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BUILDING A MODEL FOR SECURING REGIONAL DEVELOPMENT FROM ECOLOGICAL THREATS

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Abstract. This paper aims to build a Sustainable Development (SD) model that considers ecological threats. We need to identify and measure those threats to prevent them from hindering sustainable regional development. The authors mine the ecological threats' indicators related to the 17 UN Sustainable Development Goals (SDGs) from the World Bank database. They found that the ecological threats affect eight SDGs out of the seventeen SDGs, as well as 43 security indicators that measure ecological threats. The obtained results are used to build a Sustainable Development Ecological Security Model made out of selected ecological indicators. The model is instrumental for further constructing an index, which allowed for estimating a level of security of sustainable development from ecological hazards. The study's novelty lies in considering ecological security issues while measuring SD. The obtained results may be instrumental for measuring countries' secure sustainable development and managing the processes through relevant economic policies.

Keywords: Sustainable Development (SD); Sustainable Development Goals (SDGs); Ecological threats; Regional Development Model; Organization for Security and Co-operation in Europe (OSCE); World Bank

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1. Introduction

1.1 Principles of Sustainable Development

The conservation of the ecosystem is a crucial principle of Sustainable Development (SD) which means development activities must be carried out according to the earth's capacity (Mensah, 2019). SD's overarching summative principle is the systematic incorporation of environmental, social, and economic concerns into all aspects of decision-making across generations. According to Guillén-Royo (2018), sustainable development necessitates action in three areas, including development strategies that encourage economic growth, social equality, and the reduction of adverse environmental impacts (Guillén-Royo, 2018). In general, sustainable development synchronizes economic, environmental, and social growth to increase overall intergenerational welfare while balancing intergenerational interest (Jin, Qian, Chin, & Zhang, 2020; Sun, Jin, Tsai, & Jakovljevic, 2022).

1. Economic sustainability involves a production system that meets current consumption levels without jeopardizing future needs (Lobo, Pietriga, & Appert, 2015).
2. Social sustainability entails equity, empowerment, accessibility, participation, cultural identity, and institutional stability (Goodland & Daly, 1996).
3. Environmental sustainability is a concern for natural environment and how it can continue to be productive and resilient to support human life. It relates to ecosystem integrity and the carrying capacity of the natural environment (Disano, 2006).

1.2 The Interpretation of Regional Development in Sustainable Development

The development of regions is commonly understood as the holistic growth of a community (social, economic, environmental, healthcare, technological, cultural, and recreational) on a particular territory (Jovovic et al., 2017) which we might add inclusivity; as a result, the development of a region must be based on the optimal expansion of constituents of sustainable development pillars (social, environmental, and economic development), and aimed at specific life-level maintenance and quality improvement (Jovovic et al., 2017).

1.3 The Sustainable Development Goals (SDGs)

Sustainable development means a harmonious balance of environmental health, ecological vitality, and social order with inclusivity (Faisal, Tunaboylu, & Koyuncu, 2020); this approach is valid for all countries irrespective of their development level.

The SDGs represent a well-balanced set of economic, social, and environmental goals and targets. To achieve the SDGs, countries must recognize and appreciate the existence of potential trade-offs and devise strategies to deal with them (Mensah, 2019). The SDGs' successful implementation will rely on piercing through the complex interactions between the goals and their targets for a better understanding of the intricacies. An integrated approach to sustainability would necessitate realizing the potential of its vital dimensional pillars while also managing the tensions, trade-offs, and synergies among these dimensions. The SDGs are an essential tool for promoting the long-term achievement of the three pillars of sustainable development (economics, environment, and social) (Griggs et al., 2013).

In 2015 the United Nations (UN) proposed 17 new Sustainable Development Goals (SDGs), with targets for sustainability accompanying each pillar. It contained 17 global goals, 169 targets, and 230 indicators that all countries must meet by 2030 (United Nations https://sdgs.un.org/goals; Faisal et al., 2020); these 17 SDGs are depicted in Figure 1.

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Figure 1. The 17 UN Sustainable Development Goals (SDGs)
Source: United Nations https://sdgs.un.org/goals ("THE 17 GOALS | Sustainable Development," n.d.)

These 17 SDGs can be categorized into the three sustainable pillars; Table 1 depicts all 17 goals arranged into three pillars: social, environmental, and economic) (Kostoska & Kocarev, 2019).

