

Research Paper for the "Helios" Competition

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Title

Optimizing the Utilization of Non-Oil
Resources in the Caspian Sea: Combination of
Blue Economy and Green Technologies for
Sustainable Development

JULY 2023

Problem of Statement

Azerbaijan faces a number of problems related to its high dependence on oil reserves and limited diversification. An oil-dependent economy is vulnerable to fluctuations in global oil prices, making it imperative to explore alternative non-oil resources for sustainable economic growth. Additionally, the environmental impacts associated with oil production, such as water pollution and ecosystem degradation, necessitate the adoption of green technologies and a shift to a more sustainable path. As we know, the Caspian Sea is mainly known for oil and gas production, processing and export. The economic efficiency of Caspian bioresources has not been studied in detail, especially in the context of sustainable agriculture of these resources. Effective use of bioresources of the Caspian Sea, marine ecosystem protection, biodiversity protection, bioenergy production, economic cooperation with the Caspian countries, and analyzes that will stimulate the development of sustainable agriculture in Azerbaijan have not been carried out much. The study of international experience in this field will bring forward innovative approaches and recommendations for the implementation of new standards of environmental policy and consumption. Azerbaijan's environmental policy demonstrates the country's commitment to protecting the ecosystem of the Caspian Sea and promoting sustainable development.

Introduction

The Caspian Sea, the largest inland body of water in the world, possesses significant non-oil resources that hold immense potential for sustainable development. The Caspian Sea region is renowned for its vast reserves of oil and gas, which have historically played a significant role in the economic development of countries in the region. However, the increasing global focus on sustainable development and the urgent need to reduce dependence on fossil fuels have prompted a reevaluation of non-oil resources in the Caspian Sea (Jones et al., 2019). Azerbaijan, as a prominent Caspian Sea littoral state, has recognized the importance of these resources and has implemented an ecological policy aimed at preserving the Caspian Sea's delicate ecosystem. As a signatory to the Convention, Azerbaijan has undertaken to maintain the ecological balance of the Caspian Sea and promote sustainable development in the region. The country has implemented various ecological policies and initiatives to promote environmental conservation, such as the establishment of protected areas, the introduction of eco-certification schemes, and the development of renewable energy sources. This research aims to explore the non-oil resources of the Caspian Sea and the ecological policy of Azerbaijan in the context of the World Economic Forum, while proposing the integration of the blue economy and green technologies for sustainable development. The blue economy, a concept championed by the World Economic Forum, emphasizes the sustainable use of ocean and coastal resources to foster economic growth, while simultaneously promoting environmental sustainability and social inclusivity. Applying this approach to the Caspian Sea entails leveraging its abundant non-oil resources, such as fisheries, aquaculture, maritime transport, renewable energy, and tourism (World Economic Forum, 2020).

Literature Review

The Caspian Sea is rich in diverse non-oil resources, including fisheries, mineral deposits, seaweed reserves, tourism resources, and renewable energy potential. It is estimated that the Caspian Sea holds approximately 90% of the world's caviar-producing sturgeons, making it a significant source of revenue for littoral states (Yamani, 2021). Adopting sustainable fisheries management practices, including quotas, improved monitoring, and the promotion of responsible fishing techniques, can help restore fish stocks and support the long-term viability of the fishing industry. Additionally, the sea's abundant mineral deposits, such as iron ore and limestone, offer prospects for economic growth and industrial development (Novruzlu, 2020). Moreover, the Caspian Sea's vast potential for renewable energy generation, particularly through wind and solar power, presents opportunities for sustainable energy production (Aliyev et al., 2021). Azerbaijan has prioritized the conservation and sustainable use of the Caspian Sea's natural resources through its ecological policy. The country has implemented various initiatives to address environmental concerns, including the reduction of pollution, the protection of marine ecosystems, and the promotion of sustainable fishing practices. Azerbaijan has also actively engaged in regional and international collaborations, such as the Convention on the Protection of the Marine Environment of the Caspian Sea, to enhance environmental governance in the Caspian region (MEPC, 2019). The country has invested in wind and solar energy projects, aiming to reduce greenhouse gas emissions and diversify its energy mix (World Economic Forum, 2020). The transition to renewable energy sources aligns with the World Economic Forum's goals of achieving sustainable energy and mitigating climate change impacts.

