Mapping SDG Implementation in Egypt:
A Cross-Country Comparative Analysis of Voluntary
National Reviews Using Text Mining and Network Analysis

Dr.Hassan Mohamed Rabie

د. حسن محمد ربيع
أستاذ مساعد بحوث العمليات وإتخاذ القرار بمعهد التخطيط القومي

hassan.rabie@inp.edu.eg

W W W . I N P . E D U . E G

جمهورية مصر العربية - طريق صلاح سالم - مدينة نصر - القاهرة - مكتب بريد رقم 11765
A.R.E SALAH SALEM ST. NASR CITY, CAIRO P.O.BOX: 11765

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رسم خرائط تنفيذ أهداف التنمية المستدامة في مصر تحليل مقارن بين البلدان للمراجعات الوطنية الطوعية بإستخدام التنقيب عن النصوص وتحليل الشبكات

د. حسن محمد ربيع

أستاذ مساعد بحوث العمليات وإتخاذ القرار

مركز الأساليب التخطيطية - معهد التخطيط القومي

hassan.rabie@inp.edu.eg

Abstract:

This study explores Egypt's Sustainable Development Goals (SDG) implementation by analyzing Voluntary National Reviews (VNRs) using text mining, topic modeling, and network analysis. By examining Egypt's VNR alongside those of Gulf, Middle Eastern, African, and selected worldwide countries, the research identifies thematic priorities, policy approaches, and governance frameworks. The findings reveal Egypt's distinct emphasis on institutional frameworks, economic reforms, and social development priorities, particularly in education, health, and sustainability initiatives. Compared to Gulf countries, Egypt balances governance strategies with social priorities, while diverging from Sub-Saharan nations that focus on agriculture and climate resilience. In contrast to worldwide countries such as Germany, Sweden, and Japan, Egypt's approach emphasizes localized governance rather than extensive international cooperation. This study highlights the value of computational analysis in uncovering thematic insights from VNRs, providing a comprehensive understanding of Egypt's SDG implementation within regional and global contexts.

الملخص:

تستكشف هذه الدراسة تنفيذ أهداف التنمية المستدامة (SDGs) في مصر، من خلال تحليل المراجعات الوطنية الطوعية (VNRs)، باستخدام تقنيات، التنقيب عن النصوص (Text Mining)، ونمذجة الموضوعات (Topic Modeling)، وتحليل الشبكات (Network Analysis) وذلك من خلال تحليل المراجعات الوطنية الطوعية الخاصة بمصر ومقارنتها مع تقارير مختارة من دول الخليج، والشرق الأوسط، وإفريقيا، بالإضافة إلى بعض دول العالم، وذلك لتوضيح أهم الموضوعات، والسياسات، وأُطر الحوكمة في هذه الدول. وقد أظهرت النتائج تركيزًا واضحًا من جانب مصر على الأُطر المؤسسية، والإصلاحات الاقتصادية، والتنمية الاجتماعية، لا سيما في مجالات التعليم والصحة والاستدامة. وبالمقارنة مع دول الخليج، تسعى مصر لتحقيق توازن بين استراتيجيات الحوكمة والأولويات الاجتماعية، في حين تختلف عن دول إفريقيا (جنوب الصحراء)، التي تُركز بشكل أكبر على الزراعة والمرونة المناخية. وعلى العكس من بعض دول العالم مثل ألمانيا والسويد واليابان، فإن مصر تُولي اهتمامًا أكبر بالحوكمة داخل النطاق المحلى بدلًا من الاعتماد على التعاون الدولي. وتسلط هذه الدراسة الضوء على أهمية التحليل الحسابي في الكشف عن أهم الموضوعات المستخلصة من المراجعات الوطنية الطوعية، وتوفر فهمًا شاملًا لتنفيذ أهداف التنمية المستدامة في مصر ضمن السياقين الإقليمي والعالمي.

الكلمات الدالة: أهداف التنمية المستدامة – المراجعات الوطنية الطوعية –التنقيب عن النصوص – تحليل الشبكات – نمذجة الموضوعات.

1. Introduction

The Sustainable Development Goals (SDGs), adopted by all United Nations Member States in 2015, provide a comprehensive framework for addressing global challenges such as poverty, inequality, climate change, and environmental degradation. Central to the 2030 Agenda for Sustainable Development, the SDGs are monitored through Voluntary National Reviews (VNRs), which enable countries to report their progress, share experiences, and foster international collaboration. VNRs serve as critical accountability mechanisms, promoting transparency and inclusiveness in sustainable development efforts by engaging governments, civil society organizations, and marginalized groups in the review process. By July 2018, over half of UN Member States had presented their VNRs at the High-Level Political Forum on Sustainable Development (HLPF), offering valuable insights into national priorities and implementation strategies.

Egypt has actively engaged in the VNR process, submitting multiple reports that outline its progress, priorities, and obstacles in sustainable development. Egypt's approach to SDG implementation is well-documented within VNR national reports, however, there is limited research comparing its strategy and policy with those of other countries. Existing studies on VNRs have largely examined regional trends in Europe, Africa, and Asia but have not systematically assessed Egypt's position within a global context. A comparative analysis is necessary to determine how Egypt's progress aligns with or diverges from other countries, particularly those with similar economic, social, or geographic characteristics.

