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The Potential of the Blue Economy in Pakistan:

Prospects and Challenges

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Abstract

The economy plays a vital role in the progress and prosperity of any nation. Economic growth is essential for executing any human development initiative, including education, health, skill and capacity building, food security, trade, industry, environment, and climate protection or for undertaking measures to ensure internal security and external defense. Pakistan has been facing economic challenges recently, with shrinking exports and increasing imports further complicating our financial and economic woes. Due to heavy reliance on imports of raw materials and higher business costs, our conventional industries are facing a competitive disadvantage. Given these tough situations, Pakistan must explore other avenues for economic turnaround. One such avenue is the blue economy, which remains underutilized in Pakistan despite its massive potential. The country has immense blue reserves in the form of fisheries, seafood, aqua tourism, long pristine beaches, water sports and adventures avenues, captivating islands, renewable power generation potential, offshore oil and gas reserves, shipbreaking and recycling, three seaports with road networks to connect with different regions like Central Asia as well as world's two largest populations China and India. Besides the vast potential of economic dividends, the blue economy also has relevance due to growing concerns about the climate cost of brown growth. Blue growth is considered an effective model for sustainable growth. The UNO's Sustainable Development Goals (SDGs 2015) also underline the

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significance of oceanic reserves for development. SDG 14 is specifically about the sustainable use of blue reserves, while other SDGs, particularly 1, 7, 8, and 9, are also connected.

Keywords: *blue economy, exclusive economic zone, maritime affairs.*

1. Introduction

Our planet Earth is considered as a blue planet with two third earth is considered a blue planet, with two-thirds (71%) of its area covered by oceans. Besides, more than half (58%) of the world's population lives within one hundred kilometers of coasts, while twelve of fifteen metropolitan cities worldwide are coastal (Gill & Iqbal, 2021). The oceans are blessed with rich resources like fisheries, seafood, minerals, renewable power offshore energy reserves, etc.; they have a variety of tourism attractions in the shape of coastal activities, islands visit, water sports, etc.; they have huge trade volume due to high global connectivity that oceans offer and for being cheapest means of shipment. This large-scale dependence on seaborne trade is evident because about 90% of global trade is carried out through sea. According to WWF, oceans across the globe have assets worth 24 trillion USD, with an estimated annual increase of 2.5 trillion USD, making it the world's seventh-largest economy in terms of GDP. It is estimated that this economic frontier alone shall generate 40 million jobs, outnumbering all land-based sectors **(**Gill & Iqbal, 2021**).**

Historically, oceans have been considered as a means of trade shipments. Use of other blue resources was mainly limited to fisheries and seafood harvesting, and that too more for domestic consumption than for large-scale commercial purposes. The concept of use of marine assets for economic growth was first formally propounded by Gunter Pauli in 2010 and he coined the term "blue economy" for this sector. He expounded the concept in his famous book "The Blue Economy: 10 Years, 100 Innovations and 100 million Jobs." He advocated reliance on abundant ocean resources rather than declining brown or green economy reserves. The next milestone vis the use of oceanic resources for economic gains came in 2012 when the UN's Rio+20 Conference on Sustainable Development and Growth introduced the concept of wise and efficient management of resources of oceans since the livelihood of more than three billion people depends on marine and coastal biodiversity. The idea of use of resources presented in the blue world for growth gained more international relevance after the UN's 2015 SDGs declaration as SDG No 14 linked sustainable development with efficient management of maritime resources, underscoring its importance in attaining the 2030 sustainable development agenda. **(**Alam, 2019**).** This shows the growing significance of the blue economy worldwide and the necessity to tap this sector to gain economic growth and sustainable development.

Figure 1.
Blue Economy

Source: Gul and Shah (2021)

According to the World Bank, Blue Economy is the "sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of the ecosystem." The European Commission defined the blue economy as "All economic activities related to oceans, seas, and coasts. It covers a wide range of interlinked established and emerging sectors". The Center has given an all-encompassing definition for blue economy for the Blue Economy in these words: "It is now a widely used term around the world with three related but distinct meanings- the overall contribution of the oceans to economies, the need to address the environmental and ecological sustainability of the oceans, and the ocean economy as a growth opportunity for both developed and developing countries."(United Nations, 2017). The concept of blue economy and its constituent sectors has been simplified in the figure given below:

1.1. Statement of the Problem

The blue economy is an emerging revenue generation sector, fast becoming a significant contributor to the economic development of many countries. The importance and relevance of this sector can be gauged by the fact that the UN has linked the blue economy with the Sustainable Development Agenda. Pakistan, despite being an important member of the Indian Ocean Region in terms of its maritime zone share, has not benefited from this sector as much as some of our neighbors have already done. Pakistan's earnings from the blue economy are 1 billion USD compared to 7 billion USD of India and 6 billion USD of Bangladesh (Gill & Iqbal, 2021). Against this backdrop, the research paper explores opportunities and challenges in tapping Pakistan's maritime potential to its fullest for maximizing economic gains.

2. Review of the Literature:

The blue economy is a fast-growing sector, and most countries are tapping their blue potential for economic growth. The sector gained more attention after adopting the UN's SDGs in 2015 as the same specifically emphasized utilization of oceanic resources for development (Hussain, 2022). Pakistan affirmed its commitment to SDGs in 2016, but its development of a blue economy for growth is not encouraging, mainly due to management issues (Butt, Ayesha). Pakistan's blue economy potential is estimated to be 100 billion USD with sectors like fisheries, seafood, marine tourism, renewable energy, offshore oil and gas reserves, sea trade, ports, and shipping. However, our earnings remain much below this potential (Askari et al., 2020). In Pakistan, the blue economy sector remains largely neglected. Despite announcing "2020 as the Year of Blue Economy", Pakistan has not taken any new measures to expand any specific sector of the blue economy (Aijaz et al., 2021).

This study analyses the current state of the blue economy in Pakistan and what its different sectors are contributing to the national economy. Data in terms of revenue and employment share has been analyzed. Moreover, comparisons with other countries in relevant sectors have been made to show the magnitude of potential and extent of neglect. Drawing insight from different research articles and reports, Pakistan's actual blue economy potential has also been explored. Besides, different challenges impeding blue growth in Pakistan have been evaluated to draw key lessons for developing policies and action plans to translate our blue growth potential into economic development.

3. Research Methodology

Qualitative and descriptive research methods have mainly relied on secondary data in research papers, articles, reports, journals, etc. Quantitative data about the blue economy, its resources, economic share, projected potential, etc., has been used for the analysis

4. Section I: Current State of Pakistan's Blue Economy

Pakistan has around 1050 km long coastline with an Exclusive Economic Zone (EEZ) of approximately 240,000 sq km and around 50,000 sq km of additional continental shelf area **(**Askari et al., 2020**)**. Pakistan is blessed with abundant marine resources that constitute a blue economy. Our maritime potential is evident from diverse bio-diversity and bio-productivity, rich fisheries and seafood reserves, blue tourism attractions, the shipping industry, strategically connected ports, tidal and wave power generation potential, and offshore energy reserves. However, before analyzing the current harnessing of our blue economy resources, it shall be appropriate first to look at the institutional and strategic framework dealing with the blue economy sector in Pakistan.