Table 1. The 17 sustainable development goals are clustered into economic, environmental, and social pillars

Sustainable Pillars	Associated Goals
Economic	1 NO POVERTY; 2 ZERO HUNGER; 3 GOOD HEALTH AND WELL-BEING; 8 DECENT WORK AND ECONOMIC GROWTH; 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
Environ-mental	6 CLEAN WATER AND SANITATION; 7 AFFORDABLE AND CLEAN ENERGY; 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION; 14 LIFE BELOW WATER; 15 LIFE ON LAND
Social	4 QUALITY EDUCATION; 5 GENDER EQUALITY; 10 REDUCED INEQUALITIES; 11 SUSTAINABLE CITIES AND COMMUNITIES; 16 PEACE, JUSTICE AND STRONG INSTITUTIONS; 17 PARTNERSHIPS FOR THE GOALS

Source: Created by the authors based on (Kostoska & Kocarev, 2019)

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Environmental sustainability is vital for two convincing reasons. First, it reduces the possible adverse environmental externalities associated with climate change, such as heatwaves, rising sea levels, flooding, droughts, food insecurity, wildfires, and displacement of people. Second, it is a precondition for sustainable development (Opoku, Dogah, & Aluko, 2022).

2. Literature Review

2.1 The Debate about the SDGs

The SDGs are integrated (and indivisible) and create a balance between the three facets of sustainable development (economic, social, and environmental) for the whole world (developed and developing countries alike) to make them perform their best in reducing inequalities considerably (Kostoska & Kocarev, 2019). According to the SDGs, sustainable development aspires to achieve social progress, environmental balance, and economic growth. However, policymakers face the issue of implementing the SDGs concurrently due to multiple interlinkages within and between these goals, including synergy and potential trade-offs (Pradhan, et al., 2017) as well as doing it equitably. However, these interconnections currently have a weak conceptual and scientific foundation to emphasize the urgent need for holistic and comprehensive techniques and tools to assess the nature and strengths of these interactions as well as how they affect policy and execution (Pradhan et al., 2017).

The SDGs' development objectives and targets are interdependent but interrelated, a crucial characteristic (Tosun et al., 2017). For instance, addressing climate change issues (SDG 13) could benefit energy security (SDG 7), biodiversity (SDG 14), and oceans (Le Blanc, 2015). Climate change (related to SDG 13 and SDG 6) leads to water-related disasters, because the imbalance between evaporation and precipitation creates either shortage or excess of water in the ecosystem accordingly (Yadav & Zeeshan Ibrar, 2022).

The actions for achieving sustainability have positive links with the SDGs related to environmental dimensions (Goals 6, 7, 12, 13, 14, and 15) as they mutually reinforce each other. However, these efforts may directly contradict the SDGs regarding social and economic factors (Goals 1, 2, 3, and 8). The SDGs incorporate the 5Ps spanning the 17 SDGs: people, planet, prosperity, peace, and partnership, emphasizing the interdependence of the targets and the need for integrated and coordinated goal execution, as shown in Table 2 (Zhai & Chang, 2018; Ho & Goethals, 2019).

Table 2. The 5Ps concept in the 2030 Agenda for Sustainable Development

P's (Themes)	**People**					**Prosperity**					**Planet**					**Peace**	**Partnership**
SDG's	**1**	**2**	**3**	**4**	**5**	**7**	**8**	**9**	**10**	**11**	**6**	**12**	**13**	**14**	**15**	**16**	**17**
Interrelation between P's	**Interacted with each other**															**People & Prosperity**	**People & Planet**

Source: Created by the authors based on Zhai & Chang (2018); Ho & Goethals (2019); Kostoska & Kocarev (2019)

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2.2 Ecological Security

Sustainable development changes it's context in the conditions of accelerating global warming. If a decade ago economic growth was emphasized, now is the time to focus on the survival of the planet as a priority. Therefore ecological security, in rather broad sense (Ciszek, 2012; Wysokinska-Senkus et al., 2021) has to be analyzed, measured and managed.

Ecological security means that hazards related to air contamination, soil, and water have to be identified, grouped, and the level of their importance identified.

Biological invasions, land-use intensification, and water scarcity jeopardize sustainability (Ho & Goethals, 2019). Furthermore, the environmental degradation mainly reflected in increasing levels of carbon dioxide (CO2). Emissions dominates the global discourse on climate change and its consequential global warming (Opoku et al., 2022).