Despite the extensive utilization of VNRs, there remains a significant gap in comprehending how Egypt's implementation of SDGs compares with that of other countries, particularly within the Middle East and North Africa (MENA) region and on a global scale. While existing research has explored SDG progress in various regions, few studies have systematically analyzed Egypt's approach in a comparative context. This study addresses this gap by employing advanced computational techniques - text mining, topic modeling, and network analysis- to examine Egypt's VNR alongside those of selected Gulf and Middle Eastern countries, African countries, and selected Worldwide countries.

The aim of this research is to analyze and compare Egypt's SDG implementation strategy within a global context by examining VNRs from multiple countries. Using text mining and network analysis, the study seeks to identify thematic priorities, and policy approaches, providing insights into Egypt's positioning relative to its regional and international counterparts. The goal is to uncover patterns in how Egypt and other countries approach sustainable development, integrating key findings to position Egypt's strategy relative to its regional and international counterparts.

This study explores how Egypt's approach to SDG implementation compares to that of Gulf, Middle Eastern, African, and selected Worldwide countries, identifying key thematic priorities and policy approaches. It examines the extent to which Egypt's policy-driven, institutionally structured model aligns or diverges from other countries and investigates the patterns that emerge from text mining and network analysis of VNRs. Finally, the study aims to provide insights into how Egypt's SDG priorities have evolved.

This paper is structured as follows: Section 2 reviews existing literature on VNRs analysis. Section 3 outlines the methodology, text mining, topic modeling and network analysis techniques used in this study. Section 4 presents the results, highlighting key thematic trends and comparative insights. Finally, Section 5 discusses the conclusions.

Literature Review

(Reyes et al., 2019) review of the Philippines' progress toward the SDGs as part of the country's VNR. The study examines key SDGs, including Quality Education (SDG 4), Decent Work and Economic Growth (SDG 8), Reduced Inequalities (SDG 10), Climate Action (SDG 13), Peace, Justice, and Strong Institutions (SDG 16), and Partnerships for Goals (SDG 17). The report highlights improvements in access to education, economic growth, and social protection programs, while identifying challenges such as regional disparities, underemployment, and vulnerability to natural disasters. The paper highlights the Philippines' commitment to the SDGs, particularly in addressing inequalities and building resilience to climate change.

(Bickler, Morton, & Menne, 2020) analyze the integration of health in the SDGs within 20 European VNRs. Using a semi-quantitative approach based on WHO Europe's SDG Roadmap, the study assessed governance, health determinants, and investment strategies. Findings revealed strong commitments to governance and monitoring but weak integration of health in sustainability policies. The study highlights the need for deeper engagement of the health sector in cross-sectoral sustainability efforts, advocating for a "health-in-all-policies" approach to maximize health co-benefits from SDG implementation.

(Sebestyén, Domokos, & Abonyi, 2020) focus on analyzing VNRs submitted by countries to assess their progress toward achieving SDGs. The authors employ text mining and network analysis techniques to identify key thematic areas and cluster countries based on their sustainability strategies. The study analyzed VNRs and found that SDG5 (gender equality) and SDG8 (decent work and economic growth) are the most frequently discussed goals, while SDG1 (no poverty) and SDG10 (reduced inequalities) receive the least attention. The research introduces a novel multilayer network-based method to compare and cluster countries, revealing potential

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cooperation groups based on similar sustainability challenges. The study emphasizes the importance of sharing best practices and fostering international collaboration to achieve the 2030 Agenda for Sustainable Development.

(Kandpal & Okitasari, 2022) analyzed the effectiveness of Follow-up and Review (FUR) mechanisms in VNRs for tracking SDG progress. The study highlights that while most countries have national-level FUR frameworks, only a few have developed sub-national mechanisms. Challenges include data gaps, fragmented reporting, and limited stakeholder participation. The study recommends integrating SDG FUR principles into national frameworks, investing in statistical capacity, and enhancing multi-stakeholder collaboration. Findings emphasize the need for robust, data-driven evaluation processes to improve policy effectiveness and accountability in achieving the 2030 Agenda.

(Elder & Newman, 2023) examined SDG implementation policies and budgets reported by G20 countries in their VNRs. The study compiled a dataset of over 4,100 policies, analyzing their distribution among SDGs and budgetary allocations. Findings indicate that G20 countries reported numerous substantive policies, including national strategies, regulations, and action plans, with a cumulative listed budget exceeding USD 2.7 trillion. However, budgetary information was often fragmented and did not fully reflect the scale of reported policies. The study highlights the need for further research on the effectiveness and implementation of these policies.

(Martins & Paes-Sousa, 2024) analyzed the accountability of states in reporting health-related SDG indicators through VNRs from 2016 to 2020. The study categorized 60 health indicators from 195 VNRs, assessing their alignment with the global indicator framework. Findings reveal a paradox where technical capacities for reporting health indicators have improved, but governance weaknesses persist, particularly in universal health coverage and health systems. High-income states exhibit lower accountability in reporting. The study highlights the selective prioritization of health indicators, raising concerns about the effectiveness of VNRs as an accountability mechanism for SDG governance.