4.1. Maritime Institutional Framework:

The Ministry of Maritime Affairs is the lead federal department dealing with the maritime sector. The MoMA emerged in 2017 after restructuring the Ministry of Ports & Shipping. It deals with marine services and facilities. However, despite its vision of "transforming Pakistan into a maritime nation" the MoMA primarily focuses on developing ports and shipping infrastructure with some contribution in harnessing fishing resources. However, the holistic view of "blue economy" or "blue growth" is yet to be evolved. Out of 16 functions of the MoMA listed in Rules of Business, 05 are about ports and shipping, 05 about fisheries, 03 about merchant navy and seamen, while out of the remaining 03, one each is about quality control, ocean research and marine biological research. Marine resources like renewable energy, aqua tourism, deep sea minerals, offshore energy reserves, etc., remain unaddressed in their functions. Similarly, out of the 08 objectives of the MoMA, 03 are about ports and shipments, 02 about fishing and 01 about seafarers, with no mention of the blue economy. The MoMA comprises 05 Sections and 11 Units, and none is given exclusive responsibility for the blue economy **(**Ministry of Maritime Affairs, 2019**).** It has been learnt through interaction with the concerned officers in MoMA that the Ministry has lately (February 2023) constituted a Steering Committee on Blue Economy to prepare proposals to move forward in this regard.

The National Institute of Oceanography under the Ministry of Science & Technology is another federal department for the oceanic world. The NIO deals with research about oceans and oceanic resources. Its focus is limited to exploration, surveys and data analysis for the marine industry and national institutions involved in marine research. Focusing on scientific research is not concerned with the economic aspects of oceans and their reserves (National Institute of Oceanography, n.d.)

Another national institution in the field of marine resources is the National Institute of Maritime Affairs (NIMA), of Bahria University. The NIMA evolved

out of the Institute of Maritime Affairs, which was established in 2006 and the following year it was renamed as National Centre for Maritime Policy Research. After Pakistan's affirmation of the UN's SDGs, the center was upgraded to NIMA in 2018. The NIMA has two setups: one in Islamabad, which serves as Head Office, and. the other in Karachi. The NIMA acts as a maritime think-tank with a primary focus on maritime research for policy formulation, advocacy, awareness and timely review to provide comprehensive solutions to stakeholders (National Institute of Maritime Affairs, n.d.). The NIMA, being a think-tank, is engaged more in promoting awareness about maritime sectors, their components and their economic dividends. However, its role in policy implementation at national and provincial levels is almost non-existent.

4.2. Maritime Strategic Framework

Pakistan's main strategic framework for developing and utilizing maritime resources is the National Maritime Policy 2002, which was prepared and issued by the Ministry of Defense. Besides covering strategic maritime interests, the NMP comprehensively listed all major aspects of the blue economy to tap marine resources for economic dividends. Since the term "blue economy" was not in vogue at that time, it was not mentioned in the NMP. Nonetheless, the NMP identifies all main areas like fisheries, seafood, aqua tourism, renewable power sources, offshore energy reserves, minerals extraction, ports development, expansion of the shipping industry, etc., for developing them to generate revenue for the country's economic growth. The policy envisaged mapping, exploitation and conservation of marine resources. Realizing that these sectors of maritime relate to different ministries, the NMP established National Maritime Affairs Coordination Committee (NMACC), headed by Secretary M/o Defense and comprising Secretaries of Cabinet Division, Economic Affairs Division, M/o Interior, M/o Finance, M/o Foreign Affairs, M/o Planning & Development, M/o Communications & Railways, M/o Food, Agriculture & Livestock, M/o Science & Technology, M/o Environment LD & RD, M/o Petroleum & Natural Resources, Chief Secretaries of Sindh & Baluchistan and Vice Chief of Naval Staff. The Maritime Affairs Wing was also established in M/o Defense to act as the Secretariat of the NMACC. The NMP envisaged a framework for coordination among various departments and related organizations for secure long-term beneficial use of marine sectors. All concerned ministries were, however, to carry out respective policymaking and implementation on their own. The NMP set out exciting ideas about capitalizing marine assets for economic growth but did not give any strategy or roadmap for translating these ideas into actual gains. The NMP failed to follow up on the ideals or goals set out in it. According to the NMP, the NMACC was to meet annually to review progress on its implementation and to provide further guidance for the timely fulfilment of its objectives. The NMP envisaged an increasing share of national carriers up to 40% in all trade cargos

of the country by 2020. It also aimed at revitalizing the shipping industry and inclusion of marine studies in the curriculum. All these objectives remained mere wishes without any tangible gains. The NMP became outdated and dysfunctional in 2010 after the 18th Amendment as many of its subjects like fisheries, seafood, minerals, and tourism, have been devolved to provinces. Similarly, many ministries with new nomenclatures like the Ministry of Maritime Affairs, Ministry of Climate Change & Environmental Coordination, and Ministry of National Food Security & Research have emerged in post-devolution scenario and these ministries, despite having role in different sectors of the blue economy, are not mentioned in NMP.

Another policy document about some components of the blue economy is Pakistan Merchant Marine Policy2001, amended in 2019 and to continue till 2030. It mainly focuses on the "growth of mercantile shipping business". It gives incentives to investors to increase the size of the shipping sector to facilitate maritime trade. The PMMP further aimed at enhancing the strength of the national carrier to increase its share in total cargo. It also underlined the need for developing infrastructure to enhance the capacity of our ports to accommodate more and larger vessels for handling additional cargo. However, these objectives remain unfulfilled as the size of our shipping industry has further decreased; the same is the case with a share of national carriers in lifting import and export cargo. The situation with regard to the development of additional infrastructure is also no different. Like our institutional arrangement, the strategic framework for the blue economy remains outdated, fragmented and inadequate. This state of affairs of our handling of such a promising economic sector lends credence to what many analysts term our "sea blindness".

4.3. Existing Harnessing of Blue Economy Resources

Due to fragmented and outdated institutional and strategic frameworks, our blue economy potential remains highly under-tapped. Pakistan's current gains from the blue economy are 01 billion USD against an estimated potential of 100 billion USD. Our fisheries exports are around 450 million USD and seafood exports are hardly 0.05 million USD while revenue from coastal tourism is 450 million USD

and from the shipping sector is 30 million USD. All sectors of the blue economy provide jobs to the 1.8 million workforces of the country (Hussain, 2022).