It is important to understand how to avoid these ecological threats that affects our regional development. Measuring their harm is the essential for devising policies for protecting our ecosystem of these ecological hazards. Previous research used traditional indicators to measure sustainability without considering the impact of ecological threats on our regional development. For example, the Ecological Footprint model measures sustainability based on converting human resource consumption and bio-productivity in a country and compares the consumption footprint to the regional bio-capacity (Liao, Li, Yan, & Hu, 2004) which these days, is found to be insufficient to determine the sustainable development of the country.

3. Methodology

For the mining of security SDGs indicators for G20 Countries related to the mitigation of ecological threats, international databases are used (e.g., the World Bank database is used since it has an SDGs database, and filtering these SD goals into the required eight security goals allows to get the related indicators). G20 countries were chosen because they are the leading countries that have reached a high green development level, whereas the medium ones move fast toward a green economy, and some laggards get worst (Shao, Jin, Tsai, & Jakovljevic, 2022).

3.1 Ecological Threats' Categorizations

The new security vision identified challenging traditional security concepts intersecting with each other, as well as, introducing non-traditional threats such as cyber threats, Geo-engineering, STEM, etc. Hence, the new security vision expands these threats categorized into 5 Types, 3 States and 5 Premises (Nardin, 2017).

Providing the summary below, Table 3 categorizes the regional threats in terms of types and premises to analyze and conclude the highest harmful regional threats that impacts regions and sustainable development goals which in turn, impacted regional development.

Table 3 also lists the concentration of ecological threats in terms of type and premise highlighted in dark blue, while their related SDGs are mentioned inside the environmental and ecological threat type cells.

The full version of categorizing the regional threats that include their states by the link located in the Data Availability Statement in the Table named "Regional Threats Analysis".

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Table 3. The summary expanded the vision of regional threats

N	Regional Threats	Threat types					Threats Premises					
		A	B	C	D	E	I	II	III	IV	V	
		State Centered	Human	Hybrid	Environ-mental	Ecological	Traditional	Old & New Threats combined and Interacted	New developments of unconventional threat	Upgraded Old Threats	Old Threats affected by external Factors (Globalization, pollution)	Authors
1	Massive Migration			✓			✓					(Campbell, 2019)
	Gender-Based Violence		✓				✓					(Gerring, 2019)
	Water Availability				✓ SDG6						✓	(Zawahri & Weinthal, 2019)
	Food Insecurity		✓	✓							✓	(Resende, & Abdenur, 2019)
2	Populist Security		✓				✓					(Garrett, 2019)
	Extremist & Terrorism			✓			✓					(Joshi, 2019)
	Corruption			✓			✓					Euromonitor International
3	Critical Infrastructure					✓ SDG9			✓			(Addington, 2019)
4	Climate Change				✓ SDG13					✓		(Below, 2019)
	Geoengineering					✓ SDG11			✓			(Beevers, 2019)
5	Cyber Security Threats			✓					✓			(Lifländer, 2019)
	STEM			✓					✓			(Sebastiani, Sanchez & Manrod, 2019)
	Energy Insecurity				✓ SDG7						✓	(Davis, & Drake, 2019)
	Supply Chain Risks & Uncertainty			✓					✓			(Bachkar, K., & Hebron, L., 2019)
	Oil Price Shock	✓						✓				Euromonitor International (Formentos, & Gokcek, 2019)
	Global Trade War	✓		✓				✓				
	Invisible Foes, Micro-enemies, Pathogens and Global Health Insecurity					✓SDG13 ✓SDG14 ✓SDG15				✓		

Source: Categorization created by the authors

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3.2 Reasons for choosing Ecological threats among other Regional Threats

Table 3 provides an overview of regional threats. The hazards related to the environment of our living planet are for instance, climate change, water security, and energy security, while the ecological threats are related to ecosystems and other forms of life, such as geoengineering, micro-enemies, pathogens, and pollution. Both types of threats are interlinked.

These ecological threats reflect the SDG insecurities such as water, energy, infrastructure, footprint, biodiversity, and terrestrial ecosystem. The aforementioned are trans-state and non-human. These ecological threats are mainly old threats affected by new external factors or old upgraded threats that have less focus, which now requires more attention to predict further threats. So, the scope of this research is ecological threats.

This research focuses on the planet security theme due to its endangered ecological threats. However, other threatening SDGs, such as SDG 11, belong to the prosperity theme and the social pillar. According to Moyer and Bohl (2019), several SDGs are closely related to human development, indicating a tendency to develop programs to consider human development and environmental elements together.