(Chisika & Yeom, 2024) examined VNRs of East African countries to assess their SDG implementation progress. Using a literature review and content analysis, the study reviewed VNRs from Kenya, Uganda, Tanzania, Rwanda, Burundi, and South Sudan, highlighting their achievements, challenges, and best practices. Findings indicate significant progress in poverty reduction, access to basic services, environmental conservation, economic growth, and gender equality. However, challenges such as governance limitations, data availability, and financial constraints persist. The study recommends increasing awareness, enhancing technical capacity,

leveraging technology, fostering transparency, and improving stakeholder collaboration to support sustainable development efforts in East Africa.

While previous research has examined SDG implementation across regions such as the Philippines, Europe, East Africa, and the G20, limited attention has been given to a comprehensive cross-country comparison of SDG strategies, particularly in the Middle East and North Africa (MENA) region. While studies have analyzed VNRs from different regions, gaps remain in understanding how Egypt's SDG implementation compares with other countries. A comparative study that examines Egypt's SDG progress alongside similar economies in Africa, Asia, and Europe would provide valuable insights into policy effectiveness, and thematic priorities.

From a methodological perspective, while different traditional approaches have been applied to VNRs, their focus has largely been on identifying frequently mentioned SDGs rather than uncovering deeper thematic structures and interlinkages. Studies employing topic modeling are rarely conducted. The integration of advanced methods, such as network analysis, text mining and topic modeling methods, remains an underexplored area. Applying these techniques to Egypt's VNR and comparing its SDG priorities with other countries would enhance understanding of policy coherence, gaps, and strategic opportunities in sustainable development implementation.

The Proposed Methodology for Analyzing VNRs

VNRs serve as key tools for assessing national progress toward the SDGs. These reports provide insights into policy priorities, implementation challenges, and thematic emphases across countries. This study employs network analysis and topic modeling through text mining to systematically analyze VNRs (Ma, Du, Liang, & Guan, 2023; Rabie, 2025). The methods presented in this section were derived using two complementary techniques: word co-occurrence network analysis and topic modeling. These methods were applied to the VNR reports of Egypt and other selected countries to uncover thematic priorities, interconnections, and collaborative frameworks that define their approaches to achieving the SDGs.

Word co-occurrence network analysis is a text mining technique that identifies relationships between words based on their frequency of appearing together in the text (Ma et al., 2023). This method was used to construct networks where nodes represent words and edges represent co-occurrence relationships (Ma et al., 2023). The process began with text preprocessing, which involved cleaning the VNR reports by removing stopwords, punctuation, and irrelevant terms. The text was then tokenized into individual words, and word pairs that co-occur within the text were identified. A co-occurrence matrix was created to quantify the frequency of word pairs, which was subsequently used to construct a network graph.

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Topic modeling, specifically using the Latent Dirichlet Allocation (LDA) algorithm, was employed to identify latent themes or topics within the VNR reports (Laureate, Buntine, & Linger, 2023; Rabie, 2025; Takizawa, 2023). This unsupervised machine learning technique assumes that each document is a mixture of topics, and each topic is a distribution of words. The process began with text preprocessing, similar to the word co-occurrence analysis, to remove noise and standardize terms. The LDA model was then trained on the preprocessed text, with the number of topics determined using coherence scores and domain expertise. The model identified topics by grouping words that frequently appear together, providing broader thematic insights. Topic modeling offers a holistic understanding of the text's overarching priorities, complementing the granular insights provided by word co-occurrence networks. Together, these methods ensure a comprehensive analysis of the VNRs, capturing both specific terminologies and broader thematic priorities.

Results and Discussion

This study applies social network analysis - Appendix A provides the co-occurrence word network- and topic modeling to Egypt's Voluntary National Review (VNR) alongside those of selected countries to uncover thematic priorities, interconnections, and collaborative frameworks in SDG implementation.

Egypt Vs. Gulf and Middle Eastern Countries
Network Analysis Results
Egypt: The word co-occurrence network of Egypt's VNR highlights "government" and "ministry" as the most central terms, indicating a strong institutional and policy-driven approach to SDG implementation. Other key terms such as "support", "policy", "economic", and "development" reflect a focus on governance, resource allocation, and economic progress.

Saudi Arabia: The word co-occurrence network of Saudi Arabia's VNR highlights "vision" and "kingdom" as the most central terms, reflecting the country's strategic framework, likely linked to Vision 2030. Other key terms such as "government", "policy", "ministry", and "support" indicate a strong institutional role in SDG implementation.

Kuwait: The word co-occurrence network of Kuwait's VNR highlights "state" and "public" as central terms, indicating a strong role of government institutions in SDG implementation. Other key words such as "economic", "government", "policy", and "support" suggest a focus on economic development and governance.

United Arab Emirates: The word co-occurrence network of the UAE's VNR highlights "technology" and "enhance" as central terms, reflecting a strong emphasis on innovation-driven development. Key terms such as "economic", "government", "global", and "policy" suggest a strategic and governance-focused approach to SDG implementation.