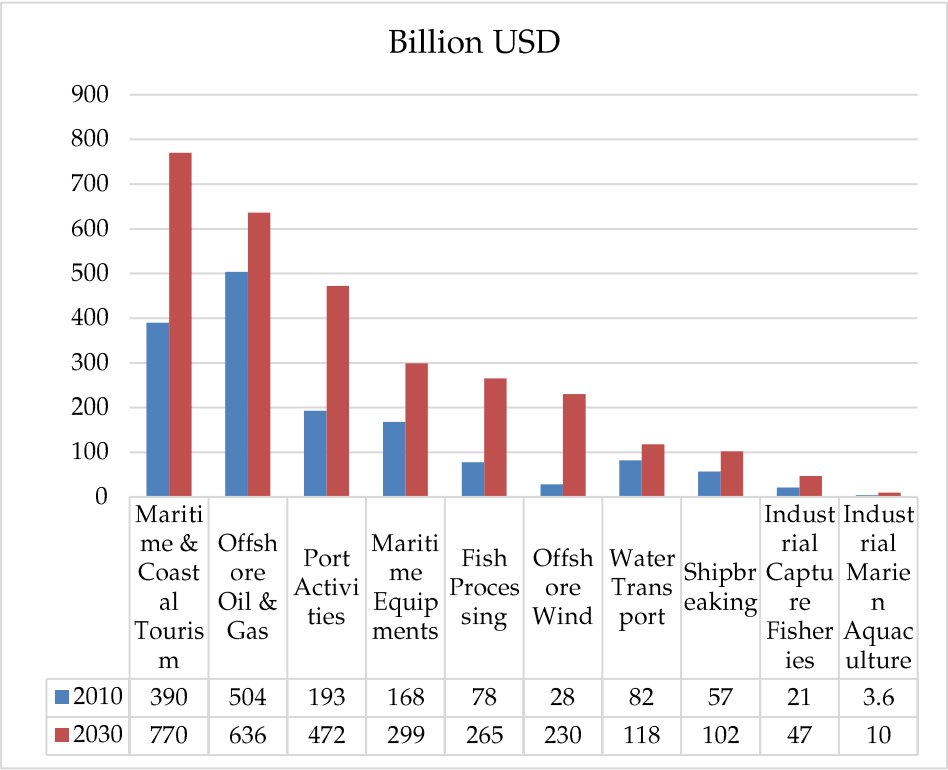
The greatness of our current state of affairs becomes more pronounced as we compare these statistics with those of neighbouring and regional countries. Pakistan lags behind other regional countries in terms of utilization of its available blue economy resources as our current utilization is 37%. In comparison, that of India is 62%, Bangladesh 60%, Sri Lanka 53% and Iran 52%. (Hussain, 2022), India generates 7 billion USD from the blue economy annually.

Bangladesh earns USD 6 billion from the ocean economy (Gill & Iqbal, 2021).

Our state of the blue economy becomes more disappointing when compared with the global growth of the blue economy. According to OED's report "The Ocean Economy in 2030", the blue economy shall globally contribute 3 trillion USD revenue to global economy by 2030 with marine and coastal tourism having highest contribution of 790 billion USD followed by 636 billion USD from offshore oil and gas sector, 472 billion USD from ports, 299 billion USD from maritime equipment, 265 billion USD from fish processing, 230 billion USD from offshore wind power generation, 118 billion USD from water sports, 102 billion USD from shipbuilding and repair, 47 billion USD from industrial capture fisheries and 10 billion USD from industrial marine culture. The below-given graph illustrates the potential of this phenomenal growth:

4.4. Sector-wise Overview of Revenue Generation by Blue Economy

Figure 2.
Sector-wise Overview of Revenue Generation by Blue Economy



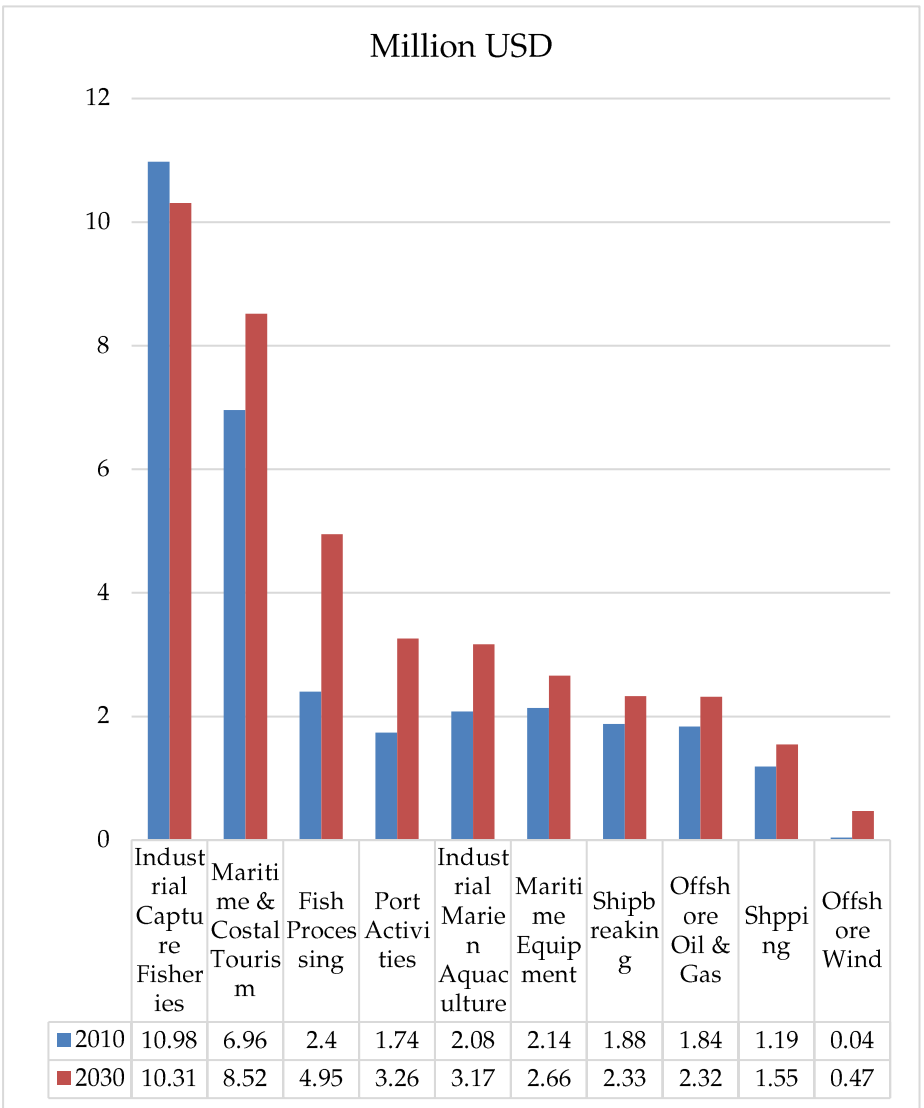
	Maritime & Coastal Tourism	Offshore Oil & Gas	Port Activities	Maritime Equipments	Fish Processing	Offshore Wind	Water Transport	Shipbreaking	Industrial Capture Fisheries	Industrial Marien Aquaculture
2010	390	504	193	168	78	28	82	57	21	3.6
2030	770	636	472	299	265	230	118	102	47	10

Source: Organization for Economic Co-operation and Development (2016)

Similarly, these sectors would take full-time job opportunities of 31 million to 40 million by 2030, as explained below.

4.5. Sector-wise Overview of Employment Generation by Blue Economy

Figure 3.
Sector-wise Overview of Employment Generation by Blue Economy



	Industrial Capture Fisheries	Maritime & Costal Tourism	Fish Processing	Port Activities	Industrial Marien Aquaculture	Maritime Equipment	Shipbreaking	Offshore Oil & Gas	Shpping	Offshore Wind
2010	10.98	6.96	2.4	1.74	2.08	2.14	1.88	1.84	1.19	0.04
2030	10.31	8.52	4.95	3.26	3.17	2.66	2.33	2.32	1.55	0.47

Source: Organization for Economic Co-operation and Development (2016)

5. Section II: Potential of Blue Economy in Pakistan - Prospects

Data analyzed in the preceding Section is in terms of the utilization of Pakistan's blue economy resources, and this underutilization should not mislead us regarding the actual blue economy potential of the country. Pakistan's blue economy potential is estimated at 100 billion USD (Hussain, 2022). In the succeeding sub-sections, the quantum of the potential in different sectors of the blue economy has been evaluated.