Therefore, it is necessary to include SDG 9 & SDG 11 along with the environmental SDGs (6, 7, 12, 13, 14, 15) to have eight SDGs (6, 7, 9, 11, 12, 13, 14 & 15) that are related mainly to mitigating ecological threats. These eight goals are described in detail in Table 3, which is also provided by the link located in the Data Availability Statement.

3.3 The World Bank Group

The World Bank Group is a significant source of funding and information for developing countries worldwide, providing a wide range of financial items and technical assistance and helping countries share and apply cutting-edge information and solutions to their problems (https://www.worldbank.org/en/who-we-are). They partner with governments, International Bank for Reconstruction and Development (IBRD) and International Development Association (IDA), which provides developing-country governments with finance, policy advice, and technical aid. IDA concentrates on the world's poorest countries, whereas IBRD aids middle-income and creditworthy poorer countries. Furthermore, The International Finance Corporation (IFC), The Multilateral Investment Guarantee Agency (MIGA), and The International Centre for Settlement of Investment Disputes (ICSID) are all focused on supporting the private sector in developing nations.

The World Bank Group supports private enterprises, including financial institutions, with finance, technical assistance, political risk insurance, and dispute resolution through these entities. World Bank database is the official organization of providing United Nations Sustainable Development (UNSD) indicators; accessing the database is through logging into the databank – World Bank website https://databank.worldbank.org/home.aspx.
The sequence of actions is as follows:
1 - Selecting the Sustainable Development Goals database from the available 84 databases is our concern for securing SDGs.
2 - Selecting the targeted G20 group countries that control two-thirds of world economies and select the targeted period afterward.
3 - Then selecting the targeted goals, the eight security SDGs (6, 7, 9, 11, 12, 13, 14, 15)
SD Goal #6 - Ensure universal access to and sustainable management of water and sanitation,
SD Goal #7 - Ensure access to affordable, reliable, sustainable, and modern energy for all,
SD Goal #11 - Make cities and human settlements more inclusive, safe, resilient, and sustainable,
SD Goal #12 - Ensure sustainable consumption and production patterns,
SD Goal #13 - Take immediate action to combat climate change and its consequences,
SD Goal #14 - The need to protect the oceans and seas,

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SD Goal #15 - The protection of the terrestrial ecosystem, sustainable forest management, and combating desertification.
Applying the filter in the series drop list, as discussed previously, these specific goals are related to Ecological security.
The data is exported as an Excel spreadsheet containing a table of 43 UNSD (United Nations Sustainable Development) indicators encompassing the 8 Goals, associated 20 targets, and the 43 attributed coded indicators related to mitigating the ecological threats.
For the model building, we made two steps; the first step is the conceptualization phase in which the goals are set, and the next step is the operationalization phase in which the indicators are formulated.

Building the flowchart for the model starts from regional sustainable development and goes toward planet security sustainable development indicators as shown below in Figure 2. This model can be used as a tool to measure and rank the sustainability of countries that enable policymakers to take the appropriate decisions and or actions.

4. Results and Discussion

4.1 Ecological Threat Indicators

Analysis of SD goals show that six goals of seventeen are related to environmental issues.
SD Goal #6 focuses on clean water and sanitation.
SD Goal #7 ensures accessible, affordable, reliable, sustainable, and modern energy.
SD Goal #9 focuses on infrastructure security by having efficient and healthy transportation by minimizing their Co2 emissions.
SD Goal #11 focuses on cities' security by having safe and healthy cities by minimizing losses related to cities' disasters and the Environmental Impact of cities, such as Solid Waste and Pollution.
Municipal environmental management is the environmental activities performed by local authorities in the municipalities to enhance city security (Mostovoy et al., 2021).
SD Goal #12 tackles consumption and production.
Consumption patterns have to be changed; stewardship of resources has to become a lifestyle; the circular economy has to become an integral part of daily life; organic farmer as to be a natural choice.
The indicator, i.e., the share of certified organic agricultural area in organic farms in the total agricultural area of agricultural holdings, has improved in the last decade.
SD Goal #13 tackles climate change. Economic growth leads to an increase in energy consumption, which, in its turn, leads to the emission of Co2 into the atmosphere. Switching towards renewable energy sources is an inevitable choice by producers and households.
The priorities are effectively reducing Co2 concentration in the atmosphere and introducing innovative technologies to use available energy sources, including geothermal energy development.
One of the indicators of this priority is the share of energy from renewable sources in gross final energy consumption.
SD Goal #14 is formulated in order for oceans and seas to be preserved. Here, tourism activities have to be rethought for urbanization and deterioration to be prevented (Sun & Ye, 2022).
The priority is also to increase the share of the maritime economy sector in GDP and increase employment in the marine economy.
An indicator describes the percentage of fish stocks within the sustainable levels.
To achieve SD Goal #14, "Biodiversity Protection," critical areas of biological diversity must be identified and protected.
Overusing agrochemicals has led to the destruction of natural resources and reduced production. Such form of agriculture relies heavily on inputs, including seeds, pesticides, fertilizers, and irrigation water, leading to higher production costs and adversely affecting the health of humans and animals (Abdar, Amirtaimoori, Mehrjerdi, &