Bahrain: The word co-occurrence network of Bahrain's VNR highlights "progress" as a central term, indicating a strong emphasis on measurable SDG advancements. Other key terms such as "government", "policy", "strategy", "economic", and "development" suggest a well-structured approach to sustainability.

Qatar: The word co-occurrence network of Qatar's VNR highlights "state" and "level" as central terms, and the presence of "government", "national", "economic" and "strategy" suggests a strong institutional framework for SDG progress.

Jordan: Jordan's word co-occurrence network places "government" and "implementation" at the core, indicating a structured and policy-driven approach to SDG progress. The presence of "development", "plan", "strategy", policy, and "framework" suggests a comprehensive governance model integrating sustainability goals.

Topic Modeling Results:
Table 1 presents the top three modeling topics of VNRs of Gulf and Middle Eastern countries.
Egypt: Egypt's focus areas include three main themes. The first revolves around SDGs, particularly in education, health, and population-related issues, with an emphasis on improving indicators for children and women. The second theme addresses sustainability projects, including climate change, water management, and energy strategies. The third focuses on poverty reduction and economic growth.

Qatar: Qatar's priorities are structured around three key areas. The first is health and public services, with a strong emphasis on healthcare access and labor rights. The second focuses on sustainability, particularly in water, food, and energy systems. The third theme highlights social development and environmental challenges, including reducing carbon emissions and addressing disabilities.

Saudi Arabia: The first is water, energy, and education, with significant investments and strategic targets aimed at achieving sustainable development. The second theme focuses on waste management, environmental, food and health, particularly in cities. The third area highlights SDGs, economic development, and improving social and economic outcomes.

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Kuwait: The first is water, education and energy management, with initiatives aimed at improving regulatory frameworks. The second area emphasizes health and social systems. The third theme is policy development and international cooperation, particularly in environmental sustainability and achieving global development targets.

UAE: The first is health and food security, with initiatives to improve access to public services and ensure food availability. The second area is sustainability, with a strong focus on energy, climate change, and education as part of strategies. The third theme highlights youth development and private sector innovation, aiming to create employment opportunities and drive economic growth.

Bahrain: The first is education and social programs, aimed at improving social and economic outcomes. The second area is economic diversification and energy sector development, with a focus on strengthening the labor market. The third theme emphasizes water and agricultural development, with targeted efforts to enhance resource management.

Jordan: The first is education and population, with an emphasis on school enrollment, student populations, and demographic indicators. This reflects Jordan's commitment to improving educational outcomes and addressing population challenges. The second theme is sectoral development and resource management, focusing on water, energy, and health. The third area highlights SDG implementation and strategic planning, and emphasizes goal achievement.

Table 1: Top Three Topics modeling Analysis of Gulf and Middle Eastern Countries' VNRs

Country	Topic	Top Keywords
Egypt	1	SDG, Education, Rate, Health, Indicator, Sustainable, Child, Woman, Population, Global
	2	Sustainable, Strategy, Project, Water, Climate, Change, Area, Energy, SDGS, New
	3	Poverty, Project, Increase, Rate, SDGS, Growth, Total, Water, Reform, Indicator
Qatar	1	health, population, total, worker, service, public, rate, right, increase, reduce
	2	strategy, water, food, production, social, voluntary, second, energy, system, use
	3	disability, gas, social, develop, world, international, emission, people, change, million
KSA	1	total, water, number, education, billion, sar, target, million, energy, annual
	2	waste, management, food, area, health, city, center, reduce, environmental, marine
	3	sdgs, key, develop, datum, energy, vision, social, effort, economic
Kuwait	1	water, energy, figure, sdg, target, source, increase, education, percent, law
	2	health, sdg, social, cent, system, csb, service, policy, authority, economic
	3	sdg, policy, environment, plan, social, international, vnr, csb, economic, target
UAE	1	indicator, health, target, people, food, ministry, service, excellence, access, population
	2	energy, water, climate, education, change, dubai, strategy, ministry, environment, uaes
	3	sdgs, sdg, datum, youth, initiative, uaes, agenda, excellence, private, work
Bahrain	1	goal, education, review, program, service, social, economic, health, achieve, sector
	2	economic, sector, energy, review, achieve, voluntary, market, labour, project, program
	3	water, sector, woman, increase, agricultural, review, area, achieve, resource, international
Jordan	1	education, proportion, actual, percentage, indicator, rate, number, school, population, student
	2	sector, work, water, energy, service, sdg, strategy, health, project, develop
	3	Sdgs, agenda, indicator, sector, sdg, work, achieve, goal, strategy, right

1.1. Selected African Countries

Network Analysis Results

- **Tunisia**: Tunisia's word co-occurrence network highlights **population** as a central node, indicating a strong emphasis on demographic aspects in sustainable development efforts. The presence of **government, implementation, plan, program, framework,** and **strategy** suggests a structured governance approach toward sustainability.

- **Morocco**: Morocco's word co-occurrence network highlights **Moroccan** as the most central term, indicating a strong national identity in discussions of sustainable development. The presence of **policy, implementation, strategy, framework,** and **management** suggests structured governance and planning for sustainability.