5.1. Fisheries& Seafood

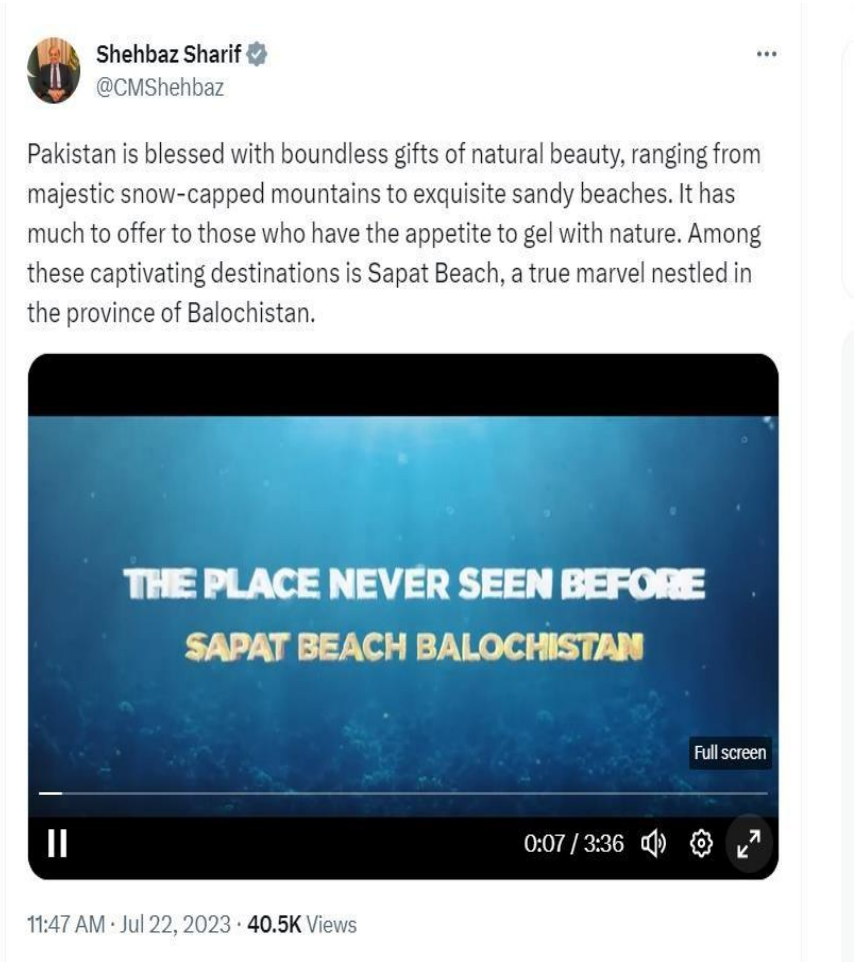
Pakistan has abundant resources of fisheries. It is relevant to add here that around 1500 types of fish are present in Pakistan's waters, while only 200 species are commercially harvested (Seafood Pakistan, n.d.). In addition to abundance, Pakistan's seafood resources have immense diversity, with species like sardines, croakers, snappers, pomfrets, sharks, catfish, barracudas, river shad, eels, tilapia, shrimp, crab, lobster, squid, cuttlefish, mollusc, shellfish, crab, lobster, squid, shrimps etc. Due to rich variety, Pakistan's fisheries have huge export potential to different international markets. According to Nazir, Pakistan's fisheries sector potential is estimated to be 3 to 4 billion USD annually (Hussain, 2022). Fisheries and seafood are thriving sectors worldwide with 270 billion USD global market (Malik, 2021) and the same shall witness further growth to 325 billion USD by 2030 (Organization for Economic Co-operation and Development, 2016).

5.2. Aqua Tourism

Tourism is an ever-evolving industry globally, as is evident from the constant growth of numbers in this sector and international tourists to reach 1.8 billion by 2030 (Organization for Economic Co-operation and Development, 2016). Revenue generated globally through the tourism economy amounts to 8.8 trillion USD, accounting for 10.4% of global GDP (Gul & Shah, 2021). According to the World Travel and Tourism Council, tourism contributes to 1 of every 5 new jobs created and this sector is fast growing industry, outpacing growth in manufacturing and other service industries (The Bank of Punjab, 2022). Maritime tourism has also become a huge source of revenue generation worldwide, and current global earnings through this sector alone are 2.9 trillion USD with Pakistan's share of only 50,000 USD (Malik, 2021). Aqua tourism in Pakistan has a 4 to 5 billion USD potential (Hussain, 2022). The country has a 1050 km long coastal line, which offers immense opportunities for the developing aqua tourism industry and tourist belts. Our coastline and maritime stretch offer opportunities for developing beach resorts, cruise trips, island tours, and water sports like boating, water scooters, scuba diving, beach sports, aqua adventures, etc., Pakistan has serene and picturesque islands along the coastal belts of Sindh and Baluchistan.

These include Charna Island, Astola Island, Manora Island, Malan Island, Zalzala Jazeera, Clifton Oyster Rocks, Bundle Island, and Buddo Island. These Islands offer pristine natural beauty and exciting wildlife like birds, rare green turtles, finless porpoises and other marine species (Alam, 2019). Besides, Pakistan's coastline has mesmerizing beach sites and attractions like sandy beaches, bays, deltas, lagoons, rock cliffs, and mud volcanoes. The beach destinations include Kund Malir, French Beach, Ormara Beach, Sapat Beach, Mubarak Village, Somiani and Hingol. On 22 July 2023, the Prime Minister of Pakistan also shared a video of Sapat Beach, showcasing the beauty and glory of the site. He termed it a "captivating destination" and "a true marvel nestled in the province of Baluchistan". A screenshot of the tweet is attached below:

Figure 4.
Screenshot of tweet



Another fascination of our coastal line is moderate weather in winter when a number of tourists to Europe falls down due to intense cold. The moderate temperature of our coasts offers huge attractions to European and Europe-bound tourists in winter. By developing coastal tourism, Pakistan can generate not only huge revenue to the tune of 5 billion USD (Alam, 2019) but also develop generally neglected coastal communities by providing jobs and livelihood-earning opportunities. Here, a case study of coastal tourism development in Kerala State by India is a pertinent example. India formulated the Kerala State Tourism Policy in 2012,, bringing exemplary benefits to the state. Under the policy, Kerala developed a 600 km coastal line with variety of facilities and attractions. Consequently, the number of foreign and local tourists visiting the state for coastal tourism multiplied in the next 5 years and 660,000 foreign tourists and 14.6 million local tourists visited the state in 2017, bringing 4.5 billion

USD revenue including 1.1 billion USD as foreign exchange earnings. Besides, it contributed to generating 1.4 million jobs **(**Gul & Shah, 2021). Bangladesh's case should also be a lesson for us as it earns 1.567 billion USD through coastal tourism (Alam, 2019).

5.3. Shipbreaking

Pakistan has a rich history of the shipping industry as the country had 81 ships in the 1970s. With such a large number of vessels, our ship shipbreaking, recycling and repairing industry was quite thriving and not only generated revenue of millions of dollars but also provided jobs to thousands of people. The Gadani Shipbreaking Yard was the largest shipbreaking yard in the world in the 1980s, employing 30,000 workforce (Malik, 2021). Pakistan can capitalize on past experience to revive the shipping industry for revenue and employment generation. Currently, 30 million USD in revenue are being generated in the shipbreaking industry, while this sector has the potential of USD 600 million in revenue (Malik, 2021). Gadani Shipbreaking Yard is now producing below $1/5^{th}$ of the scrap it produced in the 1980s. It is pertinent to add here that this scrap is a major source of steel for many industries like cutlery, surgical instruments, etc.