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Boshrabadi, 2022) (Zulfiqar & Thapa, 2017). The indicator is the share of forest land in the land area, about 30%. This Goal's degree of implementation is determined by the indicator of the percentage of devastated and degraded land requiring reclamation in the total area.

Table 4 lists the main ecological threats with descriptions related to eight security SDGs, the security targets, the security code of the Goal and task, and their SD pillar and theme categorization for each ecological threat.

Table 4. The 43 Ecological threats Indicators based on SDGs

No.	Main Ecological Threats	Security Targets	Ecological threats security SD Tasks	Ecological threats Indicators Description	Indicator SDG code (Goal. Task)	Indicator pillar, Theme
1	**Water Insecurity**	Availability and Accessibility water	Securing drinking water	People using at least basic drinking water services (% of population)	6.1	Environmental, Planet
2				People using safely managed drinking water services (% of population)		
3			Securing sanitation and handwashing	People practicing open defecation (% of population)	6.2	
4				People using at least basic sanitation services (% of population)		
5				People using safely managed sanitation services (% of population)		
6				People with basic handwashing facilities including soap and water (% of population)		
7			Securing freshwater	Annual freshwater withdrawals, total (% of internal resources)	6.4	
8				Level of water stress: freshwater withdrawal as a proportion of available freshwater resources		
9				Renewable internal freshwater resources per capita (cubic meters)		
10				Water productivity, total (constant 2010 US$ GDP per cubic meter of total freshwater withdrawal)		
11			Securing water related ecosystem	Change in the extent of water-related ecosystems over time	6.6	
12	**Energy Insecurity**	Stable, Sustainable and Accessible Energy	Electricity accessibility and stability	Access to electricity (% of population)	7.1	Environmental, Prosperity
13				Access to clean fuels and technologies for cooking (% of population)		
14			Renewable energy sustainability	Renewable electricity output (% of total electricity output)	7.2	

15				Renewable energy consumption (% of total final energy consumption)		
16			Energy intensity	Energy intensity level of primary energy (MJ/$2011 PPP GDP)	7.3	
17	**Infrastructure Insecurity**	Efficient, Safe, and Healthy infrastructure	Transportation (Efficient and Safe)	Air transport, passengers carried	9.1	Economic, Prosperity
18				Railways, passengers carried (million passenger-km)		
19			Healthy CO2 emissions reduction	CO2 emissions (kg per PPP $ of GDP)	9.4	
20	**Cities threats**	Safe and Healthy cities	Minimize losses related to cities disasters	Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population	11.5	Social, Prosperity
21				Direct economic loss in relation to global GDP, damage to critical infrastructure and number of disruptions to basic services, attributed to disasters		
22			Minimize environmental impact of cities such as solid waste & pollution	PM2.5 air pollution, mean annual exposure (micrograms per cubic meter)	11.6	Social, Prosperity
23	**Resources Consumption threats**	Sustainable Ecosystem	Reduce ecological footprint	Adjusted net savings, excluding particulate emission damage (% of GNI)	12.2	Environmental, Planet
24				Coal rents (% of GDP)		
25				Forest rents (% of GDP)		
26				Mineral rents (% of GDP)		
27				Natural gas rents (% of GDP)		
28				Oil rents (% of GDP)		
29				Total natural resources rents (% of GDP)		
30			Reduce fossil-fuel consumption	Number of sustainable tourism strategies or policies and implemented action plans with agreed monitoring and evaluation tools	12.8	
31	**Climate change threats**	Stable and Safe climate	Control Climate impact	Droughts, floods, extreme temperatures (% of population, average 1990-2009)	13.1	Environmental, Planet
32			Augment disaster risk reduction such as GHGs emissions and geoengineering impacts	Disaster risk reduction progress score (1-5 scale; 5=best)	13.2	
33	**Aqua Insecurity**	Sustainable production and threats prevention on Aqua systems	Coastal ecosystem SD	Proportion of national exclusive economic zones managed using ecosystem-based Approaches	14.2	Environmental, Planet
34			Aqua production	Aquaculture production (metric tons)	14.4	