- **Zimbabwe**: Zimbabwe's word co-occurrence network highlights **sustainable, progress, key,** and **source** as central terms, indicating a focus on sustainability and resource management. The presence of **policy, strategy, framework, government,** and **implementation** suggests structured governance and policy-driven approaches.
- **Ghana**: Ghana's word co-occurrence network emphasizes policy as a central concept, indicating its critical role in shaping sustainable development efforts. The presence of government, implementation, plan, programme, and report suggests a structured governance and monitoring approach.
- **Zambia**: Zambia's word co-occurrence network emphasizes **goal** as the most central term, suggesting a strong focus on achieving specific sustainability objectives. The presence of **policy, implementation, plan, review,** and **government** indicates structured governance and strategic planning in sustainable development.
- **Ethiopia**: Ethiopia's word co-occurrence network highlights agriculture and high as key terms, suggesting a focus on food security and economic performance. The presence of policy, strategy, plan, government, institution, and implementation indicates structured governance and institutional involvement in sustainable development.
- **Eritrea**: Eritrea's word co-occurrence network highlights sustainable, progress, support, promote, and increase as central terms, reflecting a focus on sustainability and development efforts. The presence of policy, framework, government, ministry, and program suggests institutional involvement in development strategies.
- **Seychelles**: Seychelles' word co-occurrence network emphasizes sustainable development, policy, government, and economy, highlighting a focus on governance, sustainability, and economic growth. Words like framework, strategy, goal, plan, and implementation suggest a structured approach to national progress.
- **Mauritius**: Mauritius' word co-occurrence network highlights development, sustainable, government, public, and policy as central terms, indicating a strong focus on governance and sustainability. Words like economic, financial, resource, opportunity, and sector emphasize economic growth and financial planning.
- **South Africa**: South Africa's word co-occurrence network highlights government, policy, development, economic, and public, suggesting a strong focus on governance, policy-making, and economic growth. The presence of Africa, African, South, and world indicates both local and global engagement.
- **Kenya**: Kenya's word co-occurrence network emphasizes government, policy, development, sector, and goal, indicating a strong focus on governance, policy implementation, and national

development objectives. The presence of Kenya, country, and public suggests discussions on national and public interests.

- **Angola**: Angola's word co-occurrence network highlights government, policy, development, sector, and program, reflecting a structured focus on governance and policy-driven development. The presence of Angola, country, and public indicates a national perspective on socio-economic issues.

Topic Modeling Results

Table 2 presents the top three modeling topics of VNRs of the African countries.

Tunisia's focus areas include three main themes. The first is **health**, **education**, and **poverty**, with programs aimed at improving family welfare. The second area is **SDGs** and **resource** management, focusing on **water** and **system** improvements. The third theme is **women's** rights and sustainable **energy**, reflecting its commitment to gender equality and environmental sustainability.

Morocco: The first is women's rights and climate action. The second area is education and urban-rural development. The third focus is on energy and economic development, with efforts to improve energy access and ensure sustainable economic progress.

Zimbabwe: The first is gender equality and social development, with an emphasis on women, children, health, education, and food access. The second is around the implementation of SDGs, with a focus on economic and social progress, and climate action. The third area highlights partnerships and public projects, emphasizing collaboration with stakeholders to support SDG implementation and national strategies.

Ghana: The first is population and resource management, focusing on access to water, health, and education, particularly for children. The second area is SDG implementation, with efforts to engage private and social sectors. The third focus is on youth, climate, education, and environmental challenges.

Zambia: The first is primary and secondary education, with a focus on improving school enrollment rates, particularly for girls and women. The second area is climate change and energy, emphasizing local policies. The third focus is on health and water access, with efforts to improve service and align with SDGs.

Ethiopia: The first is health, education, and rural development, with programs targeting women, children, and water access. The second area is SDG implementation and poverty reduction, supported by stakeholder engagement and performance reviews. The third theme is progress monitoring and risk management, with a focus on domestic planning and conflict resolution.

Eritrea: The first is health and population, with a focus on improving access to services for women. The second area is education and gender equality, emphasizing literacy, school enrollment, and women's rights. The third focus is on water management and SDG progress.

Seychelles: The first is climate change and ocean protection. The second area is public health, water and education, supported by investments in infrastructure and private partnerships. The third focus is on economic development and poverty reduction, with programs targeting employment and economic rights.

Mauritius: The first is education and data tracking, with programs aimed at achieving development goals and increasing access to services. The second area is health and social development, with a focus on poverty reduction and SDG implementation. The third focus is on water and climate management, emphasizing sustainable energy use and project planning.

South Africa: The first is **water**, **energy**, and **poverty** reduction, with efforts to improve **access** to **services** and address **income** inequality. The second area is gender equality and **education**, focusing on **women's** rights, **violence** prevention, and **school systems**. The third focus is on **SDG implementation**, with strategies to improve **resource access**, economic **growth**, and **national development plans**.

Kenya: The first is population and social indicators, with efforts to improve access to services for women. The second area is health and education, emphasizing primary education, water access, and population health. The third focus is on SDG implementation, with stakeholder engagement, economic planning, and progress reviews.