5.4. Trade Route

Pakistan's geo-strategic position along the Indian Ocean and existing/planned road as well as railway networks with our seaports offer it a unique advantage of freight movement towards Central Asia, the Middle East, Europe, India, and China. Pakistan's trade is mainly sea-bound as over 90 % trade is through sea (Hussain, 2022). Karachi Port has 30 berths for dry cargo and 03 for liquid cargo. It handles around 40-43 million tons of cargo annually against the capacity of 9o million tons. The berth occupancy is only 45%, showing that the port is highly underutilized compared to its actual capacity (Alam, 2019). Port

Qasim has 18 berths with an annual handling capacity of 89 million tons in 2022; it has handled 55 million tons cargos (Alam, 2019). Gwadar Port has the potential to become a regional hub for global trade due to several reasons. It is one of the deepest seaports to accommodate sixteen meter deep cargo ships. It has 03 multipurpose wide berths to house a ship carrying 23,000 TEU containers, while its regional competitor, Dubai Port World has the capacity to handle 8000 TEUs ships (Alam, 2019).

Another advantage to Gwadar Port is its proximity – only 400 km distance – to the Strait of Hormuz, one of the busiest channels for global trade and oil supply. The Strait of Hormuz is a vital trade route that connects the Arabian Sea, the Gulf of Oman, and the Persian Gulf. This gives Gwadar Port the strategic proximity for trade to Central Asian Republics, Afghanistan, and China (Malik, 2021). Gwadar Port offers opportunities for the trans-shipment of dry and liquid cargo to the Persian Gulf and also to ports around the Horn of Africa and the Bay of Bengal (Malik, 2021). Having a strategic connection with China's Belt & Road Initiative (BRI) through China

Pakistan Economic Corridor (CPEC), Pakistan offers an opportunity for trade cargos of landlocked Central Asian Republics as well as of China towards the Middle East and Europe. Karachi Port handles cargo of 40-45 million tons annually, Port Qasim 40 to 50 million tons, and Gawadar Port 50-60 thousand tons. In contrast, the actual handling capacity of our ports is between 180 to 200 million tons (The Bank of Punjab, 2022). UAE has 12 commercial ports with 310 berths having the capacity to handle 80 million tons of cargo (Seaports, n.d.). By fully developing our ports, Pakistan can earn revenue up to 10 billion USD (Hussain, 2022).

5.5. Offshore Oil and Gas Reserves

Offshore basins are known to have rich oil and gas reserves, as is evident from the fact that the seabed provides 32% of the global supply of hydrocarbons (Alam, 2019). Pakistan's offshore sedimentary region has an area of about 300,000 sq km, which is highly underexplored. Pakistan's continental shelf is estimated to have 16 billion barrels of oil and gas with a current worth of 14 billion USD (Hussain, 2022). Pakistan's offshore basin comprises two distinct geological basins, the Indus Offshore and Makran Offshore, with immense energy potential in its shallow, deep and ultra-deep zones. Both the basins present an unparalleled opportunity for investors seeking to capitalize on untapped energy reserves. Covering an extensive area of more than 282,623 Sq km, the Indus Offshore basin is the second largest and least explored basin of the world, holding the key to unlocking vast hydrocarbon riches (Humayun & Zafar, 2014). Sun Oil Company first carried out Exploration in the area in 1961. At present about 17 companies are operating in the offshore area of Pakistan to exploit the potential reservoir of hydrocarbon resources. Exploration efforts in the Indus Offshore have barely scratched the surface of its immense potential,

with only 14 wells drilled to date while the basin's geological enormity calls for comprehensive exploration to fully gauge its true potential (Gong et al., 2020; Humayun & Zafar, 2014).

The comprehensive geological studies, carried out by reputable local and international companies, reveal a staggering gas potential of over 60 trillion cubic feet (TCF), making it a game-changing resource with global implications. Drawing comparisons to some of the world's most prolific hydrocarbon-bearing deltas, the Indus Offshore mirrors the geological abundance of the Nile, Mahakam, and Niger basins, offering prospects of huge investments. It is estimated that proper exploration with modern equipment will unlock substantial oil and gas reserves, revolutionizing the energy landscape of Pakistan (Carmichael et al., 2009). The Oil and Gas Company Limited's Pakistan Basin Study Project undertook intensive surveys in the offshore region, revealing that the area holds immense hydrocarbon reserves. Besides, NIO's surveys for the assessment of gas reserves in the deep sea revealed that Pakistan has 7th largest reserves of methane gas (Humayun & Zafar, 2014).

5.6. Renewable Energy Reserves

Pakistan's coastal and offshore areas have the potential to generate 1100 MW of renewable energy by tapping tidal power in coastal areas of Sindh and Baluchistan (Amjad, 2022). A network of 17 major creeks is located in 170 km of the Indus deltaic area. Coastal areas of Karachi experience two high and two low tides during 24 hours. Tidal amplitude between low and high tide in these coastal areas ranges from 0.1m to 4.5m, causing tidal water to move in and out of these creeks at high velocity of 0.2-0.5 m/s. In other coastal areas, seawater has a speed of 60 km while moving inland due to lower land elevation and intense tidal fluctuation (Amjad, 2022). Similarly, Baluchistan's coastal areas are also quite suitable for generating wave and tidal power. Potential locations are Omara and Gawadar along Makran coast. Besides, Sonmiani Beach and Kalamat also have huge potential for tidal energy (Alam, 2019). Preliminary feasibilities conducted by NIO Pakistan assess 1100 MW energy potential along Indus delta creeks and Makran coastal area. Needless to mention multiple advantages of tidal and wave energy over fossil fuels like higher efficiency, more climate-friendly with no pollution, durability and renewability due to the 27/4 movement of tides, etc. It is relevant to add here that this sector is becoming popular globally due to these reasons, and the current installed capacity of offshore wind power generation is 7 Giga Watts while the estimated potential is around 60 gigawatts (Organization for Economic Co-operation and Development, 2016).

Another yet to be tapped avenue of renewable energy generation from oceanic resources is through the ocean thermal energy conversion (OTEC) technique. The oceans, large collectors of solar radiation from the sun, store the energy that generates thermal energy. There is generally an 8 C^{o} to 14 C^{o} temperature

difference at the surface and bottom of the water in the ocean. Thermal difference absorbed by oceans can be converted into electricity through the ocean thermal energy conversion method. The OTEC technique utilizes temperature difference between warm upper ocean surface and cooler water below 500m. A vaporizing fluid like propane or ammonia is used in circular pipes. The vapour expands, moving a turbine at moderate pressure. The turbine is attached to a generator that produces electricity. The working fluid is cooled in a heat exchange condenser through cold seawater from ocean depths. Temperatures on surface water in the Arabian Sea generally range between 24 C^o to 28 C^o. In contrast, the temperature in 500m below water ranges from 10 C^o to 15 C^o. This is the ideal difference for the OTEC technique to generate power. Three different locations have been identified in Pakistan's offshore areas for generating energy through the OTEC technique. These locations are Astola Island, Churna Island and Indus Canyon (Amjad, 2022). It may be added that exact potential of power that can be generated by using OTEC method is yet to be calculated. However, given vast areas on these islands suitable for deployment of OTEC equipment, it is estimated that the venture and invest are worth the effort.