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35				Capture fisheries Production (metric tons)		
36				Total fisheries Production (metric tons)		
37			Marine protection	Marine protected areas (% of territorial waters)	14.5	
38	**Biodiversity Insecurity**	Sustainable production and threats prevention on Biodiversity systems	Terrestrial conservation	Forest area (% of land area)	15.1	Environmental, Planet
39				Terrestrial and marine protected areas (% of total territorial area)		
40				Terrestrial protected areas (% of total land area)		
41			Biodiversity extinction	Fish species, threatened	15.5	
42				Mammal species, threatened		
43				Plant species (higher), threatened		

Source: Created by the authors, based on World Bank- sustainability database

The legend below is based on the retrieved data from the World databank for G20 countries and shows that five non-available indicators are highlighted in grey color. Also, there are two available indicators with no available data highlighted in green.

The remaining thirty-six indicators are available. Their data are retrieved and attached by the link located in the Data Availability Statement in the tab named "Ecological threats indicators" of the Excel sheet named "Appendix".

Color coding	Indicator data Availability in World bank databases	Quantity
	N/A	5
	Available but not recorded	2
	Available	**36**

The above two tables are listed by the link located in the Data Availability Statement as a reference.

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4.2 Implications of Sustainable Development Goals security Indicators

Many indicators are either grouped in a framework of categories or aggregated into an index to make a problem visible (Pravitasari et al., 2018); however, there are criteria to identify and select the appropriate indicators for aggregation such as credibility, relevance, and legitimacy (Hák, Janoušková, & Moldan, 2016).

The relationship between the indicators and the facts they reflect must be empirically tested using proper methodologies (Hák, Janoušková, & Moldan, 2016), considering the challenges in selecting indicators and determining their weights.

The eight ecological Security SD Goals are related to three SD pillars, and SD indicators are retrieved from these ecological Security SD Goals.

The originality of this SD model is that it lists 43 SD indicators to measure ecological security, which can be used to mitigate ecological threats to enhance regional SD.

Previous studies mainly focused on reviewing and comparing the indicators developed to measure sustainable development. However, it does not measure the harm of ecological threats to our regional development. It does not account for securing SD related to these ecological threats based on securing SD Goals. In contrast, this research considers these security issues that affect our ecosystem security and, ultimately, SD security, which is the concern of the policymakers and stakeholders.

This model can serve as a framework for constructing an index that measures countries' performance, which can be used for countries' ranking based on theoretically grounded sustainable development parameters.
It would allow policymakers to rate policy initiatives aimed at the same policy goals based on their effectiveness at getting the country on a sustainable development path. It will enable ranking policy initiatives and harmonizing policies aimed at diverse sectors and goals (Štreimikienė & Baležentis, 2013).

4.3 Model Construction

Filtering 1443 indicators available in the World Bank into 404 sustainable development indicators, then reviewing the filtered indicators, their categories and themes.

Below, Figure 2 describes the flow chart of the proposed SD Ecological Security Model, whereas the list of indicators along with their implications included in the Sustainable Development Ecological Security Model is provided in Table 5 below. They are listed in the same sequence in Figure 2 from up to downward, starting from environmental indicators till ending with economic indicators. Besides that, the table shows the Targeted Direction of change for these indicators based on their long definitions, Statistical concepts, and methodology listed in the Appendix - Series Metadata that is provided by the link located in the Data Availability Statement.