Angola: The first is education, climate strategies and data management, with a focus on improving administrative systems and addressing climate-related challenges. The second area is health and efforts to improve access to education and child health services, particularly in Luanda. The third focus is on water, energy, and economic progress, with programs aimed at sectoral development and SDG alignment.

Table 2: Top Three Topics modeling Analysis of the selected African Countries' VNRs

Country	Topic	Top Keywords
Tunisia	1	child, health, people, education, rate, program, family, report, woman, poverty
	2	sdgs, sdg, strategy, project, plan, ministry, local, resource, water, system
	3	woman, law, energy, water, program, health, rate, project, report, strategy
Morocco	1	woman, water, violence, climate, law, right, association, action, change, project
	2	rate, sector, education, support, health, urban, aim, rural, strategy, increase
	3	energy, strategy, sustainable, sector, service, household, proportion, economic, develop, rate
Zimbabwe	1	woman, cent, gender, child, access, health, increase, food, education, source
	2	sdgs, implementation, sdg, economic, review, vnr, voluntary, second, social, climate
	3	sdgs, implementation, review, vnr, support, provide, partner, nds, project, public
Ghana	1	percent, figure, proportion, increase, population, child, water, access, indicator, area
	2	sdgs, agenda, implementation, ghanas, support, private, social, datum, provide, group
	3	youth, education, percent, climate, region, child, people, action, change, high
Zambia	1	school, percent, education, girl, primary, woman, child, rate, proportion, secondary
	2	percent, climate, change, local, policy, energy, forest, service, capacity, sdgs
	3	percent, sdgs, health, figure, sdg, service, water, access, child, area
Ethiopia	1	woman, health, percent, education, water, program, rural, child, rate, number
	2	sdgs, gtp, report, review, poverty, growth, stakeholder, performance, system, goal
	3	progress, program, management, sdgs, vnr, risk, domestic, conflict, goal, planning
Eritrea	1	percent, health, woman, water, population, access, increase, rate, service, report
	2	education, percent, school, increase, literacy, child, woman, enrolment, right, gender
	3	water, review, agenda, countrys, sdgs, progress, management, area, report, vnr
Seychelles	1	energy, climate, change, project, protect, ocean, area, proportion, access, international
	2	water, cent, education, project, public, health, investment, increase, need, private
	3	sdgs, figure, poverty, economic, right, programme, employment, agenda, economy, department
Mauritius	1	indicator, track, education, achieve, programme, available, increase, new, act, datum
	2	health, sdg, education, social, sdgs, ministry, service, country, implementation, poverty
	3	water, project, climate, management, energy, change, sdg, use, area, plan
South Africa	1	water, energy, poverty, service, access, income, high, social, poor, system
	2	woman, education, plan, act, system, framework, school, violence, training, change
	3	sdgs, improve, sdg, access, growth, resource, level, implementation, ndp, system
Kenya	1	cent, proportion, indicator, increase, total, act, number, woman, age, population
	2	health, cent, water, education, increase, indicator, primary, population, total, rate
	3	sdgs, report, agenda, stakeholder, review, plan, economic, programme, datum, support
Angola	1	education, source, datum, administrative, data, age, late, baseline, climate, strategy
	2	health, develop, luanda, include, education, increase, management, child, conservation, access
	3	program, water, sector, energy, economic, social, tion, sdgs, production, progress

Selected Countries Worldwide

Network Analysis Results

▪ **Germany:** Germany's word co-occurrence network emphasizes government, development, policy, strategy, and framework, highlighting a strong focus on governance and structured planning. The presence of global, international, and partnership indicates Germany's involvement in global sustainability efforts.

▪ **Sweden:** Sweden's word co-occurrence network highlights government, policy, agenda, development, and sector, emphasizing structured governance and strategic planning. The presence of global, international, cooperation, and initiative suggests Sweden's active participation in international sustainability efforts.

▪ **Japan:** The word co-occurrence network of Japan's VNR highlights key themes, with country, organization, and development exhibiting the highest centrality, emphasizing national efforts, institutional engagement, and development strategies. Terms like policy, support, cooperation, government, and measure indicate a governance-focused approach, while sustainable, environment, and social reflect thematic priorities in sustainability and social inclusion.

▪ **Sri Lanka:** Sri Lanka's word co-occurrence network emphasizes development, government, policy, and sustainability, indicating a focus on structured governance and sustainable progress. The presence of economic, resource, programme, sector, and public suggests attention to economic growth and resource allocation.

▪ **India:** India's word co-occurrence network emphasizes governance, social inclusion, and sustainability. Key terms such as government, policy, national, and state highlight a strong governmental role in shaping sustainability efforts. The presence of social, health, education, and development suggests a focus on improving social well-being.

▪ **Philippines:** The Philippines' word co-occurrence network highlights key themes related to governance, economic development, and social sustainability. Prominent terms such as government, policy, national, and organization emphasize the role of institutions in shaping sustainability strategies. The presence of economic, system, business, and framework suggest a focus on economic planning and structural development.

Topic Modeling Results

Table 3 presents the top three modeling topics of VNRs of the selected Worldwide countries.