6. Section III: Potential of Blue Economy In Pakistan-Challenges

The preceding section shows the abundance of Pakistan's maritime resources, which, if tapped properly, can make the country a leading blue economy. However, multiple challenges impede the capitalization of our vast and immense potential, which have been discussed in the succeeding sub-sections.

6.1. Lack of Robust and Cohesive Maritime Institutional Framework

As discussed earlier, Pakistan's current maritime institutional framework is not as robust and cohesive as it should be. The Ministry of Defense took the lead in 2002 by framing NMP and outlining different maritime sectors having huge growth potential. It established NMACC with advisory-cum-supervisory role. However, formulating and implementing strategies to develop related sectors were left to respective ministries, entailing inherent fragmentation in the whole framework. This scattered framework became dysfunctional after the 18thAmendment with the devolution of many maritime-related subjects like fisheries, seafood, coastal development, tourism, mangroves, etc., to provinces. As a consequence of devolution, some new ministries emerged at the Federal level, but they have no mention in NMP or presence in NMACC. The maritime sector was left to the Ministry of Ports & Shipping, which, as evident from this nomenclature, remained largely focused on ports affairs and the shipping industry.

Due to our commitment to UN SDGs 2015, we moved from the Ministry of Ports & Shipping to the Ministry of Maritime Affairs in 2017, but the blue economy remained neglected as no specific mention of this sector was made in functions allocated to MoMA in Rules of Business nor the Ministry included the growth of the blue economy in eight objectives MoMA set for itself. No dedicated unit of Blue Economy has been established in MoMA. It was only in February this year that the Blue Economy Steering Committee was constituted to chalk out proposals for the integration of this sector in MoMA's functions and objectives for necessary legislative amendments and administrative measures. The Ministry of Defense also could not follow up on exciting objectives set out in the NMP. Similarly, MoMA has also not been able to take charge of NMP and ambitious plans set out in the document remain only plans so far. Our efforts to observe 2020 as a Blue Economy Year were derailed by the Covid-19 pandemic. The inadequacy of our maritime institutional framework is evident from the fact that the NMP, formulated in 2002, has not been reviewed since then despite landmark national developments like the 18th Amendment or international milestones like UN's SDGs 2015. Similarly, PMMP set a target of increasing the share of national carriers in total trade cargos to 40% by 2020 from 5% in 2001. However, it still remains a mere 11% (Gul & Shah, 2021). The MoMA has not been able to infuse energy or vision into provincial institutions dealing with blue economy sectors. The provincial frameworks are also fragmented, with various aspects being dealt with by different departments with no coordination mechanism.

Due to inadequate attention given to the blue economy by MoMA, other support institutions are also not playing a very effective and proactive role towards the blue economy sector. The NIO is focused on scientific research, surveys and data collection for marine research. However, no meaningful work about the economic dividends of the ocean and its reserves or about tapping them for growth is being carried out by it. The NIMA emerged in 2018 after evolving from the National Centre for Maritime Policy Research of 2007. The Institute is primarily concerned with research and policy inputs related to maritime affairs and subsequently sharing findings/recommendations with different stakeholders in public sector. It is still in the process of evolution and does not have adequate capital, personnel and infrastructure resource.

Since the blue economy is a very wide realm comprising different sectors, it is necessary to have an elaborate and robust institutional framework in the form of an Authority or National Task Force to deal with all aspects rather than leaving it to fragmented arrangements.

6.2. Absence of Comprehensive Blue Economy Policy

As mentioned above Blue Economy is a very vast sector involving various industries like fisheries, tourism, aquaculture, ports, shipping, tourism, coastal development, renewable power, offshore energy, minerals, etc. These subjects

are dealt by different ministries, which have their own policies and priorities about their functions. The NMP tried to at least bring all related departments on the single platform of NMACC for some kind of collaboration. However, it did not synergize their respective maritime matters policies, leaving the issue of policymaking and implementation to respective ministries. The NMP has become outdated and redundant as more than 20 years have passed since its formulation, and a lot of constitutional, legislative, administrative and technological developments have taken place all along. Moreover, regional and global dynamics vis-a-vis the maritime sector have also changed particularly after the UN's SDGs 2015. However, we have neither reviewed NMP nor formulated any new strategic framework for the blue economy in line with relevant national, regional or international happenings. The same is the situation of policies of provincial departments dealing with different sectors of the blue economy. Their policies are outdated and lack the synergy essential for a consolidated outlook for the growth of the blue economy. Similarly, Pakistan Nationa Merchant Marine Policy is of 2001 and was amended through a notification in 2019, extending its timeline to 2030. In a nutshell, a comprehensive national policy spelling out priority for the blue economy, consolidating relevant components of policies of different departments, envisioning effective coordination among them, outline phase future measures to harvest dividends of the blue economy is missing. It is also relevant to add here that Pakistan's National Security Policy (2022-2026), despite being human and economic development-centric, does not mention capitalizing on our maritime potential to achieve economic growth for sustainable national security.

6.3. Coordination Issues

The absence of robust and proactive national-level institutional as well as a strategic framework for the blue economy sector entails coordination issues among concerned departments. As discussed in succeeding sections, the blue economy is a very vast sector incorporating activities planned and executed by different Federal and Provincial departments. The Federal departments include the Ministry of Maritime Affairs, the Ministry of Commerce & Trade, the Ministry of Energy, the Ministry of Climate Change & Environmental Coordination and the Ministry of National Food Security & Research. The Provincial departments include Fisheries, Forests, Tourism, Minerals and Coastal Development etc. These Federal and Provincial departments make isolated policies considering peculiar targets, resources and constraints. A blue economy involves complementarity of these departments and their policies, but an overarching institutional coordination framework for consolidation of relevant components of their policies remains fragmented, if not non-existent. Without sustained and proactive cooperation among all these and related departments, translating our maritime potential and resources into economic dividends would remain a wish.

6.4. Capacity & Capital Constraints

Sectors constituting the blue economy are diverse and specialised. Each of them requires a workforce with peculiar skills and abilities. For example, harvesting fisheries and seafoods and their storage and transportation while preserving high quality and taste for consumers, require a highly skilled workforce. However, fisheries and seafood harvesting and processing in Pakistan are outdated and underdeveloped. Consequently, our yield does not fetch good rates as our fish sells for 2.5 to 2.75 USD per kilogram in the international market, whereas other regional countries get the price of 7 USD per kilogram. This wide gap is due to primitive harvesting methods, poor post-harvest processing and non-adherence to international standards (Syed & Safdar, 2021). Outdated means and methods are inflicting losses on our stocks, too. In a bid to earn more revenue, fishermen resort to overharvesting and even capture underage stocks. They even continue fishing during the breeding season of July/August. This affects the re-generation of stocks, which consequently adversely impacts fisheries reserves **(**Askari et al., 2020**).** This disregard for hygiene and bio-security measures led to the imposition of the ban in April 2007 by the EU on importing fisheries from Pakistan due to sanitary and phytosanitary concerns. It remained effective for almost six years and was lifted in March 2013 (Syed & Safdar, 2021). Besides capacity issues, Pakistan's fisheries sector faces numerous challenges due to weak monitoring and regulatory frameworks. The sector is vulnerable to a number of illegal activities like unregulated fishing, use of illegal nets, overfishing, bull trawling as well as poor fish processing arrangements. Illegal, Unreported and Unregulated (IUU) fishing is causing serious loss in terms of revenues and fisheries stocks and their replenishment. Pakistan bears a loss of approximately 300 million USD due to the use of primitive methods, traditional and rudimentary means and outdated or faulty machines to harvest fisheries and seafood (Syed & Safdar, 2021).