Another non-oil resource of the Caspian Sea is seaweed, which offers many ecological, economic and social benefits. It has gained significant attention globally for its potential in sustainable agriculture, biofuels, pharmaceuticals and bioremediation (Nayar, S., et al., 2021). Bioenergy production based on seaweed has several attractive advantages. With increasing global energy demand and concerns about fuel depletion, seaweed can serve as a renewable energy source. In addition, seaweed-based bioenergy provides environmental and climate benefits. Seaweed bioenergy production has a significantly lower carbon footprint than fossil fuel extraction and combustion. The development of the seaweed bioenergy industry can stimulate job creation, particularly in coastal communities. In addition, the production of value-added products from seaweed, such as biofertilizers and bioplastics, can diversify revenue streams and drive innovation in the green economy (UNEP,2023; Kumar et al., 2019). Research by Abdullayev et al. (2021) discusses the application of green technologies for sustainable aquaculture development in the Caspian Sea, highlighting the importance of eco-friendly practices to minimize environmental degradation.

The Caspian Sea faces substantial pollution challenges resulting from industrial activities, agricultural runoff, and rapid urban development along its shores. These activities introduce harmful substances and pollutants into the water, affecting its quality and posing risks to marine life and ecosystems. Industrial discharges, such as oil and chemical spills, can have devastating consequences on the Caspian Sea's

delicate ecosystem and contribute to the degradation of its habitats. The Caspian Sea has a potential for Recreational Activities, Beach, Coastal and Cruise tourism perspectives. The Caspian Sea provides opportunities for various water-based activities such as fishing, boating, and water sports. The Caspian Sea's geographical location makes it an ideal route for cruise tourism connecting Europe and Asia. Promoting cruise tourism along the Caspian Sea can enhance regional connectivity and attract international visitors (Smith, J, 2018). Additionally, the Caspian Sea serves as a vital stopover for migratory bird species during their long-distance journeys. These avian visitors contribute to the unique ecological tapestry of the region. The degradation of their habitats due to pollution and urbanization can disrupt their migration patterns and reduce their numbers. Protecting these habitats through the establishment of protected areas and promoting bird-friendly tourism practices can enhance the tourism potential of the Caspian Sea while safeguarding its biodiversity (Caucasus Biodiversity Council, 2012).

Table 1: Overview of various non-oil resources of the Caspian Sea

Non-Oil Resources	Description
Fisheries	The Caspian Sea is known for its diverse fish species, including sturgeon, carp, trout, herring, and others.
Mineral Resources	The region has deposits of natural gas, sulfur, limestone, clay, sand, gravel, and other minerals.
Renewable Energy	The Caspian Sea holds potential for renewable energy generation, particularly through offshore wind farms.
Biodiversity	The sea supports a rich biodiversity, with numerous fish species, mollusks, crustaceans, and seabirds.
Ecosystems	The Caspian Sea ecosystems include wetlands, coastal zones, and unique habitats supporting various species.
Seaweed	Seaweed, also known as macroalgae, is a valuable resource for various applications such as food, agriculture, biofuel production.
Shipping and Trade	The sea serves as a vital transportation route, facilitating trade and connecting landlocked countries.
Tourism	The natural beauty of the Caspian Sea attracts tourists, offering opportunities for coastal, beach, marine and cruise tourism.

Resource: Own Compilation

Conclusion

Efficient and sustainable use of the resources of the Caspian Sea can improve the social welfare of all countries and peoples located around it. Of course, oil and gas are necessary for our economic development, but a healthy environment is also important for those living on the shores of the Caspian Sea. This can only be done by balancing the environment and the economy. The balance itself usually occurs with sustainable development approaches. Initiatives such as the "State Program on Sustainable Development of the Regions of the Republic of Azerbaijan" and the "Green Energy Concept" demonstrate Azerbaijan's commitment to a sustainable future and provide a roadmap for Caspian Sea nations to follow.

Each border country causes the degradation of the ecological landscape of the Caspian Sea. For example, the construction of the Bautino oil terminal in Kazakhstan has led to the degradation of coastal habitats. Turkmenistan experiences significant coastal erosion along its Caspian Sea coast. The erosion is exacerbated by sea-level rise and changing wave patterns, resulting in the loss of valuable coastal habitats and threatening local communities. Oil pollution is a major ecological problem in the Iranian section of the Caspian Sea. Oil spills and leaks from offshore oil platforms and illegal dumping of petroleum-related waste contribute to contamination and affecting the overall ecosystem health. The Volga River, which flows from Russia into the northern Caspian Sea and The Sefid Rud (White River) flows into the southern Caspian Sea in Iran faces significant pollution challenges.