▪ **Germany:** The first is climate, women and resource management, with an emphasis on water, energy, and partnerships to address climate change and achieve sustainability targets. The second theme is sustainability agenda and implementation, focusing on SDG indicators, social

sustainability, and progress reviews. The third area is education, health, and human rights, highlighting cooperation, health systems, and promoting human security.

- **Sweden:** The first is climate and business collaboration, with an emphasis on climate action, business-sector cooperation, and research. The second theme is health and SDG implementation, focusing on public health, child welfare, and SDGs objectives. The third area is gender equality and youth development, highlighting children and women's rights, youth empowerment, and education.

- **Japan:** The first is data-driven development, with an emphasis on indicators, targets, and population-related metrics. The second theme is local and business engagement in SDGs, focusing on efforts to achieve goals through local initiatives and business partnerships. The third area is health and disaster management, highlighting child welfare, resource management, and disaster management.

- **Sri Lanka:** The first is sustainable development and resource management, with an emphasis on water, energy, and provincial-level initiatives. The second theme is education and health access, focusing on school enrollment, health services, and data-driven needs assessments. The third area is economic growth and exports, highlighting land use, economic resources.

- **India:** The first is education and social development, with an emphasis on access to education, women's empowerment, and water challenges. The second theme is energy and service provision, focusing on growth, and children. The third area is SDG implementation and local development, highlighting frameworks, local processes, and global agendas.

- **Philippines:** The first is SDG progress and stakeholder engagement, with an emphasis on reviews, targets, and sustainable development. The second theme is education and climate, focusing on school access, sectoral growth, and risk management. The third area is health and pandemic response, highlighting COVID-19 projects, partnerships, and public health initiatives.

Table 3: Top Three Topics modeling Analysis of selected Worldwide Countries VNRs

Country	#	Top Keywords
Germany	1	climate, water, woman, area, change, energy, target, resource, partnership, programme
	2	energy, agenda, sustainability, indicator, sdgs, social, implementation, review, report, climate
	3	education, health, cooperation, people, right, system, partner, promote, security, need
Sweden	1	agenda, goal, climate, country, implementation, company, business, sector, cooperation, research
	2	agenda, health, agency, sdgs, public, sdg, report, implementation, child, objective
	3	young, woman, child, health, gender, right, education, cent, target, man
Japan	1	indicator, number, target, definition, total, proportion, age, population, food, value
	2	sdgs, local, society, work, effort, achieve, business, goal, company, promotion
	3	sdgs, effort, society, health, order, child, system, resource, addition, disaster
Sri Lanka	1	sustainable, ministry, sdgs, department, sdg, provincial, goal, water, energy, management
	2	sdg, education, target, second, datum, need, school, access, health, level
	3	target, second, export, economic, include, available, growth, land, increase, source
India	1	cent, education, access, woman, child, challenge, million, area, water, improve
	2	cent, million, energy, provide, service, child, woman, growth, access, mission
	3	agenda, develop, framework, process, local, implementation, niti, aayog, global, sector
Philippines	1	sdgs, sdg, retrieve, sustainable, progress, vnr, stakeholder, department, target, review
	2	percent, education, sector, rate, provide, climate, school, increase, sustainable, risk
	3	covid, health, retrieve, project, percent, provide, act, partnership, oda, pandemic

2. Conclusion

This study employs network analysis and topic modeling to examine Egypt's Voluntary National Reviews (VNRs) in comparison with of a diverse set of countries - including Gulf and Middle Eastern nations, African countries, and selected worldwide countries - to uncover the distinct thematic priorities shaping each country's approach to achieving the Sustainable Development Goals (SDGs). This comprehensive analysis uncovers patterns in how Egypt and other countries approach sustainable development, integrating key findings to position Egypt's strategy relative to its regional and international counterpart.

2.1. Egypt Compared to Gulf and Middle Eastern Countries

Egypt's VNR consistently emphasizes a strong, government-led, and policy-driven framework, reflected in the prominence of terms like "government" and "ministry" in its network analysis. While Egypt shares certain institutional emphases with its regional neighbors, it exhibits a more diverse thematic focus than many Gulf countries. Countries like Saudi Arabia and the UAE

emphasize national visions and technological innovation, whereas Egypt balances institutional frameworks with concrete social development priorities.

Topic modeling further highlights Egypt's balanced approach across social, economic, and environmental dimensions of sustainable development. Unlike the Gulf states' emphasis on economic diversification and resource management, Egypt prioritizes poverty reduction programs and human development indicators, particularly those related to children and women.

2.2. Egypt Compared to Selected African Countries

Compared to African countries, Egypt's approach is more institutionally structured and governance-focused. While Ethiopia prioritizes agriculture and South Africa emphasizes resource access, Egypt maintains a stronger ministerial and governmental framework for SDG implementation. Among African countries such as Tunisia, Morocco, and Kenya, Egypt shares a common emphasis on governance, policy implementation, and resource management. However, its thematic priorities -such as education, health, and sustainability projects- align more closely with North African countries like Tunisia and Morocco, which also highlight demographic challenges and gender equality. In contrast, Sub-Saharan African countries, including Ethiopia and Zambia, focus more on agriculture, climate change, and local policy implementation, reflecting their distinct socio-economic contexts

Topic modeling results reveal that Egypt places less emphasis on gender equality and climate action compared to Morocco, Tunisia, and South Africa. Instead, it focuses more on broad-based poverty reduction and economic reforms. This contrasts with the more specific sectoral priorities seen in countries like Kenya (population indicators) and Angola (data management).