Likewise, aqua sports or adventures require well-trained professionals to engage tourists and make their visits more entertaining and more memorable. Similarly, exploration, extraction, and processing of maritime minerals or offshore energy reserves require specialized vocational skills, which can be imparted in training institutions equipped with required instructional resources and paraphernalia. Establishing such training centres with the required technical wherewithal involves huge capital. However, due to our general neglect of the blue economy, no specialized centres for imparting training about these areas have been established. In addition, using modern equipment and infrastructure for fisheries and seafood processing, aqua theme parks, water sports and adventures, renewable power generation, offshore energy, or minerals exploration requires huge finances. Due to financial constraints caused by ongoing economic hardships, developing infrastructure for the blue economy has further slipped downward in our priorities.

6.5. Inadequate Infrastructure and Allied Facilities

To tap sectors like coastal and maritime tourism or ocean minerals and energy reserves, sophisticated equipment and modern infrastructure are required. Tourists can be attracted to such areas only on the availability of facilities like motels, hotels, restaurants, aqua theme parks, adventure facilities or beach infrastructure. Tourists would never choose to spend time and revenue on coastal belts without such facilities and attractions. The travel and Tourism Competitiveness Report 2019 by the World Economic Forum gives a dismal picture of tourism in Pakistan, having 121 number out of 140 countries (Alam, 2019). Countries with coastal areas with well-developed infrastructure facilities are favourite destinations for international tourists. These countries earn huge revenue through international tourism to strengthen their economies. For example, Thailand earns 18% of its GDP through tourism, Malaysia 6%, while Pakistan earns a mere 0.4 % of GDP through international tourism. The success story of Maldives in another inspirational example for Pakistan. Maldives also has a thriving coastal tourism sector, with one-third of the national economy dependent on revenue from coastal regions (Alam, 2019). Maldives has developed the tourism sector as a highly lucrative industry and the single largest contribution to GDP with a 35% share. This sector alone accounts for 60% of its foreign exchange earnings (Alam, 2019). Malaysia has set a target of 16.1 million foreign tourists with estimated revenue generation to 11.19 billion USD (Lee, 2020). The case of Kerala State of India has already been discussed. However, our aqua-tourism sector lacks state-of-the-art facilities and attractions. Consequently, our gains from this sector remain merely 450 million USD (Hussain, 2022).

6.6. Decreasing National Carrier Fleet

Another challenge to the growth of the blue economy in Pakistan is the constant decline in the number of ships in the national fleet, leading to a shrinking share of the national shipping industry PNSC in seaborne trade. Pakistan, despite having a trade of over 100 billion USD, has a small shipping sector. Pakistan's 90% of trade is seaborne, but the share of national carriers in the entire trade cargo is around 11% only (Gul & Shah, 2021). Pakistan has the lowest fleet as compared to other regional countries, as is evident from below mentioned statistics for 2021:

Table 1.
Number of Cargo Fleet Held by Pakistan and Neighboring Countries

	India	Iran	Bangladesh	Sri Lanka	Pakistan
Total Fleet	1801	893	468	90	57

	India	Iran	Bangladesh	Sri Lanka	Pakistan
Oil Tankers	136	84	144	11	07
Bulk Carriers	63	32	48	06	05
General Cargo	587	371	140	13	0
Container Ships	22	31	06	-	0
Other types of Ships	993	375	130	60	45

Source: Gul and Shah (2021)

According to UN's Liner Coder 1974, a country can lift 40% of its cargo in its own ships and this can be further increased by 20% by ensuring that not resort to unfair trading practices. However, Pakistan lifts only 10-11% of total trade cargo on its national carrier due to depleted fleet (PIDE). Heavy reliance on foreign carriers for cargo transportation costs Pakistan high freight bills, to 4 to 5 billion USD. It is intriguing to note that the volume of our trade has increased over the period, but the share of national carrier PNSC has decreased, as is evident from the table.

Table 2.
Year-wise Share of PNSC in Total Trade Cargo (Million Tons)

Year	Dry Cargo	Wet Cargo	Total Cargo	PNSC Share	PNSC Share %
2016	58.867	29.419	83.286	13.326	16
2017	42.653	32.863	89.852	14.304	15.919
2018	65.836	34.411	100.243	12.797	12.765
2019	80.253	30.44	110.693	10.383	9.38
2020	66.585	27.736	94.321	8.80	9.33

Year	Dry Cargo	Wet Cargo	Total Cargo	PNSC Share	PNSC Share %
2021	77.968	32.303	110.271	11.099	10.06

Source: (Pakistan National Shipping Corporation, 2021; Syed & Safdar, 2021)

6.7. Shrinking Shipbreaking Industry

Shipbreaking is a very vital component of the blue economy and many countries are earning huge revenue through this sector. Bangladesh now annually earns 770 million USD from the shipbreaking industry, while Pakistan's earnings from this sector are 30 million USD (Alam, 2019). During the 1980s, shipbreaking was a thriving industry in Pakistan, earning huge revenue for the country and also providing thousands of jobs as shipbreaking is a labor-intensive industry. Gadani Shipbreaking Yard was the largest shipbreaking facility in the world at that time, employing 30,000 workforces. However, Gadani Shipbreaking Yard has faced negligence over time and failed to keep pace with modern means and methods of shipbreaking. The tragic incident of 2017, wherein 30 workers lost their lives in an explosion, dented its repute, leading to international backlash with a severe decline in the number of ships coming for breaking. With the decline in its capacity over the years, it has been relegated to the third position after India's Along shipbreaking yard and Bangladesh's Chittagong shipbreaking yard. Its workforce has also come down to 6000 only (Malik, 2021). The current grim state of our shipbreaking industry is explained by a comparison of below-mentioned statistics for 2021 for Pakistan, India, and Bangladesh:

Table 3.
Shipbreaking Statistics for Pakistan, India, and Bangladesh

Type	India	Bangladesh	Pakistan
Oil Tankers	1934	3245	0
Container Ships	1750	890	750
Dry Bulk Carriers	1060	1460	2526
Offshore Vessels	320	57	77
Total	6323	6260	3459

Source: Syed and Safdar (2021)

6.8. Outdated Facilities at Ports and Missing Transportation Networks

It is necessary to establish hinterland connections of ports to maximize benefits from their cargo handling capacities. This requires a strong road and railway network for efficient and speedy transportation of cargo. Similarly, infrastructure at our ports also requires upgradation as in terms of connectivity between ships and ports, Pakistan has 34.06 points on the Liner Shipping Connectivity Index. In comparison, India has 54 points, with China having the highest position on the index with 151.91 points (The Bank of Punjab, 2022). Gwadar Port has been operational since March 2007. However, it remains highly underutilized largely due to incomplete infrastructure around the port for cargo handling. Besides, railway networks to connect Gwadar Port with the rest of the country are yet to be completed, and without the same, large-scale transportation of cargo to other countries shall not be possible.

6.9. Sea Level Rise

Pakistan's marine reserves, particularly fisheries, seafood, and coastal tourism avenues, are facing a threat because of the rise in sea level, causing inundation of low-lying land, intensification of coastal erosion and upstream flow of salt water. All these factors pose a grave challenge to marine bio-productivity, bio-diversity and coastal ecosystems. Taking cognizance of the gravity of the situation, the government launched a five years research project in October 2020 for empirical conclusions about the rise in sea level (Ayub, 2021). The research study is a step in the right direction, but a mere study shall not suffice to contain damages, and emergent countermeasures in the light of the findings and recommendations of the study would be required.