The Caspian Sea presents a multitude of non-oil resource potential that aligns with Azerbaijan's ecological policy and promotes sustainable development. By embracing unique ideas such as marine renewable energy, seagrass restoration, underwater archaeological research, blue carbon conservation, ecosystem-based fisheries management, desalination technology, and marine biotechnology, Azerbaijan can unlock economic opportunities while safeguarding the environment. These initiatives contribute to the preservation of the Caspian Sea's delicate ecosystems, support biodiversity conservation, and mitigate the impacts of climate change. They also create avenues for eco-tourism, scientific research, and technological innovation, fostering a green economy and promoting the well-being of coastal communities. By tapping into the non-oil resources potential of the Caspian Sea, Azerbaijan can diversify its economy, reduce dependence on fossil fuels, and establish itself as a leader in sustainable resource management. This approach not only enhances ecological resilience but also provides long-term benefits for future generations, ensuring the continued prosperity of both the country and the unique marine environment of the Caspian Sea.

Recommendations

Based on the research findings, the following recommendations are proposed:

- 1) Foster collaboration and knowledge sharing among Caspian Sea countries to develop a joint approach for sustainable resource utilization. Collaborate with other Caspian Sea littoral states, regional organizations, and international stakeholders to exchange best practices, share data, and promote joint initiatives for the sustainable use of Caspian Sea resources.
- 2) Invest in research and development to identify and harness the full potential of non-oil resources. Encourage research and innovation in the development of green technologies specific to the Caspian Sea region. This can involve collaboration between universities, research institutions, and industry stakeholders to identify and implement environmentally friendly practices.
- 3) Robust policies and regulations are necessary to guide the exploitation of non-oil resources in the Caspian Sea region. Governments should establish clear guidelines for fisheries management, mineral extraction, tourism development, seaweed cultivation, and renewable energy projects. These frameworks should incentivize sustainable practices, encourage innovation, and ensure compliance with

environmental standards.

- 4) Encourage public-private partnerships to drive innovation and investment in sustainable industries.
- 5) Raise awareness and educate the public about the importance of sustainable consumption patterns and the potential benefits of non-oil resources.
- 6) Strengthen monitoring and enforcement mechanisms: Enhance the monitoring and surveillance systems to combat illegal fishing activities and ensure compliance with fishing quotas and regulations.
- 7) By using the potential of seaweed resources in the Caspian Sea, Azerbaijan can reduce the environmental impact of oil production, provide alternative livelihoods and contribute to food security. In addition, green technologies offer innovative solutions to challenges in seaweed cultivation, processing and product development. The application of green technologies in the seaweed industry of Azerbaijan can increase productivity, reduce environmental impacts and create new business opportunities. By using seaweed-based bioenergy, Azerbaijan can contribute to climate change mitigation efforts and accomplish its obligations under international agreements such as the Paris Agreement.
- 8) International experiences in sustainable resource utilization and the integration of blue economy and green technologies can provide valuable insights for the Caspian Sea region. Examples of successful initiatives and projects from other countries, such as Norway, Canada, and Denmark, can be analysed to identify best practices and adapt them to the Caspian Sea context. These experiences can inform policy decisions, technological investments, and capacity building efforts in the region.
- 9) Solar Energy: The Caspian Sea region experiences ample sunshine throughout the year, making it suitable for solar energy harnessing. Solar photovoltaic (PV) systems can be deployed in the surrounding coastal areas, deserts, and even on the water surface itself. Floating solar farms can be a particularly viable option, leveraging the vast expanse of the Caspian Sea to generate clean electricity. Such installations can maximize energy production while conserving valuable land resources.
- 10) Hydropower: Several rivers flow into the Caspian Sea, providing a potential source of hydropower generation. Constructing hydroelectric power plants on these rivers could harness the kinetic energy of water and convert it into electricity. The Volga River, in particular, represents a significant hydropower opportunity due to its large flow rate and the presence of multiple dams. Utilizing hydropower can help diversify the renewable energy portfolio in the Caspian Sea region.

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