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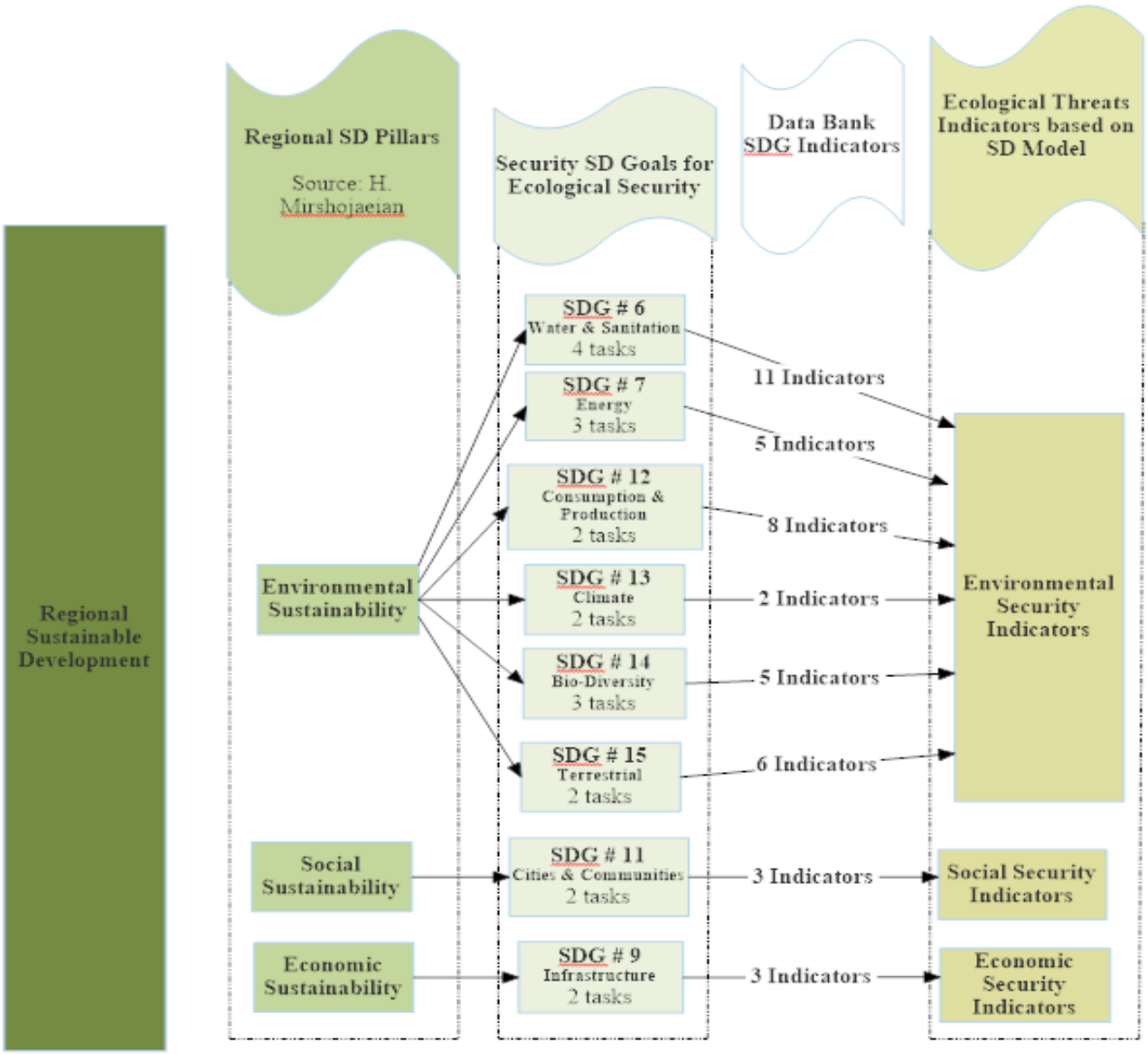

Figure 2. Sustainable Development Ecological Security Model
Source: created by the authors

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Table 5. The list of indicators' implications

Indicator number	Indicator Description	Sustainability Pillar	SDGs	Targeted Direction of change	Data Availability
1	People using at least basic drinking water services (% of population)	Environmental	6	↑	Yes
2	People using safely managed drinking water services (% of population)	Environmental	6	↑	Yes
3	People practicing open defecation (% of population)	Environmental	6	↓	Yes
4	People using at least basic sanitation services (% of population)	Environmental	6	↑	Yes
5	People using safely managed sanitation services (% of population)	Environmental	6	↑	Yes
6	People with basic handwashing facilities including soap and water (% of population)	Environmental	6	↑	Yes
7	Annual freshwater withdrawals, total (% of internal resources)	Environmental	6	↑	Yes
8	Level of water stress: freshwater withdrawal as a proportion of available freshwater	Environmental	6	↓	Yes
9	Renewable internal freshwater resources per capita (cubic meters)	Environmental	6	↑	Yes
10	Water productivity, total (constant 2010 US$ GDP per cubic meter of total freshwater withdrawal)	Environmental	6	↑	Yes
11	Change in the extent of water-related ecosystems over time	Environmental	6	↑	No
12	Access to electricity (% of population)	Environmental	7	↑	Yes
13	Access to clean fuels and technologies for cooking (% of population)	Environmental	7	↑	Yes
14	Renewable electricity output (% of total electricity output)	Environmental	7	↑	Yes
15	Renewable energy consumption (% of total final energy consumption)	Environmental	7	↑	Yes
16	Energy intensity level of primary energy (MJ/$2011 PPP GDP)	Environmental	7	↓	Yes