2.3. Egypt Compared to Selected Worldwide Countries

When compared to Worldwide countries in sustainable development like Germany, Sweden, and Japan, Egypt demonstrates a less integrated approach to SDG implementation. Advanced economies balance local and global initiatives, emphasizing global partnerships, climate action, and business sector engagement.
Topic modeling reveals that while countries like Germany and Japan prioritize data-driven approaches and local-global coordination strategies, Egypt focuses more on local-based frameworks. Countries like the Philippines and Sweden focus on stakeholder partnerships, while Egypt focuses on ministerial coordination.

Egypt's VNR reflects a more localized focus on governance and economic development, whereas global counterparts emphasize international cooperation, climate resilience, and data-driven strategies. For instance:

Germany and Sweden prioritize global partnerships and climate resilience.

Japan emphasizes disaster management and business sector engagement.

India and the Philippines share some thematic similarities with Egypt in governance, education, and sustainability but also highlight social inclusion and pandemic response.

2.4. Key Findings

This study examines how Egypt's SDG implementation compares to other countries by analyzing Voluntary National Reviews (VNRs) using text mining and network analysis. By mapping key priorities and governance approaches, the findings highlight Egypt's alignment and divergence with regional and global countries. Additionally, the study demonstrates how advanced analytical methods can uncover hidden themes and interconnections, providing deeper insights into national and regional SDG strategies.

Regional and Global SDG Priorities

- Egypt aligns with Tunisia, Morocco, and Gulf states in governance priorities but differs by emphasizing poverty reduction, education, and sustainability over economic diversification and technology.
- Compared to Sub-Saharan Africa, Egypt focuses less on agriculture and climate resilience, prioritizing institutional frameworks and infrastructure-driven development.
- Unlike Germany, Sweden, and Japan, which emphasize global cooperation and private sector engagement, Egypt relies more on centralized, government-led strategies.

1. **Methodological Contributions**

- Network analysis and topic modeling reveal hidden themes and interconnections in VNRs, enhancing the understanding of national and regional SDG strategies.
- These methods offer a novel approach to identifying key patterns and relationships in SDG implementation across different countries.

Acknowledgment

References

- Bickler, G., Morton, S., & Menne, B. (2020). Health and sustainable development: an analysis of 20 European voluntary national reviews. *Public health, 180*, 180-184.
- Chisika, S. N., & Yeom, C. (2024). Voluntary national reviews on implementation of sustainable development goals: key lessons from East African Member States. *Sage Open, 14*(2), 21582440241257319.
- Elder, M., & Newman, E. (2023). Monitoring G20 Countries' SDG Implementation Policies and Budgets Reported in Their Voluntary National Reviews (VNRs). *Sustainability, 15*(22), 15733.
- Kandpal, R., & Okitasari, M. (2022). Advancing follow-up and review for the SDGs: Lessons from the 2021 voluntary national reviews.
- Laureate, C. D. P., Buntine, W., & Linger, H. (2023). A systematic review of the use of topic models for short text social media analysis. *Artificial Intelligence Review*, 1-33.
- Ma, C., Du, J., Liang, M., & Guan, Z. (2023). *Topic model based on co-occurrence word networks for unbalanced short text datasets.* Paper presented at the 2023 5th International Conference on Data-driven Optimization of Complex Systems (DOCS).
- Martins, A. L. J., & Paes-Sousa, R. (2024). The paradox of growing technical capacities with low global governance: a review of Voluntary National Reviews' SDG health-related indicators. *Globalization and Health, 20*(1), 50.
- Rabie, H. (2025). Exploring the Interlinkages Between Education and Sustainable Development Goals--An Advanced Text Mining and Network Analysis Approach. *Egyptian Review of Development and Planning, 33*(1), 273-297.
- Reyes, C. M., Albert, J. R. G., Tabuga, A. D., Arboneda, A. A., Vizmanos, J. F. V., & Cabaero, C. C. (2019). *The Philippines' voluntary national review on the sustainable development goals*. Retrieved from
- Sebestyén, V., Domokos, E., & Abonyi, J. (2020). Focal points for sustainable development strategies—Text mining-based comparative analysis of voluntary national reviews. *Journal of Environmental Management, 263*, 110414.
- Takizawa, P. A. (2023). Using a topic model to map and analyze a large curriculum. *Plos one, 18*(4), e0284513.

Appendix A

Egypt	KSA
Kuwait	UAE
Bahrain	Qatar

Jordan

Tunisia

Morocco

Zimbabwe

Ghana	Zambia
Ethiopia	Eritrea
Seychelles	Mauritius

South Africa

Kenya

Angola

Germany

Sweden	Japan
Cambodia	Sri Lanka
Australia	India

Simplified Word Co-occurrence Network (Top 50 Words)

Simplified Word Co-occurrence Network (Top 50 Words)

Philippines	

Simplified Word Co-occurrence Network (Top 50 Words)