6.10. Security Issues

Pakistan's blue economy opportunities largely lie in Baluchistan due to the 700 km coastal line and Gwadar Port, the region's largest sea port. The province is facing security challenges due to the activities of Baloch insurgents as well as militants of different terrorist organizations like Tehreek e Taliban Pakistan or Islamic State / Da'esh. The province's deteriorating security situation is evident from below mentioned statistics of the last 05 years:

Table 4.
Year-wise Terrorist Incidents in Baluchistan

Year	Incidents	Killed	Injured
2022	79	106	271

Year	Incidents	Killed	Injured
2021	81	136	345
2020	42	95	216
2019	84	171	436
2018	115	354	589

Source: Pakistan Institute for Parliamentary Services (2018-2022)

Needless to mention, the volatile security situation deters tourists as well as investors. This deteriorating security situation is one of the greatest hurdles to developing the requisite infrastructure for different sectors of the blue economy.

7. Conclusion

Discussion and analysis in the preceding sections show that the blue economy is a highly promising sector globally as well as for Pakistan, with huge economic potential and dividends. This economic sector is quicky becoming popular with more and more countries harnessing blue economy potential. They are developing all constituent sectors of blue economy to make maximum gains. Pakistan has diverse and abundant oceanic resources like fisheries, seafood, blue minerals and renewable power generation, as well maritime assets like aqua tourism and adventure avenues, ports with the capacity to handle huge trade cargos for to and fro movement to regional and tarns-regional markets, shipping industry and offshore oil and gas reserves. These resources have the potential to fetch 100 billion USD for Pakistan. However, our actual gains from this sector are 01 billion USD. Our neighbouring and regional countries like India and Bangladesh are making huge from tapping their blue reserve to the tune of 7 billion USD and 6 billion USD, respectively.

This under-utilization of blue economy potential by Pakistan clearly indicates that there are issues and challenges, which largely are of institutional, strategic, capacity, infrastructure and security nature. The country's institutional framework to tap and develop the blue economy is not very well organized, cohesive or proactive. Similarly, the strategic framework remains fragmented and outdated without adequate coordination mechanisms for Federal and Provincial governments and inter-departments liaison. Moreover, technical knowledge and sophisticated equipment to ensure the tapping of marine resources under international standards are also deficient. Infrastructure and

amenities to attract tourists to maritime attractions are missing. Our shipping industry is also shrinking, with a share of national carriers in cargo lifting to have declined to a mere 11%. Ship breaking and recycling sector is also in shambles. The deteriorating security situation in Baluchistan is obstructing the initiation of projects to tap blue resources in the province with the largest coastline, highest fisheries and seafood reserves and largest port of the country. These issues can be addressed by giving due priority to the blue economy sector, by adopting strategic and institutional framework with global best practices, by allocating adequate resources, by focusing on research and capacity building and by establishing requisite infrastructure.

8. Recommendations

In order to harness blue economy potential and resources, Pakistan needs to adopt a multi-pronged strategy to tackle challenges impeding our progress in this sector. Recommendations in this regard are as under:

i. The First and foremost requirement for Pakistan to develop a blue economy is to evolve an ocean governance regime, focusing on establishing and strengthening the institutional and strategic framework for making and implementing policies about different sectors of the blue economy. This regime should be at Federal and Provincial levels to harmonize policies and priorities.

ii. To acknowledge the significance and potential of the blue economy, a comprehensive Blue Growth Policy envisaging guidelines for each sector of the blue economy and also to chalk out effective mechanisms for coordination among concerned Federal and Provincial departments is required for bringing cohesion in our fragmented policies and approaches. The NMP has become outdated and dysfunctional, while the PMMP is too much focused on mere incentivization of the shipping industry, which, despite it's huge share in and prospects for blue growth, is just one component. In this regard, MoMA needs to engage all stakeholders to evolve a broad-based "Blue Growth Policy", outlining both short and long-term measures for the next 05 to 15 years.

iii. The above proposed strategic framework should ensure smooth and effective coordination among Federal and Provincial departments. Most of the blue economy prospects lie in Sindh and Baluchistan with other federating units having negligible resources. Such a situation entails highly divergent priorities and even conflicts. Moreover, some of the blue economy components are provincial domain while others are in federal jurisdiction. Only a robust coordination mechanism can help iron out differences and conflicts.

iv. Collection, compilation and updating of data on marine resources reserves, their tapping, replenishment, etc., is essential for developing an efficient ocean governance regime. Such data is vital for making policies and also for their reviews. Without regular reviews, policies become stagnant and then redundant. The blue economy is an emerging sector and is soon to become highly competitive. Data collection and its accuracy have to be integral components of the strategic framework. This responsibility is to be apportioned to concerned departments in unequivocal terms otherwise, policy formulation would remain fragmented and sketchy for want of exact statistics about available resources, their utilization and replenishment.

v. The federation needs to extend technical support and guidance to provinces for adopting new means and methods to tap marine resources for efficient management and addition.

vi. Constituent sectors of the blue economy are capital-intensive, particularly for installing initial equipment and paraphernalia. This requires making special allocations for its different sectors for at least three to five years to increase momentum in these fields. Subsequently, revenues generated shall be helpful in sustaining and expanding the activities.

vii. Robust awareness campaigns to promote the importance and potential of the blue economy among the general public, as well as investors, are required to overcome the phenomenon of "sea blindness" and also to cultivate interest in this sector.

viii. Given the immense potential of the sector, the government needs to encourage public- private partnerships to develop a blue economy. The same shall be helpful in setting up small as well as large enterprises. Depending upon nature and magnitude of ventures, partnership model can be worked out. Special incentives and concessions be given to attract investors. Policy for ease of doing business in the blue economy sector may be introduced through the engagement of all stakeholders.

ix. Coastal communities need to be particularly focused on engagement, awareness and capacity development to adopt modern means and techniques to catch fisheries/seafood to ensure not cause damage to marine resources and ecosystems.

x. Special incentives and concessions for the people of Baluchistan, particularly for residents of coastal areas need to be given to mitigate their resentment and to turn them away from militants. Measures

like providing interest free loans to them for developing small enterprises, reserving special quotas for local youth in jobs in projects being undertaken, obligating investors to execute corporate social responsibility projects in local areas, etc., would be helpful in this regard. Such measures shall evolve the stakes of locals in different initiatives and curtail outreach of anti-state elements. This shall improve the security situation, thus cultivating an investment and development friendly environment.

xi. There is a need to develop, upgrade and diversify PNSC's fleet to increase its share in cargo shipment. Besides, the shipbreaking industry needs to be revamped by introducing globally acceptable modern methods and means for ship recycling to revive this once thriving sector.

xii. Planned rail and pending road networks/infrastructure for connectivity of Gawadar Port should be expedited for optimum utilization of the facility.

xiii. Specialized capacity building institutions for imparting training on modern methods of fish harvesting, minerals exploration, operating water adventures paraphernalia, etc., should be established.

xiv. Given the specialized and sophisticated nature of marine industries, a research centre should be established to explore the latest means, methodologies and equipment for adoption in the relevant industries.

xv. Stringent enforcement of industry best practices and regulations is necessary for efficient tapping and sustainability of marine resources. Without observing the same, not only the quality of harvested resources is badly affected but also stocks of these face depletion threat.

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