17	Air transport, passengers carried	Environmental	12	↑	Yes
18	Railways, passengers carried (million passenger-km)	Environmental	12	↑	Yes
19	CO2 emissions (kg per PPP $ of GDP)	Environmental	12	↓	Yes
20	Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population	Environmental	12	↓	No
21	Direct economic loss in relation to global GDP, damage to critical infrastructure and number of disruptions to basic services, attributed to disasters	Environmental	12	↓	No
22	PM2.5 air pollution, mean annual exposure (micrograms per cubic meter)	Environmental	12	↓	Yes
23	Adjusted net savings, excluding particulate emission damage (% of GNI)	Environmental	12	↑	Yes
24	Coal rents (% of GDP)	Environmental	12	↓	Yes
25	Forest rents (% of GDP)	Environmental	13	↑	Yes
26	Mineral rents (% of GDP)	Environmental	13	↓	Yes
27	Natural gas rents (% of GDP)	Environmental	14	↓	Yes
28	Oil rents (% of GDP)	Environmental	14	↓	Yes
29	Total natural resources rents (% of GDP)	Environmental	14	↓	Yes
30	Number of sustainable tourism strategies or policies and implemented action plans with agreed monitoring and evaluation tools	Environmental	14	↑	No
31	Droughts, floods, extreme temperatures (% of population, average 1990-2009)	Environmental	14	↓	Yes, but no available records
32	Disaster risk reduction progress score (1-5 scale; 5=best)	Environmental	15	↑	Yes, but no available records
33	Proportion of national exclusive economic zones managed using ecosystem-based approaches	Environmental	15	↑	No
34	Aquaculture production (metric tons)	Environmental	15	↑	Yes
35	Capture fisheries Production (metric tons)	Environmental	15	↓	Yes
36	Total fisheries Production (metric tons)	Environmental	15	↓	Yes
37	Marine protected areas (% of territorial waters)	Environmental	15	↑	Yes
38	Forest area (% of land area)	Social	11	↑	Yes

39	Terrestrial and marine protected areas (% of total territorial area)	Social	11	↑	Yes
40	Terrestrial protected areas (% of total land area)	Social	11	↑	Yes
41	Fish species, threatened	Economic	9	↓	Yes
42	Mammal species, threatened	Economic	9	↓	Yes
43	Plant species (higher), threatened	Economic	9	↓	Yes

Source: Created by the author, based on World Bank - Sustainability database

The list of indicators included in the model with their data from the year 2010 to 2019 is additionally provided by the link located in the Data Availability Statement.

5. Conclusions and Limitations

5.1 Conclusions

The authors came to the following insights:

- in contemporary conditions sustainable development can be secured only if ecological threats are neutralized;
- those threats have to be identified and measured, therefore a set of 43 indicators was suggested;
- Sustainable Development Ecological Security Model was constructed, which clearly showed place of environmental security indicators in sustainable development of regions; data for G20 countries was collected;
- The obtained results may be instrumental for measuring countries' secure sustainable development and managing the processes through relevant economic policies.

5.2 Limitations

The collection of indicators is limited to selecting ecological indicators threatening SD goals, provided in World Banks' Sustainability database. We provided data collected for G20 countries in the Appendix. The data of a few extracted indicators is not available for some tackled countries, therefore, further results are subject to several uncertainties and qualifications where knowledge gaps and measurement issues could cause uncertainty that warrant further consultation by experts.

5.3 Future Improvement

All indicators, particularly for developing nations, are hampered by the poor quality and coverage of available data, inconsistent techniques, weak time series, and major gaps. Governments must ensure and acknowledge that data collecting is primarily their duty. Investing in data collection pays off handsomely in terms of better decision-making. However, using the most recent methodology and data, it is possible to compute an index for earlier years to begin measuring relative performance between nations and how each country's performance changes over time.

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Data Availability Statement: More information and data can be found in the repository on Zenodo: BUILDING MODEL FOR SECURING REGIONAL DEVELOPMENT FROM ECOLOGICAL THREATS | Zenodo: md5:737bb33c0e7cef1ede8c0e1b75d70ae9

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