainable environment". UN Human Rights Council (2012) and (2018). Current practices cause inevitable violations relating to environment by the sanctioners and sanctionee.